THE PROSODIC STRUCTURE OF LATVIAN

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To a free and independent Latvia

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ABSTRACT

THE PROSODIC STRUCTURE OF LATVIAN

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MARK LIBERMAN

This dissertation investigates the rhythmic and melodic structure of standard Latvian, which has a system of syllable intonations independent of the metrical structure of the language. Latvian can thus be classified as a semi-tonal language which is between a pitch-accent language and a purely tonal language. The investigation of the prosodic structure is based upon empirical data gathered and analyzed using techniques of experimental phonetics, and builds upon earlier linguistic work on Latvian conducted primarily within the tradition of Latvian philology. The analysis of the data is conducted within the generative frameworks of Optimality Theory and autosegmental phonology.

The phonology of Latvian distinguishes "long" syllables from "heavy" ones. Whereas metrically long syllables can influence the duration of voiceless obstruents, only metrically heavy syllables can be associated with lexical tones. This division of syllable types justifies a two-layer moraic analysis of the language.

The metrical structure of the language ideally builds two feet or one colon per word, with the addition that the main word stress is associated with a H tone. Of the three syllable intonations–level, falling, and broken–only the falling and broken are lexically specified for tone. The level intonation is lexically unspecified, and its tonal contour is dependent upon the presence or absence of a stress-induced H tone. Thus, although the metrical and tonal systems are independent in the language (every heavy syllable has a syllable intonation regardless of stress), they nevertheless interact insofar as the metrical H tone influences the tonal contours of all three syllable intonations.

Table of Contents

List of Tables

Chapter 2 tables

Chapter 3 tables

Chapter 5 tables

List of Figures

Chapter 3 figures

Chapter 4 figures

Chapter 5 figures

Chapter 1

Introduction

As anyone can easily discover, the Ancient Greek word προσῳδία is defined as 'a song sung to music' or 'the tone or accent of a syllable' (Liddell & Scott, 1983:700).[1] In current linguistic theory, the study of prosody has grown beyond its etymological roots, and now includes the study of both rhythm and tone in language.

In this dissertation, I investigate how the rhythmic and tonal systems are manifested in Latvian, one of the two surviving Baltic languages in the Indo-European family tree. Unlike its closest relative Lithuanian, Latvian has developed an interesting split and coexistence of lexically specified tone on the one hand, and metrically determined stress on the other. Whereas primary word stress almost always falls on the initial syllable, every heavy syllable regardless of its position in the word has a characteristic syllable intonation. Unlike the Japanese or Lithuanian tonal systems, the Latvian syllable intonations are not "pitch-accents" insofar as being tonal characterizations of "accented" or stressed syllables. The Latvian syllable intonations are a feature of heavy syllables independent of word stress, and are not a feature or an effect of the metrical system of the language.

However, although the metrical and tonal systems of Latvian are indeed independent, they nevertheless interact. Specifically, primary word stress is associated with a H tone, which interacts (in stressed syllables) with the lexically-specified tonal features to produce the audible syllable intonations. Evidence for this comes from the fact that one of the syllable intonations has one tonal contour in stressed syllables, and a different one in non-stressed syllables. In addition, short stressed vowels which are not

[1] This was pointed out once by Mark Liberman during a seminar on prosody.

characterized by a syllable intonation surface with a pitch peak relative to the following syllables.

1.1 Methodology

1.1.1 Theoretical framework

Within the field of linguistics, there are a number of approaches taken by different researchers to uncover the underlying structure of language, and a number of different ways of gathering linguistic data. One such approach is that of formal linguistic theory, which addresses the abstract structure of the various parts of grammar, including the theories of syntax, semantics, and phonology. The data for such theory-building is usually based upon speech as reported by others, and is rarely based upon experimentally gathered data. Another approach to studying language is that of experimental phonetics, which, although grounded in empirical and experimental data, often lacks a revealing theoretical account of the patterns discovered (for more discussion, see Chapter 4).

In what could be considered a third approach, a growing number of researchers are showing that the sound structure of language (phonology) is best understood by considering *both* phonetic and phonological analyses (see, for example, Blumstein 1991; Liberman & Pierrehumbert 1984; Keating 1988, 1991; Pierrehumbert 1980, 1990). This dissertation accepts the third approach as the most desirable, and attempts to derive phonological structures and constraints from observed phonetic facts.

The general theoretical framework adopted for the phonological analyses is that of Optimality Theory, first put forward by Prince & Smolensky (1991, 1993), and since discussed by a great many researchers. Chapter 4 discusses both a rule-based and constraint-based approach to the metrical pattern of Latvian, and concludes that a

constraint-based approach is more desirable. For the phonological representations (as opposed to rules/derivations or constraints), the general approach of Autosegmental Phonology is adopted (see Goldsmith 1976, 1990).

1.1.2 Experimental procedure

The analyses of stress and tone in Chapters 4 and 5 are based upon data which I have gathered experimentally both in Philadelphia and near the town of Smiltene, Latvia. The data for the analysis of syllabification is based upon experimental phonetic work conducted by Liepa (1968).

As discussed in greater detail in the relevant chapters, my phonetic data is based upon recordings of native speakers reading prepared sentences containing a chosen target word placed in a carrier phrase. All five subjects utilized in this dissertation are native speakers of Latvian. None of the recording sessions was conducted in the sound-proof environment of a recording booth in a phonetics laboratory. Instead, all recordings were made in maximally noise-free environments in the homes or workplaces of the subjects. The tape recorder used was a Sony WM-D6C analog recorder, and the microphone used was a lavaliere-type Sony ECM-121 stereo microphone, which was clipped to the shirt or collar of the speaker as close to the mouth as possible. While none of the resulting recordings are therefore "ideal" for a phonetic investigation, the data thus acquired is surprisingly clear, and in no way inhibited the analysis of the data. The physical difficulty or impossibility of moving the subjects to a properly equipped phonetics laboratory is the reason for this type of "field gathered" data. I must add that were such field recording not made possible by portable tape recorders and high-quality miniature microphones, this dissertation as it is could not have been written.

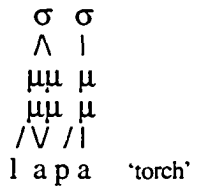
While the recording of data was not made in ideal conditions, the analysis of the data certainly was. For the analysis of data, I utilized the phonetics laboratory at the University of Pennsylvania, which has Sun SPARC stations running the acoustic-phonetic analysis software Xwaves in a UNIX environment. The data, which was recorded on regular magnetic tape, was converted to a digital signal at a sampling rate of 8,000 Hz. All analyses are based upon the digitized data. In addition, the tape recorder used was checked for speed reliability in the following manner: First, the signal of a tuning fork calibrated to 440 Hz was recorded with the tape recorder. Next, the resulting recording was digitized at 8,000 Hz and analyzed via the Xwaves program. The analysis indicated a uniform cycle of the signal throughout the duration of the recording.

1.2 Outline of the dissertation

Chapter 2 provides the reader with a general overview of the structure of the Latvian language, together with an historical overview of the development of the prosodic system. This chapter is intended as a reference and point of departure for the theoretical analyses presented in Chapters 3 - 5. It places a referential framework around the discussion of the syllabic, metrical, and tonal structures of the language.

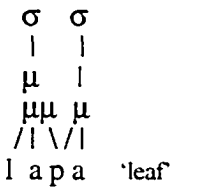
Chapter 3 investigates the syllable structure of Latvian. It discusses the work conducted to date on the topic, provides illustrative examples of syllabification patterns, and ends with an Optimality Theory account of the stated patterns of syllabification. Importantly, this chapter also provides evidence for the necessity of a two-mora analysis of the Latvian syllable, as summarized in (1) below (see Hayes, 1995).

(1) a.



'torch'

b.

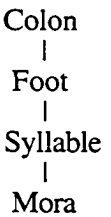


'leaf'

In (1a) above, the first syllable is heavy, whereas the second is light. Being heavy, the first syllable is also associated with a characteristic syllable intonation. In (1b) above, although the first syllable is "long", both syllables are light, and neither is associated with a characteristic syllable intonation. In Latvian, a heavy syllable is one with two moras on layer 2. While all stressed syllables will have two moras on layer 1, as shown in (1b), this does not constitute a heavy syllable, and is thus not associated with a syllable intonation.

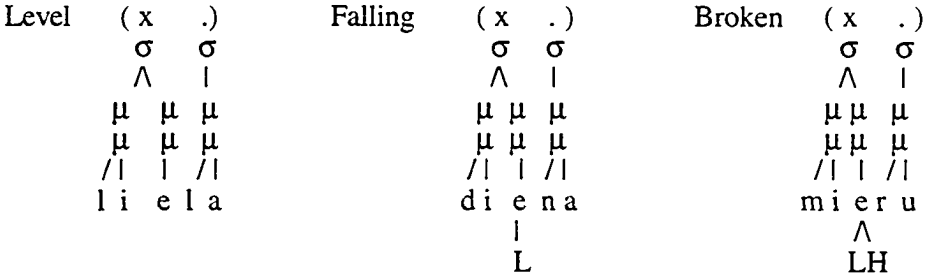
Chapter 4 discusses the metrical structure of Latvian, building an OT account of the stress patterns upon a phonetic investigation of the effects of voiceless obstruent lengthening following a stressed syllable. Importantly, this chapter not only provides evidence which confirms claims in traditional grammars such as Endzelīns (1922) that Latvian does indeed have secondary stress, but also provides a theoretical account of these patterns, along with an account of the obstruent lengthening indicated in (1b) above. In addition, the prosodic hierarchy shown in (2) below is proposed for Latvian, based upon both evidence from the metrical structure of traditional folksongs, as well as constraint interaction in secondary stress assignment.

(2) Proposed prosodic hierarchy of Latvian



Chapter 5 provides the first phonological analysis of the Latvian syllable intonations within generative linguistics, being based upon a phonetic investigation of the phenomena. The analysis reveals that of the three syllable intonations–level, falling, and broken–only the falling and broken intonations have lexically specified tone. As discussed in the chapter, the observed level-to-rise pitch of the level intonation is a result of a *metrical* H tone being associated with the second mora of the heavy syllable. A summary of the phonological analysis of the three syllable intonations is provided in (3) below.

(3)



Finally, Chapter 6 provides a brief conclusion of the major findings of the dissertation, and suggests productive avenues for future research related to both the prosodic structure of Latvian, and prosodic structure in general.

Chapter 2

Language background

In order to begin a discussion about stress and syllable intonations in Latvian, it is first necessary to become acquainted with the general phonological system of the language, and just how stress and syllable intonations fit in with the whole. For an in-depth discussion of the Latvian phonological system and the various phonological rules active in the language (albeit in an early Generative Phonology framework), the reader may wish to consult Steinbergs (1977). The discussion below is complementary to Steinberg's work, and focuses more on that part of the phonology relevant to the understanding of the metrical and tonal systems of the language. In addition, unlike Steinberg's work, the discussion below provides the reader with a general sketch of the historical development of these systems, together with a relevant comparison with Latvian's closest relative, Lithuanian. For a non-theoretical account of the phonological system, the reader may also wish to consult Laua (1969).

2.1 General structural description

2.1.1 Phonological inventory of Latvian

I begin with a basic phonological inventory of the sound system of Latvian, given in (1), (2), and (3). The basic source for this is Laua (1969), which is cited in work after work on Latvian phonology.

(1) The consonants of Latvian

	Bilabial	Labiodental	Dental	Alveolar	Postalv.	Palatal	Velar
Plosive	p b		t d			c ɟ	k g
Nasal	m		n			ɲ	
Trill				r			
Fricative		f v	s z	ʃ ʒ		x	
Approx.						j	(h)
Lat. app.				l		ʎ	
Affricate			ts dz	tʃ dʒ			

As a matter of convenience, I will follow the current orthographic convention of Latvian for the consonants, and use the following symbols:[1]

[ts] = c	[tʃ] = č	[c] = ķ	[ɟ] = ģ	[x] = h
[ʃ] = š	[ʒ] = ž	[ɲ] = ņ	[ʎ] = ļ	

(2) The monophthongal vowels of Latvian

	Front	Central	Back
High	i		u
Mid	ɛ		ɔ
Low	æ	a	

For each of these short vowels in Latvian, there is a corresponding contrasting long vowel. A more precise description of the acoustic quality of Latvian vowels is found in Grigorjevs (1992). The standard orthography of Latvian ignores the (now) phonemic distinction between [ɛ] and [æ], writing both as *e* (see Fennell, 1970 for a discussion). In Latvian, [ɔ] and [ɔ:] occur only in loanwords. Orthographic *o* represents either long or short [ɔ] or the diphthong [uɔ]. For convenience, I will use the following symbols:

[1] Many Latvians in the West still write [x] as *ch*, and thus maintain a distinction (at least in the orthography) between [x] and [h], as in the words *chirurgs* 'surgeon' and *hipoteze* 'hypothesis'. However, this distinction appears to have been neutralized in Latvia today. Standard Latvian orthography made the change of merging *ch* and *h* as *h* in the 1950's. Neither of the sounds [x] or [h] is native to Latvian, and they occur only in loanwords. For a discussion of the development of Latvian orthography, see Rūķe-Draviņa (1977).

[ɛ] = e [ɔ] = o

I will indicate a phonemically long vowel with a colon, as in */a:/*, instead of the orthographic macron over the long vowel *ā*.

Latvian is generally acknowledged to have 10 diphthongs, shown in (3) (see Laua, 1969:13; Steinbergs, 1977:1-3). Endzelīns (1922:13) presents a smaller system of diphthongs, and does not include the diphthongs /oi/ and /ou/ (which occur only in a few loanwords), and /eu/ (which occurs in a few loanwords and also as a result of syllable-final /v/ vocalization).

(3) The diphthongs of Latvian

Phonetically	[ia]	[ɛi]	[ɛu]	[ai]	[au]	[ui]	[uɔ]	[iu]	[ɔi]	[ɔu]
Orthographically	ie	ei	eu	ai	au	ui	o	iu	oi	ou

I shall write the diphthong [uɔ] as *uo* instead of the orthographic *o* in order to distinguish this sound from the monophthong [ɔ] and to make it clear that this is indeed a diphthong. In the Latvian philological literature, there is not complete agreement whether these diphthongs are to be interpreted as one phoneme or a sequence of two phonemes (see Sokols *et al.*, 1959:25; Laua, 1969:13; Bendiks, 1972). What is relevant to the discussion here is that all of these sounds, together with the long vowels, represent vowel sequences roughly double the duration of the short vowels (see Bond, 1991; Liepa, 1979).

2.1.2 Segmental quantity

Among consonants, phonemic length contrasts exist only for the resonants, as shown in (4). Standard orthographic convention writes these lexical geminates with two consonant symbols. Practically all of the words with geminate resonants are loanwords in the language. There is no phonemic length distinction for the obstruents (see Laua, 1969:70).

(4) Illustration of contrastive length for the resonants

geminate	single	gloss
nulle	nule	zero; just now
ķerra	vara	wheelbarrow; power
ķemme	zeme	comb; earth
manna	mana	cream of wheat; my

As mentioned above, Latvian has a system of phonemically contrasting long and short vowels (see Laua, 1969; Bond, 1991). The data in (5) illustrate that vowel length can be contrastive in any position of a word.

(5) Illustration of contrasting vowel length in Latvian

word	gloss
ada	3rd knits/is knitting
a:da	skin
lapa	leaf
la:pa	torch
lapa:	in the leaf
la:pa:	in the torch

In an acoustic analysis of vowel and word durations, Bond (1991) demonstrates that the duration ratio between phonemically long and phonemically short vowels is approximately 2:1 (see also Ekblom, 1933). Bond also shows that stressed vowels are (not surprisingly) longer in duration than their unstressed counterparts.

2.1.3 Syllabic structure

Of the various aspects of the phonological system of Latvian, syllabification and syllabic structure are perhaps the least described. Indeed, it is quite difficult to find works that have been written on this topic. Endzelīns (1922:16-17) devotes only a single page to this question. His discussion is mostly a listing of various syllable types. Liepa (1968) has a much more thorough discussion of this subject. However, his discussion is more from an articulatory viewpoint than from a structural one. As could be expected, Steinbergs (1977) makes no mention of syllabic structure in her Early Generative Phonology analysis. More recently, Bond (1994) discusses Latvian syllabic structure from the point of view of phonotactics. Kariņš (1995b) also provides some discussion of syllable structure and syllabification in Latvian. In the discussion below I attempt to provide a concise overview of possible syllable types in Latvian. In Chapter 3, I provide a closer look at the processes of syllabification in the language.

Latvian freely accepts both open and closed syllables. Syllables need not contain onsets or codas, but when these occur, they can be either single consonants, or clusters of up to three segments in the onset, and four segments in the coda. The data in (6) below provide some examples of possible syllable types in Latvian. As indicated in (1) above, I am considering final [ts] and [tʃ] clusters as single segments. These affricates occur as single phonemes in the language (see also Bond, 1994).

(6) Some examples of possible syllables types in Latvian
[note: *R* = resonant]

CV	ka	'that'
CVV	ka:	'how'
CCV	tra.ki	'crazy (masc. nom. pl.)'
CCCV	stru.pa	'short (fem. nom. sg.)'
CVC	kas	'who'
CCVCC	krist	'to fall'
CCCVCC	strigts	'fish bait'
CCVRCC	spilgts	'dazzling'
CCVRCCC	zvirgzds	'fine stone'
VC	es	'I'
VVCC	e:st	'to eat'
CVCC	nest	'to carry'
VCC	akts	'an act'

The syllabic nucleus in Latvian can be a phonemically short vowel, a phonemically long vowel, or a diphthong. Examples are found in the words *man* 'for me', *di:gt* 'to sprout', and *znuots* 'son-in-law'. In addition, it appears that resonants can also form syllabic nuclei, albeit not in primarily stressed syllables, but in words such as *ča.kls* 'diligent', *ku.pls* 'filled out', and *ka.tls* 'pot'. Liepa (1968) analyzes such words as containing two syllables, based upon the acoustic qualities of the sonorant. On the other hand, Bond (1994) provides a templatic syllable analysis in which such words contain only one syllable, despite the problem with the rise in sonority following an obsturent in the coda of the syllable. However, she acknowledges that such an analysis is disputable, and that one could argue that words such as *kupls* do indeed contain two syllables.[2] Bond (1994) does not provide any acoustic or psycho-acoustic evidence for her analysis. This issue is discussed further in Chapter 3, where I accept that standard Latvian does indeed allow for resonants as syllabic nuclei.

[2] Following Rudzīte (1964), the High Latvian dialect cannot have resonants as syllabic nuclei, while the Low Latvian dialects can. Of these, Tamian readily admits resonants as syllabic nuclei, while the Middle dialect often avoids them by inserting a vocalic segment. The standard language is based upon the Middle dialect.

Position in a syllable is important for the phonetic realization of /v/. When it occurs in the onset of a syllable, it is pronounced as [v]. Some examples of this are the words *vi:rs* 'man', *viņa* 'she', *visi* 'everyone', and *vienme:r* 'always'. The data in (7) illustrate that when /v/ occurs in the coda of a syllable, it is vocalized as the offglide [w] from the syllable nucleus. The table also illustrates how /v/ in coda position can resyllabify as the onset of a following syllable, and be pronounced as [v].

(7) The differing realization of /v/ in syllable onset and coda position

base form	pronunciation	gloss
tev-i	[tevi]	'you ACC sg.'
tev-is	[tevis]	'you GEN sg.'
tev	[tew]	'you DAT sg.'
nav	[naw]	'3rd does not have'
tev nav	[tew nau]	'you sg. do not have'
tev ir	[te.vir]	'you sg. have'

2.1.4 Word stress

Latvian is an Indo-European language in the the Baltic sub-family of languages. The only surviving close relative of Latvian is Lithuanian. Historical linguists are not in complete agreement regarding the relationship between the Baltic and Slavic languages. Some claim that the existing evidence points to a common Balto-Slavic ancestor language, while others claim that the two have remained distinct since their split from Proto Indo-European (PIE), and that the similarities found between these two language families are explainable in terms of language contact due to geographic proximity (see, for example, Senn, 1970; Van Wijk, 1923). There is no conclusive evidence to completely confirm or refute either side of this argument.

Lithuanian (as well as Russian) has a "free" stress pattern, inherited (with many changes of detail) from PIE. Old Prussian also apparantely had a "free" word stress system (see Endzelīns, 1948; Rudzīte, 1993:89). The placement of stress in a Lithuanian word depends upon the declension paradigm to which the given word belongs (see Senn, 1966). There is only one stress per word in Lithuanian (Young, 1991:13). Latvian, on the other hand, has a "fixed" stress system, where main stress normally occurs on the first syllable of a word (see Endzelīns, 1922; Laua, 1969; Rudzīte, 1993). Latvian represents the newer, innovative pattern. The issue of secondary stress patterns is taken up in depth in Chapter 4.

The origin of the Latvian stress system lies somewhat obscured in the undocumented past. What we know from historical reconstruction is that soon after the period when proto-East Baltic began its diversification into what is today Latvian and Lithuanian, main word stress changed from being "free" to being placed on the first syllable of most Latvian words (see Endzelīns, 1922, 1948). Not surprisingly, there is not complete agreement about the origin of this phenomenon. On the one hand are those such as Comrie (1981:149) and Thomason & Kaufman (1988:241) who claim that this is a result of the substrate influence of assimilated Livonian speakers (see Moseley, 1993; Sjögren, 1861), whose native Livonian (a Finno-Ugric language) had stress on the first syllable.[3] This claim could be summed up by stating that Latvian is a Baltic language spoken with Livonian stress. Others, such as Endzelīns (1922:19-20) and Rudzīte (1993:91-92) are more cautious, and suggest that this process could have developed independently in Latvian, while the Livonian substrate would have served to further along (not instigate) this change. What is important is that regardless of its precise origin, this change in the stress

[3] At the time of this writing, there are only about 10 elderly bilingual Livonian speakers left in Kurzeme, the northwestern province of Latvia. The rest have been fully assimilated to Latvian.

pattern of Latvian resulted in stress and tone becoming independent and separated from one another in Latvian words. They remain linked in Lithuanian.

2.1.5 Syllable intonation

The Baltic languages have inherited from PIE a system of contrastive syllable intonations which occur over long syllables (see Van Wijk, 1923). In the two extant Baltic languages, Lithuanian and Latvian, various changes have taken place which have affected the realization of these syllable intonations. The discussion which follows begins with the system as inherited by Lithuanian and Latvian, and does not consider the numerous changes which have taken place in the long period since PIE. The phonetics and phonology of Latvian syllable intonations are discussed in detail in Chapter 5.

Lithuanian has a pitch-accent system where main word stress is associated with an additional distinctive syllable intonation contour. That is, in standard Lithuanian, contrastive syllable intonations are found just in the syllable receiving word stress. Although Van Wijk (1923:26-28) mentions some claims that non-stressed long syllables can also have intonations, they do not appear to be contrastive. His work does not contain a systematic discussion of any such system. Indeed, Young's (1991) work on the prosodic structure of Lithuanian makes no mention of such a phenomenon. I am therefore assuming that stress and intonation are indeed linked in Lithuanian.

Standard Lithuanian can have an intonation on long and short stressed syllables. However, there is only one intonation for the short syllables (called the grave stress or the short intonation). It is only in the long syllables that two contrasting intonations are found, one which is falling in pitch (also called the acute intonation), the other which is rising in pitch (called the circumflex intonation) (see Dambriunas, Klimas & Schmalstieg, 1966; Senn, 1966; Young, 1991; Van Wijk, 1923).

In standard Latvian, because of the retraction of main word stress onto the initial syllable, word stress and distinctive syllable intonations do not always co-occur, since both stressed and unstressed long syllables can have a distinctive syllable intonation (Ekblom, 1933; Endzelīns, 1922; Laua, 1969; Mühlenbachs, 1923-32). That is, as main stress (the main word emphasis) was retracted onto the initial syllable, the contrastive tonal contours over long syllables in non-initial position remained. Today, long syllables in standard Latvian can have one of three contrastive syllable intonations: level (which is sometimes slightly rising), falling, and broken (which is falling with a marked glottalization or laryngealization on the latter part of the syllable). Standard Lithuanian, on the other hand, distinguishes only two syllable intonation types, falling and rising. In Latvian, long syllables (which bear the intonations) can be comprised of (i) a syllable nucleus with a phonemically long vowel (monophthong), (ii) a syllable nucleus with a diphthong, or (iii) a short vowel nucleus with a following tautosyllabic resonant *l*, *m*, *n*, or *r*. The standard source for the occurrences of the Latvian syllable intonations is in the voluminous Latvian-German dictionary Mühlenbachs (1923-32). Mühlenbachs was a mentor of Jānis Endzelīns, who later edited and completed the dictionary begun by Mühlenbachs, and added two more volumes of additions and corrections together with Edīte Hauzenberga.

A comparison of Lithuanian and Latvian nominal declension patterns, provided in (8), reveals the relationship between Lithuanian and Latvian syllable intonations. This figure uses the standard convention for indicating syllable intonations in these two languages. For Lithuanian, an acute accent as in *výras* 'man' indicates a falling intonation, and a circumflex as in the word *draũgas* 'friend' indicates a rising intonation. For Latvian, a circumflex as in the word *vîrs* 'man' indicates a level intonation, a grave accent as in the word *draùgs* 'friend' indicates a falling intonation, and a caret as in the word *diêgs* 'thread' indicates a broken intonation.

(8) Lithuanian and Latvian syllable intonation correspondences

		Lithuanian acute (falling)	Latvian level	Lithuanian acute (falling)	Latvian broken	Lithuanian circumflex (rising)	Latvian falling
sg.	Nom.	výr-as	vĩr-s	diẽg-as	diêg-s	draũg-as	draùg-s
	Gen.	výr-o	vĩr-a	diẽg-o	diêg-a	draũg-o	draùg-a
	Dat.	výr-ui	vĩr-am	diẽg-ui	diêg-am	draũg-ui	draùg-am
	Acc.	výr-ą	vĩr-u	diẽg-ą	diêg-u	draũg-ų	draùg-u
	Loc.	výr-e	vĩr-a:	dieg-è	diêg-a:	draug-è	draùga:
pl.	Nom.	výr-ai	vĩr-i	dieg-aĩ	diêg-i	draũg-ai	draùg-i
	Gen.	výr-ų	vĩr-u	dieg-ų̃	diêg-u	draũg-ų	draùg-u
	Dat.	výr-ams	vĩr-iem	dieg-áms	diêg-iem	draũg-ams	draùg-iem
	Acc.	výr-us	vĩr-us	diẽg-us	diêg-us	draug-ùs	draùg-us
	Loc.	výr-uose	vĩr-uos	dieg-uosè	diêg-uos	draũg-uose	draùg-uos
	Gloss	'man'		'thread'		'friend'	

The generally accepted view of the development of the syllable intonations from Proto-Baltic through the present day can be found in Endzelīns (1922) and Rudzīte (1993), among others. This view is schematized in (9) below (see Endzelīns, 1899, 1922; Rudzīte, 1993:101).

(9) The generallly accepted historical development of Baltic syllable intonations

Proto-Baltic	Old Prussian	Lithuanian	Latvian
*acute-rising (level?)	*rising	falling	level/broken
*circumflex-falling	*falling	rising	falling
Ø	Ø	accent on short σ	Ø

In this view, Proto-Baltic acute develops into the level (rising) and broken intonation in Latvian, and "flips over" as the falling intonation in Lithuanian, while Proto-Baltic circumflex remains as falling in Latvian, and becomes switched to the rising intonation in Lithuanian (see Stang, 1966). The generally accepted explanation for the split of the Proto-Baltic acute into the level and broken intonations in Latvian is that the Latvian broken tone developed from the acute, which is falling in Lithuanian, in those cases where stress was retracted from a later syllable in Latvian (Endzelīns, 1899, 1913:513). Since Endzelīns was the first to note the correspondence between the Lithuanian and Latvian syllable intonations, this phenomenon is commonly referred to as "Endzelīns' law" (see Rudzīte, 1993; Young, 1994).[4]

The evidence for this can be seen in a comparison of Lithuanian and Latvian cognates, shown in (10) (see Trautmann, 1923). The level intonation in Latvian is a direct reflex of the rising intonation in Proto-Baltic, while the broken intonation has resulted from words where a stress shift has occurred. For example: Lith. *galvà* Latv. *gâlva* 'head,' Lith. *uodaĩ* Latv. *uôdi* 'mosquitoes'. The Latvian falling intonation corresponds to the rising intonation in Lithuanian, and is a reflex of the falling intonation in Proto-Baltic.

[4] What Collinge (1985) refers to as "Endzelin's law" is a completely different phenomenon.

(10) A comparison of Lithuanian and Latvian cognates; (M) indicates a word in the mobile stress paradigm in Lithuanian

Latvian	Lithuanian	gloss
vĩrs	výras	man
liẽpa	líepa	linden tree
mãte	mótina	mother
saũle	sáule	sun
uõla	úola	egg
diêgs	díegas (M)	thread
dzîvs	gývas (M)	alive
puôds	púodas (M)	pot
siêts	siétas (M)	sieve
uôga	úoga (M)	berry
dràugs	draũgas	friend
àuskars	aũskaras	earring
dzìmt	gimti	to be born
raìbs	raĩbas	colorful
sveìks	sveĩkas	healthy, well

A recent departure from the generally accepted view of the historical development of the Latvian broken tone can be found in Young (1994), who is builds upon a proposal made by Kortlandt (1975) that the broken tone of the northern Lithuanian dialect of Žemaitie is a direct continuation of the Indo-European laryngeal.[5] Young writes that the broken tone is the primary realization of the acute tone in the "prosodically conservative" Žemaitic dialects of northwestern Lithuania (p. 102). The traditional view is (apparently) that this is an areal feature (see Young, 1994 for discussion). Young disagrees with this view.

Young argues that although the Lithuanian-Latvian acute tonal correspondences hold well for monosyllabic bases (see (10) above), in polysyllabic bases there are numerous cases of the broken tone occurring in non-initial syllables in instances where it

[5] Steinbergs (1975) also finds difficulties with Endzelīns' account of the historical development of the Latvian broken tone, but does not go so far as to argue that the broken tone was original.

would not be predicted to occur via stress-retraction. Thus, he writes that one could consider that the Latvian broken tone "represents acute in unstressed syllables" (p. 105).

If the broken tone is to be understood as the inherited acute in Latvian, then an explanation is required for the occurrence of the level tone realization of the acute. Young (1994:106-107) answers this by referring the reader once again to the Žemaitic dialects of northern Lithuania, where there is a prosodic dissimilation: a series of two broken tones in a word will be broken up into a falling tone (without the glottal constriction) followed by a broken tone. Young argues that in Latvian, the original broken acute tones in initial position could have similarly been dissimilated in Latvian, and become the default level tone. At a later time, the level (non-glottal) tone could have been generalized as the realization of a stressed acute in Latvian.

Thus, there are (at least) two views on the historical development of the Latvian intonational system. A more thorough consideration of this newly sparked debate is outside the scope of this dissertation. However, it does raise some very interesting questions for historical linguistics. This debate is relevant to the present discussion insofar as the potential plausibility of Young's arguments raises the issue about the phonetic "naturalness" of a level or rising tone becoming broken via stress retraction. This issue is addressed in Chapter 5.

2.1.5.1 Syllable intonations in the Latvian dialects

Two well-known Latvian dialectologists Gāters (1977) and Rudzīte (1964) divide Latvian into three main dialect areas: Middle, Tamian, and Latgalian. The standard or literary language is based upon the Middle or Central dialect. The Tamian dialect, which is sometimes referred to as the Livonian dialect, is spoken along the coast where the now-

assimilated Livonian speakers once lived. The Latgalian dialect, also called High Latvian, is spoken in the eastern portion of the country.[6] A dialect map is provided in Appendix A.

The three dialects differ from one another in both their phonology and morphology. Speakers of both the Middle and Tamian dialects have considerable difficulty understanding people speaking in the Latgalian dialect. There are those who claim that Latgalian is a separate language (for example, see Bukšs & Placinskis, 1973). It is true that there is a separate literary tradition in this dialect. The part of the country where this dialect is spoken has a separate history from the rest of Latvia. While the rest of what is now Latvia was variously under German and Swedish rule starting in the 13th century, Latgale (where Latgalian is spoken) spent much of its time under Polish rule (Bilmanis, 1951).

These three broad dialect areas have different manifestations of the inherited Proto-Baltic intonations. Rudzīte (1993:110) sums up the realization of syllable intonations in a concise manner, shown in (11). The table presents the "traditional" view of the development of the Baltic intonations. In Young's (1994) view, the Latvian broken intonation would be an inherited feature from Proto-Baltic, and the Latvian level intonation would be an innovation following the analogical spread of dissimilation (see section 2.1.5).

[6] Rūķe-Draviņa (1977) takes a slightly different approach. She divides Latvian into two main dialect areas, Low Latvian and High Latvian (Latgalian). Low Latvian is then subdivided into the Middle and Tamian (or Livonian) dialects. The result, however, is practically the same as that presented in Gāters (1977) and Rudzīte (1964).

(11) The realization of syllable intonations across the three main Latvian dialects

Proto-Baltic	rising	falling	rising
Proto-Latvian	level	falling	broken (after stress shift)
Middle dialect (restricted area)	level	falling	broken
Middle dialect (general area)	level	broken	
Tamian dialect	level	broken	
Western Latgalian dial. (*nesēliskās*)	falling		broken
Eastern Latgalian dial. (*sēliskās*)	falling		rising

Source: Rudzīte (1993:110, 1964)

Note that standard Latvian with its three intonational contrasts is spoken only in a restricted portion of the country. The capital city Rīga (also the largest city in the country, containing about one-third of the population; see Zvidriņš, 1992), which falls within the broad scope of the Middle dialect, lies in the portion of the dialect area which makes only two intonational contrasts. Indeed, the areas where three intonational contrasts are made are quite small now, and are in the process of decreasing in size (Rudzīte, 1993). While collecting data on syllable intonations during 1994/95, I went to the town of Smiltene in the center of Vidzeme, one of the reported bastions of the three-way tonal distinction. However, in order to find speakers who actively maintained this distinction, I had to turn to rural speakers living in the countryside surrounding this town. On the whole, the town dwellers no longer make a clearly audible distinction between the falling and broken intonations.

2.1.5.2 General phonetic characterization of the syllable intonations

Since the phonetic characterization of the syllable intonations will be discussed in depth in Chapter 5, I present here only a truncated explanation of what the syllable intonations sound like.

The level intonation is characterized by a level or slightly rising pitch over the duration of the syllable. In a two-syllable word such as *mã:ja* 'house', the first syllable (with the level intonation) is steady to slightly rising in pitch. There is a considerable fall in pitch between the first and the second syllable.

The falling intonation is characterized by a high pitch in the initial part of the syllable, and a steady fall in pitch towards the end of the syllable. Unlike the level intonation, the pitch on the end of a syllable with falling intonation is roughly equal in pitch to the following syllable.

The broken intonation is like the falling intonation, with the addition of a laryngealization of the latter part of the syllable which corresponds to a sharp fall in pitch. The second portion of the syllable is also more quiet than the first. This intonation is apparently similar to the Danish *stød* (see for example Basbøll, 1985; Ekblom, 1933; Endzelīns, 1922; Fischer-Jørgensen, 1989; Lehiste, 1972, 1978), and sounds as if the syllable is "broken" in the middle by a glottal catch.

Because of the shifting stress pattern of Lithuanian, an intoned long syllable in a given word can have a different intonation in a derived form. This is not the case in Latvian, which has fixed intonations on a given syllable in a given stem (for a discussion of the few exceptions, see Endzelīns, 1922:29; Steinbergs, 1977:191).

2.1.5.3 Functional role of the syllable intonations

In Latvian, contrastive syllable intonations can change the meaning of a word, similarly as contrastive vowel lengths can change meaning. In this regard, the syllable intonations are "phonemic" in the language. Standard Lithuanian also has some such minimal pairs, such as *siẽtas* 'tied' and *síetas* 'sieve' (see Grīsle, 1970:155).

For Latvian, Grīsle (1970, 1990) writes that she has found about 400 lexical heterotones (intonational minimal pairs) in the language, creating about 5,000 heterotonic forms when all of the possible inflections and derivatives are taken into account. The data in (12) illustrate some of these heterotones, which can have up to a three-way distinction.

(12) Examples of some heterotonic words in Latvian

level		falling		broken	
ta:	'N. sg. fem. article'	ta:	'G. sg. masc. art.'	ta:	'thus'
luoks	'chives'	luoks	'bow'	luoks	'window'
		ka:	'whose'	ka:	'how'
ri:ts	'swallowed'			ri:ts	'morning'
auksts	'cold'			auksts	'high'
		griezt	'to turn'	griezt	'to cut'
		li:st	'to crawl'	li:st	'is raining'
za:le	'hall'			za:le	'grass'
se:ju	'I sowed'	se:ju	'I tied'		
		aust	'to dawn'	aust	'to weave'
ru:sa	'pile'			ru:sa	'rust'
pla:ni	'plans'			pla:ni	'thin'

Work conducted by Kariņš (1994, 1995b) in the area of Latvian morphological ending neutralization indicates that simply because the syllable intonations affect the meaning of a word does not mean that this system is rock solid, without variation, and without a tendency to change. As studies of other languages have also shown, speakers do not always consider the need to preserve grammatical information when choosing one variant or another (see also Guy, 1993; Labov, 1987, 1994; Poplack, 1979, 1981; Ranson, 1991).

2.1.5.4 The stability of the system of syllable intonations

Although the syllable intonation contrasts for any given dialect are clearly realized on the initial stressed syllable, the linguistic literature reports that there is quite a bit of variability in the realization of unstressed syllable intonations, even within a dialect (see Endzelīns, 1922:23-24; Grīsle, 1970:160; Sokols *et al.*, 1959:67; Steinbergs, 1977:209-210). Thus, not all intonational contrasts are maintained in non-initial (or non-primary-stressed) syllables.

Besides the variable realization of the syllable intonations in non-stressed syllables within a dialect, there is additional evidence that the contrasts between the intonations are generally on the decline. As claimed in the linguistic literature (see Rudzīte, 1993) and confirmed by my own investigations, the remaining areas where a three-way intonational contrast is still maintained are decreasing. The tremendous proportion of non-Latvians in Latvia, which is currently about 46% of the population (see Mežs, 1994; Zvidriņš, 1992), is also going to put a continuing strain on the maintenance of distinctive syllable intonations. Although I am not aware of any formal investigation on this topic, my impression from interaction with many non-native speakers is that they have difficulty learning the syllable intonation contrasts. Given the large proportion of non-native speakers in the country, their possible linguistic assimilation could lead to changes in the language as profound as those left earlier by the assimilated Livonian speakers. Indeed, even among native Latvian speakers in Riga (whose families come from varying parts of the country), my experience shows that there is often disagreement about the intonation of a primary-stressed syllable in a given word.

2.2 Previous studies of Latvian prosodic structure

2.2.1. The description of Latvian

The first printed grammar of Latvian (Rehehusen, 1644) appeared over 350 years ago. It was written by a German pastor who worked in both Aizkraukle and Koknese in the southeastern part of Vidzeme by the Daugava river. This work marks the beginning of a long tradition of descriptive Latvian grammars, including Adolphi (1685), Stender (1783), Hesselberg (1841), and Bielenstein (1863, 1864). The culmination of this tradition is found in the work of Jānis Endzelīns (1922), whose grammar is still the basic reference for the structure of the Latvian language.

Although the grammar of Latvian (including the sound system) has been described by numerous authors with varying competence in the language itself, little work on the language has been conducted within the framework of generative linguistics. The reason for this is twofold. First, from the end of the Second World War until 1991 Latvia was under the domination of the Soviet Union, whose government successfully denied local linguists (and other academics) free access to work conducted on the other side of the Iron Curtain. Generative linguistics had its origins after the end of the Second World War, which means that the current generation of linguists trained in Latvia did not have access to the new approach to language study which has been the mainstream approach in the West for many years. Second, there were very few linguists in the West who knew enough about the language to study it.

Behind the Iron Curtain the tradition of describing Latvian continued to flourish. This tradition, as exemplified by Endzelīns (1922, 1938, 1948) and others, can perhaps best be described as a Structuralist approach to language study. All of it falls under the

broad rubric of Baltic philology. This approach is characterized by paying meticulous attention to details such as historical origin, classification of forms, and recording of dialectal variation, without looking to see how these details pertain to more general processes of langauge. Another way of describing the work could be to call it atheoretical. Some more recent (albeit eclectic) examples of such work are Ancītis (1977), Blinkena (1987), Bušmane (1989), Celmiņa (1980), Grabis *et al.* (1986), Graudiņa (1969), Laumane (1983), Markus (1987, 1994), Poiša (1985), Rudzīte (1964, 1993). To a Generative linguist, these works and others similar to them represent a wonderful point of departure for further experimental and theoretical work.

While work on Latvian has also been conducted outside of the country during the past 50 years, work on the structure of the language within generative linguistics has been limited to a rather small group of researchers. An early Generative-Phonology account of the morphological structure of Latvian can be found in Halle & Zeps (1966) and Zeps (1970). More recent works on Latvian morphology include Metuzāle-Kangere (1985) and Halle (1987b). Works on various aspects of phonetics, phonology, prosody, and linguistic variation include Bond (1978, 1991, 1994), Kariņš (1995b), Lehiste (1972), Lehiste & Bond (1984), Steinbergs (1975, 1977), and Zeps (1963, 1973, 1989). Needless to say, there is still an incredible amount of research which has not yet been conducted on Latvian. The language remains under-studied within the paradigm of generative linguistics.

2.2.2 Studies on the general prosodic structure of Latvian

As mentioned above, the majority of the studies on the prosodic structure of Latvian have been conducted within a pre-generative, atheoretical framework. As in most areas of Latvian philology, Endzelīns (1922) is the basic source of information, including that on

the prosodic structure. Laua (1969) is the often-cited general source of information specifically about standard Latvian phonetics and phonology. While her work is at least partly based upon the experimental work of others, it does not include any experimental data, and is atheoretical as well. The most recent full-length treatment on the phonology (including prosody) of Latvian is Steinbergs (1977). While her work analyzes the language within a general theoretical framework, it focuses quite narrowly on various phonological rules active in the language, touching more in a descriptive than a theoretical manner on stress patterns and syllable intonations. The framework used is Standard Generative Phonology, which does not yet distinguish prosodic (suprasegmental) structure from segmental structure (see for example Chomsky & Halle, 1968). It is interesting to note that, in her formalization of the rule for intonational dissimilation which occurs in some morphological combinations, Steinbergs makes reference to the syllable instead of the expected CV structure. This shows that intonations in Latvian are linked to syllables so clearly, that even a Standard Generative analysis cannot disregard them (Steinbergs, 1977:199). Like the previously mentioned works, Steinbergs' work is not based upon raw experimental data, but instead upon the general descriptions of others, or in some cases, upon the experimental results of others, such as Schmidt-Wartenberg (1899) and Ekblom (1933). Description of the prosodic structure of the High Latvian or Latgalian dialect can be found in Breidaks (1972) and Markus (1994).

The experimental work conducted on Latvian prosody, like the general phonological work, focuses almost exclusively on pure description and does not include a theoretical interpretation of the acoustic facts presented (see Ābele, 1926, 1929, 1930, 1931, 1932; Birzniece 1931; Ekblom, 1933; Liepa, 1963, 1967, 1979; Markus, 1987, 1994; Martinsone, 1934; Šmite, 1938). However, one thing that all these works have in common is paying enough attention to detail to accurately report the facts as they find them. As shown in Kariņš (1995a) and in Chapter 4, some claims about the prosodic structure of

Latvian made in recent linguistic (that is, non-philological) literature are not quite accurate (see Halle & Vergnaud, 1987; Goldsmith, 1990).

2.2.3 Analyses of the Latvian syllable intonations

The earliest phonetic investigation of Latvian syllable intonations that I am aware of is Schmidt-Wartenberg (1899), and the earliest philological descriptions of syllable intonations are Endzelīns (1899, 1901, 1911, 1913). The majority of the extant phonetic descriptions date mostly from the 1920's and 1930's (see above). The principal investigator of the time was Anna Ābele, who led the experimental phonetics laboratory at the University of Latvia. The tradition begun more than 50 years ago in the Baltic countries has continued to this day, as evidenced in a very recent phonetic investigation conducted in Vilnius, Lithuania (Markus, 1994). One could consider this work a direct descendent of the same tradition: while the descriptive aspect seems adequate, there is a noticeable lack of phonological interpretation of the facts presented. The work does not have a strong theoretical base.

The most thorough phonetic work to date on the intonational patterns of standard Latvian is Ekblom (1933). His work is based upon acoustic measurements of words and phrases spoken by Jānis Endzelīns, who grew up in a part of Latvia which has a three-way intonational contrast. The analysis is strictly descriptive, indicating the duration, tonal contour and intensity of the three intonations. The other thorough descriptive work on the syllable intonations is Markus (1994), who deals with the intonations of the High Latvian dialect. Similar to Ekblom (1933), Markus' work is also purely descriptive in nature, being the first such thorough phonetic work on the patterns found in this dialect. The theoretical perspective is (still) structuralist, whereby the contrastive intonational contours are described as "tonemes" without any further phonological investigation. In addition to

these two larger phonetic works, there are numerous smaller phonetic studies conducted by Ābele and others during the 1920's and 1930's, mentioned in section 2.2.2 above.

From a phonological perspective, Steinbergs (1977) provides an overview of the intonational patterns in Latvian. However, the patterns of the syllable intonations that this work discusses are only a small portion of the work, and its purpose is not to analyze the phonetics of the phenomenon. In addition, the phonological model used has since been superseded by models which appear to be more productive. Thus, while the intonational patterns have been described rather extensively within both a philological and a phonetic framework, practically no work has been conducted on this system combining both the phonetics and the phonology of the phenomenon within the paradigm of Generative Linguistics. Chapter 5 takes up this issue where the numerous descriptive works leave off.

Chapter 3

The syllable in Latvian

In order to discuss the stress and syllable intonation patterns of Latvian (in effect, the prosodic system), it is first necessary to ascertain the nature of the syllable in the language, which is, after all, the building block necessary for determining the other phonological structures. It is interesting to note that the internal structure and boundaries of the syllable are often assumed in discussions of Latvian prosody, although the nature of the syllable itself is rarely discussed. Indeed, in reading the linguistic literature on the subject, one notices that very little has been written on the Latvian syllable to date, and some of what has been written is contradictory. While I do not intend to answer all of the outstanding issues concerning the Latvian syllable in this Chapter, I hope to at least bring together the work on this topic so far, add phonological analysis to the stated facts, and point out areas where future research is required.

3.1 The syllable in linguistic theory

During the Standard Generative Phonology period (see Chomsky & Halle, 1968; Kenstowicz and Kisseberth, 1977), the syllable was not used as a theoretical construct (see also Steinbergs, 1977). However, since that time the syllable has come to be not only a generally accepted entity in generative linguistics, but also a somewhat elusive one.

The notion of a syllable is variably discussed by phoneticians, psychologists, and phonologists, each with their own differing approaches to this construct. In writing about the syllable in his well-know introductory phonetics text, Ladefoged (1982) discusses various approaches to defining the syllable, none of which is completely satisfactory.

The first approach that Ladefoged discusses could be termed the acoustic approach to the definition of the syllable. This approach requires the notion of sonority, defined as the "...loudness [of a sound] relative to that of other sounds with the same length, stress, and pitch" (p. 221). One view is that syllables are characterized by peaks of sonority. However, this view can be problematic in cases of words such as *spa*, which, strictly speaking, has two sonority peaks, the [s] and the [a]. Another view is that syllables are marked not by peaks of sonority, but by peaks of prominence, which combines sonority with duration, pitch, and stress. The problem with this view is that there is no clear way to define "prominence", although the idea is relatively clear: in the word *spa*, the [a] is taken to be more prominent than the [s] (having, for example, a greater measurable amplitude), and hence constitutes the peak of the syllable.

A second approach that Ladefoged discusses could be called the articulatory approach to the definition of the syllable. In this view, syllables are defined by the activities of the speaker, such as the contraction of the muscles of the rib cage to produce chest pulses, or the combination of respiratory and laryngeal activity. However, these views have not been supported by empirical measurements.

A third approach mentioned by Ladefoged could be called the structural or organizational approach. In this view, syllables are abstract units of structure that "exist at some higher level in the mental activity of the speaker" (p. 223). Support for this view comes from occurrences such as slips of the tongue, where syllable onsets are switched with other syllable onsets, and syllable codas are switched with syllable codas. On the whole, phonologists and psychologists discuss the syllable via this third approach. Phonologists in particular are interested in the internal structure of the syllable, as evidenced by the organizational changes in consonant and vowel sequences in various positions of the word (see, for example, Kenstowicz, 1994). Thus, the example in

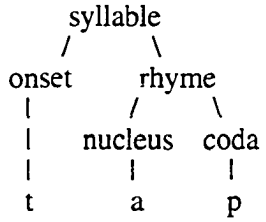
Chapter 2 of Latvian /v/ changing its phonetic realization from [v] to [w] would be difficult to characterize without recourse to its position in a syllable.

Given that linguists accept the syllable as part of abstract hierarchical prosodic structure, the question arises: what is the internal structure of the syllable?

3.2 The internal structure of the syllable

There are a number of different theoretical approaches that generative linguists have in discussing syllabic structure. While everyone seems to agree that a syllable has internal structure, just what that structure is has different interpretations. The first is the "classical" templatic representation of the syllable, found in Selkirk (1982), among others. In this view, the structure of the syllable includes an onset and rhyme, the rhyme being composed of a nucleus and coda. An example is given in (1) below.

(1) The "traditional" view of syllabic structure (Selkirk, 1982)



In addition to this view of the syllable, there are at least three other accounts of syllabic structure: CV Theory, X Theory, and Moraic Theory (see discussion in Hayes, 1989).

The first two theories of syllabic structure, the CV and X Theories, can be referred to as segmental or constituent theories of syllabic structure, insofar as segmental count or syllable constituency (onset, nucleus, coda), is overtly indicated in the structure of the

syllable. Moraic Theory differs from the segmental theories insofar as it gives an indication of weight rather than segmental content.

In examining each of these approaches, I begin with a sketch of CV Theory, first put forward by McCarthy (1979). This is shown in (2) below.

(2) The CV Theory view of syllabic structure (McCarthy, 1979)

The other segmental (or constituent) theory of syllabic structure is shown in (3) below.

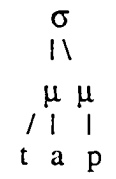
(3) The X Theory view of syllabic structure (Levin, 1985; Lowenstamm & Kaye, 1986)

In current phonological work, the theory of Moraic Phonology is the prevalent (although not only) view of the internal structure of the syllable. This theory has grown out of the work of Hyman (1985) and McCarthy & Prince (1986), and is argued for strongly in Hayes (1989). This theory does away with the segmental level (either CV or X-tier) altogether, by positing that the most important aspect of the syllable is its *weight*, and how that can play a role in determining aspects of prosodic structure such as placement of stress, as well as how that helps to explain the preservation of durational quantity after segmental deletion, known as *moraic conservation* (Hayes, 1989). It is important to note

that in stress systems which take syllable weight into account, it is not segmental quantity *per se* which determines weight, but whether a given syllable is considered heavy or light (see Hayes, 1995:50). Moraic theory thus posits the *mora* as the sole element of structure below the syllable, the mora being a representation of syllable weight, which can also be understood as a unit of duration. This is illustrated in (4) below.

(4) a.

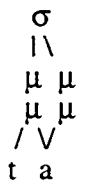
b.

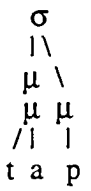


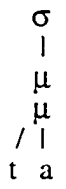
As illustrated in (4), there is disagreement about the correct representation of the syllable onset, whether it is a daughter of the syllable or of a mora. Some researchers, such as Hayes (1989), adhere to the analysis in (4a), which captures in the representation the fact that no languages make syllable quantity distinctions of light vs. heavy based upon the presence or absence of onset consonants, and hence onset consonants never license moras. Others, such as Hyman (1985) and Zec (1988) adhere to the analysis in (4b), which captures in the representation the claim that moras are prosodic constituents dominated by syllables. Hayes (1995) accepts the representation in (4b), basically arguing that this simplifies the view that syllables are the only true stress-bearing units, since then one does not have to stipulate that onsets are ignored. I will also accept the representation in (4b) for purposes of simplicity coupled with the adherence to the claim that moras are constituents of syllables.

As an addition to moraic theory, Hayes (1995) posits that some languages have two moraic layers, instead of the one shown in (4) above. The reason that a language would utilize two moraic layers is because it makes a distinction between different kinds of heavy syllables, some which act heavy for some prosodic rules, and light for others. Similar to

x's in grid theory, these moras obey the Continuous Column Constraint (Prince, 1983). What they refer to is the relative sonority of the segment with which they are associated. More sonorous segments are associated with two moras, while less sonorous segments are associated with one. In effect, the two-layer moraic theory encapsulates information concerning both duration (on the horizontal plane) and sonority (on the vertical plane). A "heavy" syllable in this analysis is one with two moras on layer 2 (the upper layer), while a "light" syllable is one with only one mora on layer 2. A sample analysis of three possible words is shown in (5). As discussed below, I am assuming the two layer analysis of Latvian syllables.

(5) a.


b.


c.


3.3 Traditional discussion of Latvian syllable structure

The primary sources for discussion of the syllable in Latvian are quite few, and are almost wholly found in the traditional philological literature. However, although the existing discussion of the syllable is quite obscure to someone trained as a generative linguist, it warrants some investigation, since it contains some valuable insight into both the syllabic and metrical structure of the language.

Most discussions of Latvian syllables cite as seminal the work of Anna Ābele, who published primarily in the 1920's and 1930's. For example, Bendiks (1972:27) cites as a point of departure for discussing Latvian syllables Ābele (1924a), while Laua (1969:106) cites Ābele (1926). A primary source of discussion of Latvian syllable boundaries is Liepa

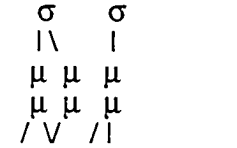
(1968). The work of Laua (1969) is also important as a basic source of information about syllables, and is perhaps the best summary of work completed before 1970. A more recent discussion of Latvian syllables from the viewpoint of sonority peaks can be found in Bond (1994). It is interesting to note that a connection with the previous works on Latvian syllables is missing in this generative work.

In the philological literature, there are two basic types of classifications of syllable types in Latvian: long vs. short, and monophthongal vs. diphthongal. I briefly discuss each in turn below.

3.3.1 Long vs. short

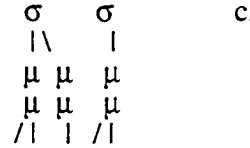
A first clear division of Latvian syllables is based upon segmental quantity: long vs. short. Laua (1969:107) defines long syllables as those containing either i) a long monophthong, ii) a diphthong, or iii) a short vowel+resonant (see also Endzelīns, 1922; Sokols *et al.*, 1959). Short syllables are those containing only a phonemically short vowel in the nucleus. As Laua writes, it is the long syllables which are characterized by one of the three syllable intonations. Some examples are provided in (6) below.

(6) a.



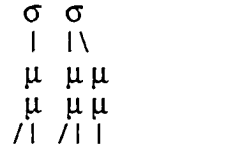
'house'

b.



'hills'

c.



'good NOM pl'

The example words in (6a) and (6b) have a long-short syllable sequence, while (6c) has a short-long syllable sequence. As discussed below, within metrical phonology in generative linguistics, the "long-short" distinction in the Latvian philological literature is really the same as a heavy vs. light distinction. It is such long or heavy syllables in Latvian which

are associated with a distinctive syllable intonation, as discussed in greater detail in Chapter 5.

3.3.2 Monophthongal vs. diphthongal

A second, much more opaque distinction of syllable types mentioned in the philological literature is one of "monophthongal" vs. "diphthongal" syllables. Following Bendiks (1972) and Laua (1969), it seems that one of the basic contributions made by Ābele is her division of Latvian syllables into two basic kinds: those with "monophthongal" nuclei, and those with "diphthongal" nuclei. Citing from Bendiks (1972:27), Ābele (1924a:21-22) writes the following:

> The center of the syllable which has only one syllabic phoneme we shall call a monophthongal syllable center, while two syllabic phonemes next to one another (in the same syllable)–a diphthongal syllable center. Such a diphthongal center is characterized by each phoneme in it being relatively free and independent with respect to quantity.[1]

While this distinction could be interpreted as the same distinction that generative linguists make when they speak of "heavy" vs. "light" syllables (see Hayes, 1995), this is not the case, since the first syllable in a word such as *la:.pa* 'torch' with a long monophthong in the nucleus would be classified as "monophthongal" along with the first syllable in a word such as *la.ba* 'good', which has only a phonemically short vowel in the syllabic nucleus (see Laua, 1969:106). In the accepted generative analysis of light vs.

[1] The translation is mine. The original states: "Zilbes centru, kurā ir tikai viena zilbiska fonēma, sauksim par monoftongisku zilbes centru, turpretīm divas zilbiskas blaku fonēmas (vienā zilbē) – par diftongisku zilbes centru. Tādu diftongisku zilbes centru raksturo tas, ka abas fonēmas tā sastāvā ir relatīvi brīvas un patstāvīgas kvantitatīvā ziņā". It is interesting to note that the division of syllable types into monophthongal and diphthongal still continues today among philologists in Rīga.

heavy syllables, a phonemically long vowel would be expected to form part of a heavy (not light) syllable.

The reason for the division of syllable types into monophthongal vs. diphthongal instead appears tied to the need to explain observed differences in syllable structure of the "same" words in the Tamian vs. the Latgalian or High Latvian dialect (see Ābele, 1926). As discussed in more detail in Chapter 4, standard Latvian (which is based upon the Middle dialect) lengthens voiceless obstruents following stress between two phonemically short vowels. In the Tamian dialect around Dundaga in northern Kurzeme, this process also reportedly affects voiced obstruents (Ābele, 1926). As a contrast, speakers of High Latvian lengthen neither voiced nor voiceless obstruents, and only slightly lengthen the syllable nucleus or vowel (see Ābele, 1926:24; Breidaks, 1972:91; Laua, 1969; Rudzīte, 1964). This is illustrated in (7). As discussed below and in Chapter 4, this lengthening of syllable onsets crucially occurs after a stressed syllable.

(7) Differing effects of stress on syllabic structure in the three main dialect areas (extrapolated from Ābele, 1926; Breidaks, 1972; Laua, 1969; Rudzīte, 1964). Illustrated with the words *lapa* 'leaf' and *laba* 'good'.[2]

	word	syllabic division	classification of first syllable
Tamian dialect (Dundaga)	lapa laba	lap.pa lab.ba	diphthongal syllabic center
High Latvian	lopa loba	lo.pa lo.ba	monophthongal syllabic center
Middle dialect	lapa laba	lap.pa la.ba	diphthongal syllabic center monophthongal(?) syllabic center

[2] The reader may wish to check the original sources for other "possible words" in these dialects. The sample words were devised to show the minimal distinction between these dialects claimed in the literature. The slight lengthening of the stressed vowel in High Latvian apparently does not interfere with the vowel's identity as phonemically long or short, and can thus be considered a phonetic (rather than a phonological) effect. Note also the vowel change in High Latvian.

Thus, the traditional division of syllable types in Latvian into monophthongal and diphthongal has more to do with the structure of *adjacent* syllables than it does with the structure of an individual syllable. A syllable with a monophthongal syllable center does not involve segmental lengthening at a syllable boundary, while a syllable with a diphthongal syllable center does. As discussed in Chapter 4, this phenomenon need not be explained in terms of syllabic type. It can be accounted for in a much clearer manner via constraint interaction in the metrical system of the language.

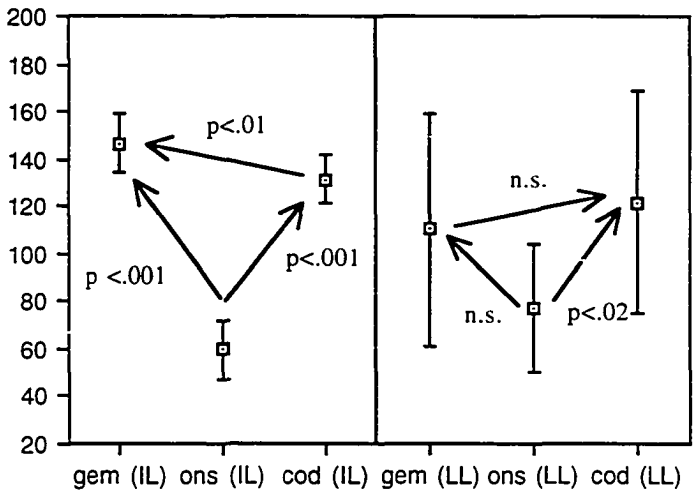
3.4 Phonetic evidence for moraic structure in Latvian

Phonetic analyses of vowel durations found in Liepa (1979:89) and Bond (1991) support the view that long vowels in Latvian have two moras, while short vowels have only one; they find a durational ratio roughly 2:1. As indicated above and in Chapter 2, two other types of syllables besides those with long syllabic nuclei can be analyzed as having two moras: stressed short syllables containing phonetically lengthened obstruents from the onset of the following syllable, and syllables with a short vowel+resonant in the rhyme (including geminate resonants).

Phonetic evidence for the phonetically lengthened obstruents is discussed in Chapter 4. To illustrate that resonants in coda position are indeed dominated by a mora, I consider phonetic evidence of the duration of the resonant *n* in the words *va.na.gi* 'ravens', *pan.niņa* 'pan (diminutive)', and *In.ga* 'personal name', where the resonant is in the syllable onset, a geminate, and in the syllable coda respectively. My data comes from two native speakers of the Riga variety of Latvian, IL and LL. More information about these speakers, the experimental situation, and the method of analysis is provided in Chapter 4. Each speaker separately read a long list of sentences containing various words in the same carrier phrase, which included each of the words above. Each word was repeated 10

times. The figure in (8) shows the mean duration of *n* for both speakers in the given word positions. The data from which (8) is generated is provided in Appendix B.

(8) Mean duration in milliseconds of *n* in syllable onset and coda position, as well as geminate *n* for two speakers IL and LL.



For both speakers, there is a significant difference in duration between an *n* in syllable onset position and an *n* in syllable coda position, indicating that the resonant in coda position is indeed dominated by a mora, for its duration is comparable to a geminate *n* which by definition spans two adjacent syllables. In addition, speaker IL indicates a significant difference between the geminate *n* and the *n* in coda position, which would correspond to the geminate being linked to two moras (in two syllables), while the coda consonant is linked to only one mora.[3]

[3] The non-significant difference between a geminate *n* vs. an onset *n* and geminate vs. coda for speaker LL is rather suprising. The figure in (8) indicates that this is due to the rather large standard deviations in the durations for all positions for speaker LL compared with speaker IL, who appears to maintain durational differences much more clearly.

3.5 A moraic analysis of the Latvian syllable

The notion of a "light" vs. "heavy" syllable in generative linguistics has long been used to capture a generalization about which syllables can or cannot (do or do not) receive stress. In many languages, it is the heavy syllables which attract stress. Within moraic theory, a heavy syllable is universally defined as one containing two moras (see Hayes, 1995). One advantage of utilizing a moraic vs. a CV analysis is that using CV slots, a heavy syllable must be specifically defined in each language as, say, CVV, CVC, or both. With moraic theory, all that needs to be defined for each language is whether a C in coda position of a syllable is moraic or not (see Hayes, 1989, 1995). Thus, moraic content in metrical phonology is associated with rhythmic rules of stress assignment.

From the above discussion, we know at least two things about Latvian syllables: i) some dialects lengthen consonants at syllable boundaries, and ii) syllables which have long nuclei attract syllable intonations. In Latvian, primary stress is determined not by the structure or weight of the syllable, but by the position of the syllable relative to the left word edge. It appears that syllable weight in Latvian has more of an affect on tone than it does on stress. This is discussed in detail in Chapter 5.

While weight is associated with tone in Latvian, it is not just any (apparently) heavy syllable which attracts tone. It is crucially only CVV or CVR (R=resonant) which attracts tone. Thus, among the Latvian consonants, only the resonants are moraic for purposes of tone. The obstruents are not, since a CVC syllable with an obstruent in the coda will never have a syllable intonation.

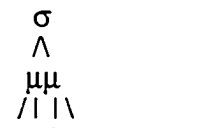
As indicated above, not only syllables with a long vowel or diphthong in the nucleus can have two moras in Latvian. As illustrated in the one-layer moraic analysis in

(9), a short vowel+resonant sequence can also have two moras as shown in (9b), as well as a stressed short syllable with a following lengthened obstruent, as shown in (9c).

(9) a.

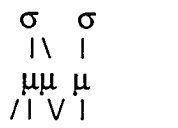
'torch'

b.



'to lift'

c.



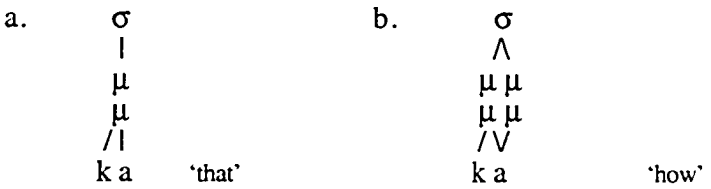
'leaf'

One problem with the moraic analysis in (9) above is that all three forms have a heavy first syllable (with two moras), while only (9a) and (9b) are associated with a syllable intonation. While all three examples show long (two-moras) syllabic nuclei, only the first two examples have heavy syllables insofar as they are associated with a syllable intonation.

This can be resolved by adopting a two-layer moraic analysis for Latvian as discussed above (see Hayes, 1995). In a two-layer analysis, segments which are [+sonorant] (vowels and resonants) are associated with two moraic layers, while elements which are [-sonorant] can only be associated with one. As shown in Chapter 4, this also has important consequences for determining the phonetic lengthening of voiceless obstruents between two short vowels. The phonetically lengthened obstruents crucially cannot be associated with tone, although they are associated with two moras on layer one.

In all regards except for the additional layer encapsulating information about sonority, the two-layer moraic theory is the same as the one-layer theory. Thus, a light monosyllabic word such as *ka* 'that' and a heavy monosyllabic word such as *ka:* 'how' would have the structures shown in (10) below. In the two-layer moraic theory, a heavy syllable must be understood as having two moras on layer 2 (the upper layer).

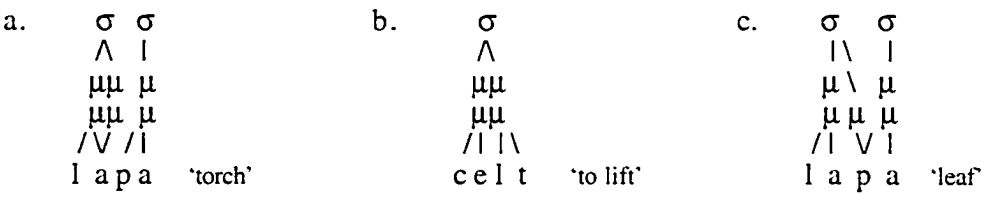
(10) Syllabic structure of two monosyllabic words



According to the traditional philological divisions, (10a) would be monophthongal and short, while (10b) would be monophthongal and long. In moraic theory, (10a) would be classified as light, and (10b) would be classified as heavy (Hayes, 1995).

Figure (11) shows the two-layer moraic analysis of the words presented in (9) above. As discussed in Chapters 2 and 5, all syllables which have two moras in the second moraic layer in Latvian (that is, VV or VR sequences) are associated with a syllable intonation. The form in (11a) has the level intonation on the first syllable, while (11b) has the broken intonation.

(11)



With the two-layer moraic analysis and onset-mora linking, a wonderful generalization about Latvian can be captured: although the *p* in the word *lapa* is associated with two moras, it is crucially linked only to a layer 1 mora in the first syllable, which only affects the duration of the segment, and cannot link it to tone. The sonorous segments in (11a) and (11b) are associated with moras also on layer 2, and are appropriately associated with a syllable intonation.

In the traditional divisions of Latvian syllables discussed above, Laua (1969) would label (11a) as monophthongal, and (11b) and (11c) as diphthongal. Given that there is no difference in the prediction of stress or intonational placement between (11a) and (11b), it seems that the traditional "quality" distinction aspect of monophthongal vs. diphthongal syllables is not linguistically important. What is linguistically important here is that the moraically *heavy* syllables (on layer 2) in (11a) and (11b) attract syllable intonations, while the moraically light syllables (on layer 2) in (11c) do not.[4] The division into monophthongal and diphthongal groups the wrong two words together.

Another advantage of the moraic analysis of syllable structure is that it allows for a straightforward account of the observed lengthening of syllable onsets in Ābele (1926), illustrated in (7) above, and discussed in detail in Chapter 4. As indicated above, such a lengthening occurs only after a stressed syllable (see Laua, 1969:67-69). Instead of analyzing one dialect as having "diphthongal" syllables which somehow inherently cause onsets to lengthen, one can posit that in Latvian, the stressed syllable is always associated with two moras on layer 1, regardless of segmental content. In case the stressed syllable is short, the second (empty) mora will associate with the onset of the following syllable.[5]

The data in (12) illustrates the effect of stress on syllable onsets (following Ābele, 1926). In Tamian (12a) and (12b), the empty mora in the first syllable in layer 1 is associated with the onset of the following syllable, causing an observed lengthening of the consonant. In Latgalian or High Latvian, (12c), this association does not occur, and the empty mora in the first syllable on layer 1 will simply remain unfilled in the surface form (see Prince & Smolensky, 1993). In all of these forms, the lengthened consonant is

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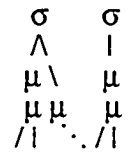
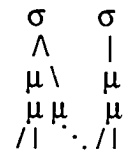
[4] A triplet such as *liela* 'large', *diena* 'day', and *mieru* 'peace' illustrates that the "diphthongal" nature of the syllable is not what determines which intonation is present: the first word has the level intonation, the second has the falling intonation, and the third has the broken intonation. All words contain the same diphthong.

[5] The Middle dialect allows only voiceless obstruents to lengthen. High Latvian does not allow any consonant to lengthen. For a discussion of the relevant constraints, see Chapter 4.

crucially not associated with a syllable intonation. The two-layer moraic theory captures this generalization, since all of the lengthenings occur only on layer 1.

(12) a. 

'leaf' [Tamian]

b. 

'good' [Tamian]

c. 

'leaf' [Latgalian]

Thus, what the traditional analyses refer to as "diphthongal" syllable types can be better understood via a two-layer moraic analysis of Latvian syllables with the following two specifications: i) a stressed syllable in Latvian always has two moras on layer 1, and ii) in each dialect, different constraints apply for the association of an empty mora on layer 1 with segmental content.

3.5.1 Summary of moraic analysis of the Latvian syllable

The moraic analysis allows one to conclude that Latvian does indeed have two major syllable types: light and heavy. In addition, the language also makes a (secondary) distinction between long and short syllables. Crucially, the language utilizes two moraic layers to encapsulate different information on duration (long vs. short) and sonority (heavy vs. light). Following Hayes (1995), light syllables are those containing only one mora on layer 2, and heavy syllables are those containing two moras on layer 2. Building upon this, long syllables are those with two moras on layer 1. Thus, all heavy syllables are also long, but not all long syllables are heavy; only those with two moras on layer 2 are heavy. Phonetically lengthened obstruents can by definition only be associated with moras on layer 1, since layer 2 is reserved for sonorous elements which can in turn be associated with

syllable intonations, as discussed in Chapter 5. The data in (12) illustrate the point nicely. While in (12a) and (12b) the obstruents are lengthened and linked with two moras, this linking occurs only on layer 1. These syllables are not associated with a syllable intonation. It is not length alone which determines which syllables are associated with tone in Latvian. It is moras on the second layer which are associated with tone. In effect, in the terms of Zec (1988), this analysis makes Latvian a "type three" language, together with Danish, Lithuanian, and others, where only a subset of the consonants are moraic on layer 2. In Latvian, this class contains all and only sonorous segments.

3.6 Syllabification in Latvian

To understand that syllables do indeed play a role in the organization of Latvian sounds, the diagnostic for the realization of /v/ in Latvian (discussed in Chapter 2) is revealing. To review the phonetic facts, the phoneme /v/ can be realized as either [v] or [w] (an offglide), depending upon its position in the syllable (see Laua, 1969:40; see also Liepa, 1968:328). These facts, discussed in part in (7) in Chapter 2, are repeated and expanded here for the sake of clarity in (13).

(13) The realization of /v/ in Latvian

	base form	pronunciation	gloss
a.	tev-i	[te.vi]	'you ACC sg.'
b.	tev-is	[te.vis]	'you GEN sg.'
c.	tev	[tew]	'you DAT sg.'
d.	nav	[naw]	'3rd does not have'
e.	tev nav	[tew naw]	'you sg. do not have'
f.	tev ir	[te.vir]	'you sg. have'
g.	vraks	[vraks]	'wreck'
h.	tvans	[tvans]	'carbon monoxide'
i.	tiev-i	[tie.vi]	'thin (masc. Nom. pl.)'
j.	tiev-s	[tiews]	'thin (masc. Nom. sg.)'

The generalization made in Chapter 2 (based upon forms a - f) is that /v/ is pronounced [v] in the onset of a syllable, and as [w] in coda position. The forms in (13g) - (13j) show that [v] does not have to be in the sole consonant in the onset, and [w] does not have to occur as the final element of the coda. Forms such as (13i) and (13j) illustrate that the generalization is not that /v/ becomes [w] following a vowel. The generalization of the realization of /v/ can thus be broadened to that shown in (14) below.

(14) When /v/ occurs in a syllable coda, it is realized as the offglide [w]; elsewhere as [v]

Thus, without recourse to abstract higher structure, it would be impossible to correctly predict the phonetic realization of /v/ in any simple way. The syllable is indeed present in Latvian.

3.6.1 Previous investigations of syllabification in Latvian

While discussion on the internal structure of the syllable in Latvian is quite limited, as indicated above, discussion on the principles of syllabification are almost nonexistent. In addition, what has been written on the topic is unfortunately often contradictory on many of the issues involved.

By far the most complete discussion of syllabification in Latvian is Liepa (1968), who used an experimental method to ascertain the syllable boundary in various words. The method involved 7 speakers of standard Latvian reading various words and inserting pauses between what they believed the syllables to be. In addition to this work, limited discussion can also be found in Endzelīns (1922), Sokols *et al.* (1959), Laua (1969), and Kariņš (1995b). Bond (1994) is a discussion mostly on Latvian phonotactics, but includes some discussion of syllabification as well.

What all of these works have in common is that they appear to contradict one another on various aspects of syllabification in Latvian. Thus, while Liepa (1968), Laua (1969), and Kariņš (1995b) agree that (in standard Latvian) the resonants *l*, *m*, *n*, and *r* can form syllabic nuclei, Bond (1994) indicates that they do not. Endzelīns (1922) and Sokols *et al.* (1959) say nothing on this topic.

In places where two consonants are next to one another within the word, Endzelīns (1922:16-17) places the syllable boundary between the two consonants in some instances (in words such as *maz.ga:t* 'to wash' and *sal.mi* 'straw'), and before both consonants in others (in words such as *sa.pnis* 'dream' and *me.dnis* 'wood grouse'). In all of these instances, the given CC sequence violates the phonotactics of a possible word onset (see Bond, 1994 and below). On the other hand, Laua (1969), Sokols *et al.* (1959) and Liepa (1968) would place the boundary between the two consonants in all of these instances.

It should be noted that all of these writers mention to various degrees the tentative nature of their conclusions. Endzelīns (1922:16), Sokols *et al.* (1959:66), and Laua (1969:108) all write that syllabic structure in Latvian is not understood very well, and needs to be studied further. Bond (1994:99-100) also indicates that it may indeed be the case that resonants can form syllabic nuclei, and calls for more research on this topic. Even the involved study by Liepa (1968) indicates that the analysis touches on only some aspects of syllabic structure in Latvian.

Given the tentative nature of these various works, and the fact that they contradict one another in various ways, all of their views cannot be incorporated into a discussion of syllabification in Latvian. Since general morphological processes in Latvian are not conditioned by syllabic structure, and there are no general processes of epenthesis to satisfy syllabic structure requirements, evidence for syllabification in Latvian is difficult to find. Indeed, the only clear example of varying pronunciation of a segment due to syllable position is the case of /v/ discussed above. What is needed is more study investigating the

performance of speakers dividing words into syllables, following the procedure of Liepa (1968), which is, as far as I am aware, the most thorough (and only) work of this kind to date. Given that Liepa's study is based upon experimentation (whereas the others are not), I will base my further discussion on this work, using his examples as the (assumed) facts of syllabification.

3.6.2 Latvian phonotactics

As in most languages, Latvian syllable structure can to a great extent be explained through the general idea of the sonority hierarchy, a version of which is presented in (15) below (see, for example, Ladefoged, 1982; Kenstowicz, 1994; Zec, 1988). Liepa (1968) writes that this is the general principle which Latvian syllables follow as well: each peak in sonority marks a new syllabic nucleus.

(15) General sonority hierarchy

Vowels > liquids > nasals > fricatives > stops

In Latvian, vowels, liquids, and nasals can form syllabic nuclei, and hence would be considered as peaks in sonority (see Liepa, 1968; Laua, 1969; for a different view of the liquids and nasals, see Bond, 1994). The syllable onset and syllable coda cluster around the peak in sonority.

3.6.2.1 Syllable onsets

As far as I am aware, the exploratory work of Bond (1994) is the most complete discussion to date of possible syllable onsets and syllable rhymes in Latvian. Her

investigation consists of examining one-syllable words for examples of possible initial consonant clusters and rhyme sequences. The discussion below builds on Bond's work.

As indicated in Chapter 2, Latvian syllables do not need to have an onset, as evidenced in onsetless words. Some examples are given in (16).

(16)	aita	VV.CV	'sheep'
	es	VC	'I'
	ir	VC	'is'
	u:dens	VV.CVCC	'water'

As indicated in Liepa (1968) and Bond (1994), Latvian can have up to three consonants in syllable onset position. Following Bond (1994), the attested initial CC clusters are shown in (17) below.

(17) Possible initial CC clusters in Latvian [origin: Bond (1994:89)]

First	Second position										
	p	t	k	ķ	r	l	ļ	m	n	ņ	v
p					x	x	x				
b					x	x	x				
t					x						x
d					x						x
k					x	x	x		x	x[6]	x
g					x	x	x		x		x
s	x	x	x			x		x	x		x
š				x	x		x	x		x	x[7]
z									x		x
ž										x	x[8]
v					x						

[6] A *k* followed by a *ņ* occurs only in loanwords such as *kņazs* 'prince'. Bond (1994) does not include this initial cluster.

[7] Bond (1994) does not include *šv* as a possible cluster, although it is commonly found in loanwords such as *švi:ka* 'streak', *Šveice* 'Switzerland', and *švaks* 'weak'.

[8] Again, Bond (1994) excludes *žv* as a possible onset cluster, although it is found in (rare) words such as *žvadzina:t* 'to jangle' and *žvinkste:t* 'to whiz'.

Besides the clusters given in (17), words can of course also begin with the affricates *c* [ts], *č* [tʃ], *dz*, and *dž* [dʒ] (in loanwords), as illustrated in words such as *caune* 'marten', *čiekurs* 'pine cone', *dzelme* 'depth', and *džemperis* 'sweater'. As indicated in Chapter 2, these affricates are considered to be single segments.

For CC clusters, the sonority sequencing in Latvian is one of the four listed in (18).

(18)	a. stop	<	fricative	(*tv*)
	b. stop	<	liquid	(*pl*)
	c. stop	<	nasal	(*kn*)
	d. fricative	>	stop	(*sk*)

Of the four combinations of onset clusters shown in (18), only (18d) violates the sonority sequence shown in (15) above. Indeed, *s* (or *š* before a palatal) can combine with any following voiceless stop as an onset cluster, thereby violating the sonority sequence. Following Kenstowicz's (1994:258) analysis of syllable onsets in English, Latvian (being an Indo-European language) also appears to have a special rule governing *s* (and *š*). Namely, if available, Latvian syllables place an *s* in the onset position. Anticipating the Optimality Theory (OT) analysis below, this can be captured in the constraint shown in (19). More on this below.

(19) S-PREFIX *s* and *š* are in the syllable prefix

As discussed in Bond (1994), if an initial cluster consists of three consonants, the first must be either *s* or *š*. This matches nicely with the OT constraint in (19). The possibilities for the second and third member of the cluster are shown in (20) and (21).

(20) Possible CCC onset clusters beginning with *s* [9]

Initial	Third		
	r	l	ļ
sp	x	x	x
st	x		
sk	x	x	x (?)

(21) Possible CCC onset clusters beginning with *š* [10]

Initial	Third		
	r	l	ļ
šp	x	x	x
št	x		

Note that for both the CCC clusters beginning with *s* and *š*, the third possible consonant is fully predictable from the table in (17) above. Following the data in that table, if a cluster begins with an *s* or *š*, and is followed by one of the voiceless stops, then the choice of the third element is predetermined by the table in (17). Once again, except for the (obligatory) first element *s* or *š*, the onset cluster must be rising in sonority, as shown in (22).

(22) fricative > stop < liquid (*spr*)

[9] Bond (1994) does not include *skl* as a possible cluster. However, words such as *sklanda* 'pole' and *skleroze* 'sclerosis' indicate that the combination is indeed possible. In addition, her example for *skļ* is the word *skļaut* 'to embrace', of which I am unaware. The word is also not listed in the extensive Mülenbachs (1923-32). In Latvian, initial *spl* is indeed very rare, occurring in only 5 little-known words in Mülenbachs' dictionary.

[10] The initial cluster *špl* is very rare. Bond (1994) includes this possible cluster, but does not give any examples. The only example in Mülenbachs (1923-32) appears to stem from an alternate pronunciation of *splintene* or *splinte*, which appears to mean some sort of wedge used to keep (wagon) wheels in place (see Mülenbachs, 1923-32; Vol. 4, p. 101; Vol. 6, p. 655).

3.6.2.2 Syllable nuclei

Following the optional syllable onset which is rising in sonority, the syllabic nucleus in Latvian can consist of i) either a long or short monophthong, as in the words *ka* 'that' and *ka:* 'how', ii) a diphthong as in the word *vai* 'interrogative particle', or iii) a resonant, as in the second syllable of words such as *kat.tls* 'pot', *kak.kls* 'throat', and *i:.gns* 'surly' (for a different view of the last option, see Bond, 1994).

As indicated above a short vowel+resonant in the first syllable of words such as *kal.ni* 'hills' and *gal.va* 'head' appears to consist of a nucleus plus coda. The sonority hierarchy shows us that the resonant is lower in sonority than a vowel, which suggests that in a short vowel+resonant sequence, the resonant is already part of the syllable coda, which is decreasing in sonority. If it were clearly the case (which it is not) that syllable intonations are only associated with syllable nuclei (as opposed to syllable rhymes), then the short vowel+resonant sequence would also be classified as a nucleus, since it would be associated with a syllable intonation. While this issue remains unresolved, it is not crucial: we know at any rate that both a lone vowel and a lone resonant can form a syllabic nucleus.

3.6.2.3 Syllable codas

Bond (1994) counts only stem consonants as part of a syllable rhyme, and writes that the suffixal consonants "...could be considered to form an appendix rather than a part of the basic syllable". Thus, in a word such as *sirm-s* 'gray-haired', the final *s* (the nominal singular suffix) is not counted as part of the syllable rhyme, but is instead a syllable "appendix". The reason for this is unclear. It could be the case that final consonants at word edges are somehow not incorporated into syllable structure (for discussion and references, see Hayes, 1995). However, lacking evidence to show that this

is indeed the case in Latvian, I will assume in the discussion here that all consonants following a nucleus within the same syllable (especially as evidenced in isolated words) are part of the syllabic structure, pending evidence to the contrary.

As indicated in the previous section, Latvian syllables do not obligatorily have to have codas. However, as discussed in Chapter 2, the language easily tolerates clusters of consonants at the end of a syllable. Liepa (1968) writes that the maximum number of consonants in a syllable coda is three (counting affricates as a single phoneme). Thus, Liepa would analyze a word such as *zvirgzds* [zvirksts] 'fine stone', as having the nucleus [ir] (which has the falling intonation) and the coda [ksts], where the final sequence [ts] is analyzed as the single affricate *c*, even though the morphological boundary is *zvirgzd-s*. While the reason for this is unclear, it (again) does not appear to be crucial. As discussed below, the constraints in Latvian relative to syllabification crucially affect the shape of syllable onsets, not syllable codas.

3.6.2 Syllabification patterns in Latvian

As discussed above, the only experimental study of syllabification in Latvian that I am aware of is Liepa (1968). While I am considering the reported patterns of syllabification in that study to be accurate, I am not adopting Liepa's explanation of the patterns. Indeed, Liepa misses the broad generalization that Latvian tends to follow the general principle of maximizing syllable onsets in his discussion of how words with two, three, and four intervocalic segments are syllabified. Philological research on Latvian syllabification does not seem to have gotten beyond local explanation.

The pattern for CV or CR (R = resonant) sequences is shown in (23). Other patterns are shown in (24) - (29) below. The syllabification is taken from Liepa (1968). I

indicate with an "*" those forms for which Liepa reports incomplete agreement among his subjects. Unfortunately, he does not provide the alternate form(s).

(23)	a. ka.za	CV.CV	'goat'
	b. ga.di	CV.CV	'years'
	c. ma:.te	RVV.CV	'mother'
	d. a.la	V.RV	'cave'
	e. ie.na:kt	VV.RVVCC	'to come in'

(24) Consecutive VV sequences (not long vowels or diphthongs)

a. sa.augt	CV.VVCC	'to grow together'
b. sa.a.di:t	CV.V.CVVC	'to knit together'

(25) Consecutive geminate CC or RR segments between vocalic segments

a. up.pe	V**C.C**V	'river'
b. ak.ka	V**C.C**V	'water well'
c. rit.tms	CV**C.C**RC	'rhythm'
d. kat.tls	CV**C.C**RC	'pot'
e. kan.na	CV**R.R**V	'can'

(26) Two consecutive non-vocalic segments between vocalic segments

a. stra:d.nieks	CCRVV**C.C**VVCC	'worker'
b. sal.mi	CV**R.R**V	'straw'
c. gal.va	CV**R.C**V	'head'
d. sal.dæns	CV**R.C**VCC	'sweet'
e. bi.ro.kra:ts*	CV.RC.**CR**VVCC	'bureaucrat'
f. as.ni	CV.RC	'young shoots'

(27) Three consecutive non-vocalic segments between vowels

a.	rak.stisks	CV**C.CC**VCCC	'written'
b.	cirv.ji[11]	CV**RC.**CV	'axes'
c.	veld.re	CV**RC.**RV	'(grass) beaten down by rain'
d.	gult.ne	CV**RC.**RV	'river bed'
e.	kar.stums	CV**R.CC**VRC	'heat'
f.	ad.bil.sti:.ba	VC.CV**R.CC**VV.CV	'correspondence'
g.	ap.va:r.snis	VC.CVV**R.CR**VC	'horizon'
h.	ad.mi.ni.stra.ti:ws	VC.RV.RV.**CCR**V.CVVGC	'administrative'

(28) Four consecutive non-vocalic segments between vowels

a.	alk.snis	V**RC.CR**VC	'alder'
b.	pulk.ste.nis	CV**RC.CC**V.CVC	'clock'
c.	pirk.sti	CV**RC.CC**V	'fingers'
d.	ab.stra.he:t	V**C.CCR**V.CVVC	'to abstract'
e.	rakst.nieks*	RV**CCC.R**VVCC	'writer'

(29) Flagged as morphological divisions by Liepa (1968)

	observed		expected	
a.	birs.ta.la*	CV**RC.C**V.CV	bir.sta.la	'grove'
b.	priekš.va:rds*	CRVV**CC.C**VVRCC	priek.šva:rds	'first name'
c.	aiz.au.se	V**VC.V**V.CV	ai.zau.se	'area behind ear'

A pattern which emerges in the above example words is that Latvian apparently keeps morphological prefixes as separate syllables. Put differently, Latvian aligns the left edge of the word stem with the left edge of the syllable. In the above examples, this includes (23e) *ie.na:kt*, (24a) *sa.augt*, (24b) *sa.a.di:t*, (29c) *aiz.ause*, and perhaps also (27g) *ap.va:rsnis*.[12] For the first three examples, the pattern could easily be explained as

[11] This form appears to contradict the claim that /v/ in coda position is realized as [w], and warrants further investigation. Liepa (1968:328) gives no further explanation for it. My own intuition places the /v/ in the onset of the following syllable as a lenited fricative with only a hint of a platalization. The form in (27h) indicates that Liepa does indeed signal the vocalization of /v/ in his notational system (p. 328).

[12] Although *ap-* is a common morphological prefix, it is not clear if *va:rsnis* is interpreted by speakers as the word stem. According to Karulis (1992), the word was created in 1869 by Atis Kronvalds, who apparently derived it from the verbs *ve:rt* 'to move (open or closed)' and *ve:rties* 'to look around'.

"maximizing onsets". However, (29c), which had full agreement among Liepa's subjects, violates this principle. Here, the prefix *aiz-* is kept syllabically distinct from the stem *ause*. It seems that two principles are active in Latvian: maximizing onsets and aligning stems with syllable boundaries.

Concerning the principle of maximizing onsets (disregarding stem alignment), only (26f) and (27c) violate the principle of maximizing onsets. In the first example, the word *as.ni* 'shoots' is divided into syllables between the *s* and *n*, which is not what one would expect with the principle of maximizing onsets, given that Latvian has words such as *sniegs* 'snow' and *snaust* 'to slumber'. In the second example, the word *veld.re* 'grass beaten down by rain' is divided into two syllables between the *d* and the *r*, although there are words which clearly begin with a *dr* cluster, such as *draugs* 'friend' and *druva* 'field with grain'.

It seems that Liepa (1968:327) is taking the division between two intervocalic consonants to be an inviolable rule in Latvian, following the tradition of Sokols *et al.* (1959), and repeated in Laua (1969). Although it is not completely clear from the article, it appears that Liepa only investigated the longer, more "problematic" forms in the language. My own intuition is that the syllable boundary in words such as *asni* and *veldre* is indeed between the *a* and the *s* in the first instance, and *l* and *d* in the second. Pending further experimental analysis of such forms, I will exclude them from the phonological analysis below. Indeed, these forms apparently contradict both the rules of patterns of (possible) syllable onsets laid out in (17), as well as the observed patterns in other forms that Liepa (1968) states.

Finally, the "exceptional" form given by Liepa in (29a): *birs.ta.la* 'grove', is also questionable. As discussed below, it seems reasonably clear that Latvian has a constraint which aligns the left edge of the word stem with the left edge of the syllable. This word has the morphological division: *birs-tala*, which would indicate a constraint aligning the

right edge of the stem also with the right edge of the syllable boundary. However, a word such as *kar.stums* 'heat' with the morphological division *karst-ums* provides evidence that such a constraint is not active. Pending further research on the syllabic division of such a form, I will also leave this out of the discussion below. It seems to quite clearly be a genuine exception.

3.6.3 An Optimality Theory analysis of syllabification in Latvian

Optimality Theory (OT), developed by Prince & Smolensky (1991, 1993), places as central in the grammar of language a series of ranked (universal) constraints. While in a rule-based system there is a series of (ordered) rules in the grammar, in a constraint-based system, there is only a relative ranking of constraints. In addition, each constraint is violable. There is also no "derivation" in such a system. Instead, all possible candidates of, say, a syllable parse enter the system at the same time, and are evaluated based upon how high up in the constraint hierarchy they violate a constraint. In effect, the candidate which violates the lowest-ranked constraint (or violates no constraint at all) is selected as the form which surfaces.

The forms in (23) above show that given CV sequences, Latvian not surprisingly will place the consonant in the onset of a syllable. Thus, while Latvian syllables appear to require onsets, they do not require codas. Of course, this constraint, shown in (30), is violable, as the forms in (16) above illustrate.

(30) ONS syllables must have onsets (Prince & Smolensky, 1993)

Of course, in order to have a syllable onset, first a proper syllable nucleus must be selected. Following Prince & Smolensky (1993), the syllable nucleus will be properly selected via the two undominated constraints in (31).

(31) a. NUC syllables must have nuclei
b. HNUC a higher sonority nucleus is more harmonic than one of lower sonority

In addition to these two constraints, Latvian has another undominated constraint which guarantees that all segments are parsed into syllables. This is given in (32).

(32) PARSE underlying segments must be parsed into syllable structure (Prince & Smolensky, 1993)

A generalization about syllable onsets in Latvian is that they rise in sonority. This is captured in the (violable) constraint in (33).

(33) O-SON a syllable onset must rise in sonority

As discussed above, words such as *skriet* 'to run' and *šķūnis* 'barn' show that this constraint is clearly violable by a preceding *s* or *š*. In (19) above, I posited the constraint S-PREFIX, which claims that both *s* and *š* are separate from the syllable structure (at least in onset position). This is repeated again as (34).

(34) S-PREFIX *s* and *š* are in the syllable prefix

By analyzing the sibilants as syllable "prefixes", the generalization that syllables rise in sonority can be maintained. Given this similar behavior of *s* in English, such an analysis indeed seems likely: these sounds are simply outside the scope of the sonority

rules governing syllable onsets (see also Kenstowicz, 1994:258). Pending evidence to the contrary, for now I accept this analysis of *s* and *š* in Latvian.

As can be seen in tableaux (35) and (36), the constraint ONS is unranked relative to O-SON and S-PREFIX, while the relative ordering between the latter two is crucially S-PREFIX >> O-SON. The constraint ranking indicates that it is more important that syllables begin with /s/ (if there is one to be had) than it is to have the onsets increasing in sonority.

(35) /pulsktenis/	ONS	S-PREFIX	O-SON
a. pulkst.e.nis	* !	*	
b. pulks.te.nis		*!	
c. ☞ pulk.ste.nis			*
d. pul.kste.nis		* !	*
e. pulk.sten.is	* !		*

(36) /pulsktenis/	O-SON	S-PREFIX	ONS
a. pulkst.e.nis		*	* !
b. ☞ *pulks.te.nis		*	
c. pulk.ste.nis	* !		
d. pul.kste.nis	* !	*	
e. pulk.sten.is	* !		*

The tableau in (37) illustrates that an additional constraint is needed to properly constrain the shape of a syllable onset. As shown in (28e) above, the candidate (37d) is the attested surface form, violating the constraint S-PREFIX. Although Liepa (1968:328) writes that out of 5 subjects' readings only 3 (60%) chose candidate (37d) *rakst.nieks*, he does not indicate what the remaining two subjects chose as the syllable boundary. Again, lacking evidence to the contrary, I am for now accepting Liepa's patterns.

(37) /rakstnieks/	S-PREFIX	O-SON	ONS
a. ra.kstnieks	* !	*	
b. ☞ *rak.stnieks		*	
c. raks.tnieks	* !	*	
d. rakst.nieks	* !		
e. rakstn.ieks	* !		*

Another constraint must be active in the language which only allows the initial consonant clusters shown in (17) above. This general constraint, shown in (38), must be ranked above S-PREFIX in order for the correct candidate to surface. A "possible onset" is defined as one specified in the table in (17) above.

(38) POSS-ONS an onset cluster must be possible

This constraint rules out impossible onset clusters such as **tl*, **pt*, **tk*, **tn*, etc. With the addition of the constraint POSS-ONS, the correct candidate *rakst.nieks* is selected, as tableau (39) shows.

(39) /rakstnieks/	POSS-ONS	S-PREFIX	O-SON	ONS
a. ra.kstnieks	* !	*	*	
b. rak.stnieks	* !		*	
c. raks.tnieks	* !	*	*	
d. ☞ rakst.nieks		*		
e. rakstn.ieks		*		* !

The constraints posited so far for Latvian syllabification are shown with their relative rankings in (40) below.

(40) Undominated: NUC, HNUC, PARSE, POSS-ONS
Ranked: S-PREFIX >> O-SON
Unranked: ONS

The constraints discussed so far would still not select the correct surface form of *aizause* 'area behind ear' in (29c), as shown in (41) below. We know that (41b) *aiz.au.se* is the correct surface form.

(41) /aizause/	POSS-ONS	S-PREFIX	O-SON	ONS
a. ☞ *ai.zau.se				
b. aiz.au.se				* !
c. aiz.aus.e		* !		*

The generalization about the form *aiz.au.se* lies in the morphological structure. Morphologically, the word divides as *aiz-aus-e*, where the stem is *aus-* 'ear'. It thus appears that a constraint such as that shown in (42) is active in Latvian, which aligns the left edge of a morphological stem with the left edge of a syllable (see also discussion of foot boundaries and morphological stems in Chapter 4).

(42) ALIGN (stem, L; syllable, L): align the left edge of the word stem with the left edge of a syllable (see Prince & Smolensky, 1993)

As shown in (43) and (44), with this additional undominated constraint, the correct surface forms for *sa.a.di:t* 'to knit together' and *priekš.va:rds* 'first name' are also selected as the optimal forms.

(43) /saadi:t/	ALIGN	POSS-ONS	S-PREFIX	O-SON	ONS
a. saa.di:t	* !				
b. ☞ sa.a.di:t					*
c. sa.ad.i:t					* *!

(44) /priekšva:rds/	ALIGN	POSS-ONS	S-PREFIX	O-SON	ONS
a. priek.šva:rds	* !			?[13]	
b. ☞ priekš.va:rds			*		
c. prie.kšva:rds	* !	*	*	*	

Finally, the universal constraint -CODA discussed in Prince & Smolensky (1993) which states that "syllables cannot have codas" needs to be considered for Latvian. The constraint, shown in (45), together with the constraint ONS, has the effect of maximizing syllable onsets.

(45) -CODA syllables cannot have codas

As shown in (46), the correct surface form for *bi.ro.kra:ts* 'bureaucrat' (46b) is selected with the addition of this violable constraint. Similar to the constraint ONS, -CODA is violable, but apparently unranked relative to the other constraints.

(46) /birokra:ts/	ALIGN	POSS-ONS	S-PREFIX	O-SON	ONS	-CODA
a. bi.rok.ra:ts			*			* *!
b. ☞ bi.ro.kra:ts			*			*
c. bi.rokr.a:ts			*		* !	* *

[13] Strictly speaking, /v/ is more sonorous than /š/, since the former is voiced. However, both are fricatives. This remians irrelevant, since S-PREFIX >> O-SON, and ALIGN dominates both.

As shown in (47), the addition of the constraint -CODA would predict the (as yet unattested) surface form (47b) *vel.dre* '(grass) beaten down by rain' as opposed to (47a) *veld.re*, claimed as the correct form by Liepa (1968) (see above). As discussed above, this is a topic for future research to investigate.

(47) /veldre/	ALIGN	POSS-ONS	S-PREFIX	O-SON	ONS	-CODA
a. veld.re						* *!
b. ☞ vel.dre						*
c. ve.ldre		* !		*		

We now know that Latvian has the constraints with their relative ranking shown in (48) below. Given the possible onset clusters presented in (17), these constraints account for all of the syllabification patterns shown in (23) - (29) above, except for the aforementioned apparent exceptions *asni*, *veldre*, and *birstala*.

(48) Undominated: NUC, HNUC, PARSE, POSS-ONS, ALIGN
Ranked: S-PREFIX >> O-SON
Unranked: ONS, -CODA

I turn now to a discussion of the stress pattern of Latvian, which of necessity involves closer discussion of the fact illustrated in (7) above, namely, the fact that standard Latvian has a rule of phonetic lengthening of a voiceless obstruent following stress between two short syllabic nuclei.

Chapter 4

The stress pattern of Latvian

4.1 Previous studies of the stress pattern of Latvian

The exact phonetic nature of stress is not easy to define. Ladefoged (1982:225) defines stressed sounds as "those on which the speaker expends more muscular energy." Borden & Harris (1984:72) write that stressed syllables "are produced by possible increases in three factors: duration, frequency, and intensity." Numerous phonetic investigations show that stress is correlated with segmental duration (see Hoequist 1983, van Heuven, 1987, Farnetani & Kori 1990, van Stanten 1993). Unfortunately, such phonetic studies often lack a discussion of the metrical system of the languages involved, and how that may play a role in the recorded segmental durations. Endzelīns (1922:17) writes that word stress in Latvian is "strongly expiratory" [*stark exspiratorisch*], which suggests that stress in Latvian is associated with intensity, as Borden & Harris partly suggest for stress in general. The Latvian phonetician Laua (1969), still the most thorough general account of Latvian phonetics, agrees with Endzelīns, and classifies Latvian stress as dynamic. She writes that it is realized by "a louder and stronger pronunciation of the relevant syllable" (p.115). My own phonetic experimentation confirms that there is an increase in the amplitude of the sound wave in the primarily stressed syllable as opposed to all other syllables in the stress domain.

In the world of metrical phonology, the exact definition of the object of study is sometimes avoided. For example, in Halle & Vergnaud's (1987) treatise on stress, the first chapter delves into the representation of stress, without ever defining clearly what it is. Hogg & McCully (1987:1-2) write that although stress is "complex" in its exact phonetic

nature, it is nevertheless "relatively simple to pick out patterns of stress." They do not go beyond this appeal to intuitions, and proceed to discuss the phonological aspect of stress.

In contrast, Hayes (1995) has an informative discussion about the phonetic nature of stress. While he admits that there is no exact phonetic correlate of stress which holds across all languages, he writes that there usually are phonological diagnostics which can be used to uncover the stress pattern of a language. For example, whenever we find a flap in English, we know that the following vowel in the same word is unstressed.

The one-sided approach of many phonetic and phonological investigations can, of course, often prove to be very fruitful. However, by not taking both phonetics and phonology into account, researchers run the risk of missing an important aspect of the phenomenon that they are studying. This is what seems to have happened in the description of the stress pattern of Latvian.

There is a break in the linguistic literature concerning Latvian stress which appears to have occurred around 1960. Those writing before that time, here representing the "traditional" view, write that Latvian has primary as well as secondary stress. Those writing after 1960 have either no mention of secondary stress, or overtly claim that there is only one stress per word. Thus, Endzelīns (1922) and Sokols *et al.* (1959) write that Latvian words have secondary stress as well as primary stress. More recent analyses of Latvian describe the language as having only one (main) stress per word, without any secondary stress (Halle, 1987a; Halle & Vergnaud, 1987:12, 112-113; Goldsmith, 1990:182).[1] Laua (1969) makes no mention of secondary stress in her work. Similarly, Steinbergs (1977) and Rudzīte (1993) also appear to assume only a single stress per word, which normally occurs on the first syllable.

[1] In a footnote, Goldsmith (1990:182) states that his data comes from Halle (1987a).

What the researcher faces, then, are two conflicting views on the stress pattern of Latvian. This issue, and a proposed resolution of the issue, is taken up in Kariņš (1995a). The discussion below builds upon that work.

4.2 An experimental investigation of stress in Latvian

As discussed in Chapter 2, Latvian has a system of phonemically contrasting long and short vowels. Liepa (1979) and Bond (1991) show that the duration ratio between phonemically long and phonemically short vowels is approximately 2:1. They also show that stressed vowels are longer in duration than their unstressed counterparts. Among consonants, phonemic length contrasts exist only for sonorants. Phonemically long sonorants or "lexical geminates" occur in relatively recent loanwords, such as *panna* 'pan' and *ķemme* 'comb'. There is no phonemic length distinction in the obstruents.

As discussed in Chapter 2, almost all Latvian words have primary stress on the first syllable. The exceptions to this are words with primary stress on the second syllable (Endzelīns, 1922; Laua, 1969). There is no dispute in the linguistic literature about primary word stress in Latvian. The disagreement lies solely in the claims concerning secondary stress.

4.2.1 Experimental design

Following the lead of Hayes (1995), I consider phonological evidence for secondary stress. As mentioned in Chapter 3, Laua (1969:67-68) writes that in Latvian, voiceless obstruents lengthen phonetically following a stress between two phonemically short vowels. This claim is based upon the phonetic work of Liepa (1963, 1967). Liepa (1968) shows that this process extends also to instances where a voiceless obstruent is

followed by a (short) syllabic resonant. Based upon this assertion, I designed an experiment to answer the following questions: (1) Does quantitative descriptive phonetics provide evidence that consonants are lengthening where they are predicted to lengthen? (2) Is lengthening restricted to the voiceless consonants? (3) Is lengthening restricted to the environment between a short stressed vowel and a short unstressed vowel? (4) Does the distribution of lengthened consonants provide any evidence for secondary stress?[2]

For this experiment, I chose 39 words containing consonants in positions where they would and would not be expected to lengthen. The experiment consisted of two subjects reading sentences containing these words within the carrier phrase shown in (1). Each sentence was repeated ten times, and the order of all sentences was randomized. Recording was conducted in two sessions, the first with each of the subjects reading 300 sentences (about the limit of good-natured cooperation), the second with the subjects each reading 90 sentences. The complete list of words investigated is provided in Appendix C.

(1) Carrier phrase

Arī _____ ir vārds. ' Also/even _____ is a word.'

The two subjects are IL and LL, both native speakers of the Riga dialect of Latvian. IL is a 48 year old man, who has a college degree in engineering earned at the Riga Technical University. However, due to the Soviet system whereby manual laborers earned a better living than better educated workers, he worked in Riga as a welder for 14 years. At the time of the recording (during the Spring of 1993), he had been working in Philadelphia for almost two years as a welder. He speaks English, but not as well as Latvian or Russian. LL is his 22-year old daughter who has a degree from a technical high

[2] In my experiment, I only consider long and short vowels as the environment surrounding the lengthened consonant. I do not include an investigation of a following syllabic resonant, as suggested by Liepa (1968).

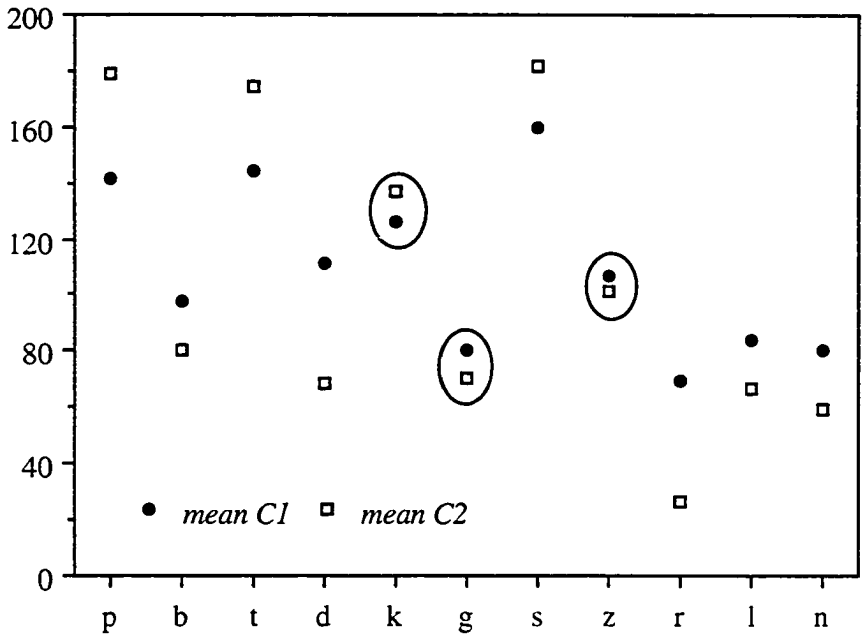
school in Riga. She works as a laboratory assistant in one of the universities in Riga. Although she also speaks Russian (as do almost all Latvians), she does not speak any English. At the time of the recordings, which took place in the home of IL, she was visiting her father for three months. Both of them were wonderfully patient subjects.

The sentences were recorded using a Sony WM-D6C recorder with a Sony ECM-121 stereo microphone on regular magnetic tape. The signal was digitized at 8,000 Hz and analyzed using the Xwaves acoustic-phonetic analysis program on a Sun workstation. Segmental durations were recorded by measuring the signal in both the waveform and a wide band spectrogram. The measurements of the plosives include both the stop closure plus release burst, or measure from the end of voicing of the preceding vowel to the onset of voicing of the following vowel. The analyses were made using the statistical program S. All claims of statistical significance are based on t-tests set at the $p<.05$ level.

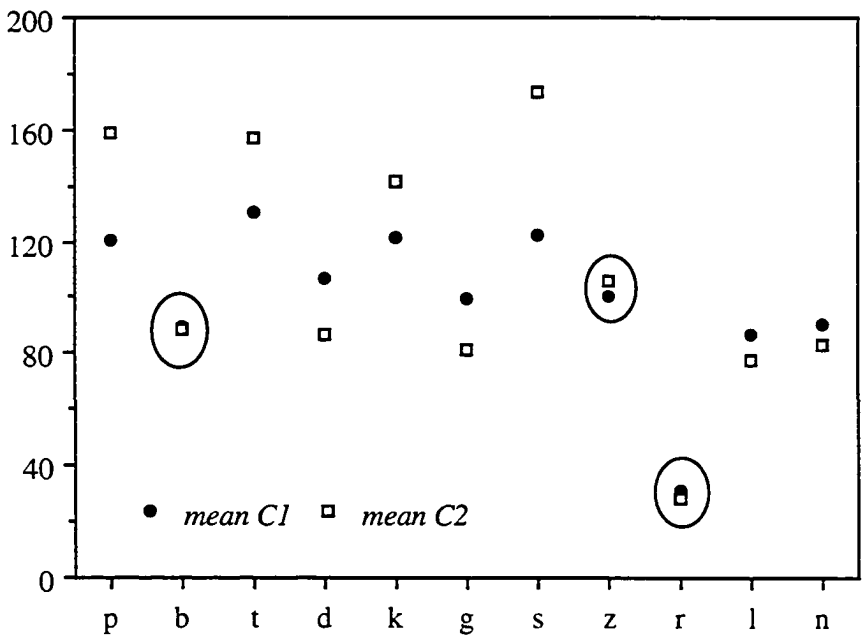
4.2.2 Experimental results

The experimental results confirm Laua's (1969) claims. Both of my subjects showed the same patterns of segmental durations. The figures in (2) and (3) show that i) all voiceless consonants for both speakers are significantly longer than their voiced counterparts, ii) for the voiced consonants, duration is greater in the onset of the first syllable, and iii) for the voiceless consonants, duration is greater in the onset of the second syllable. The raw data of all figures are provided in Appendix D.

(2) Mean duration (in ms) of consonants in onset of 1st syll. (C1) and onset of 2nd syll. (C2); speaker IL. Circled differences are not significant.



(3) Mean duration (in ms) of consonants in onset of 1st syll. (C1) and onset of 2nd syll. (C2); speaker LL. Circled differences are not significant.

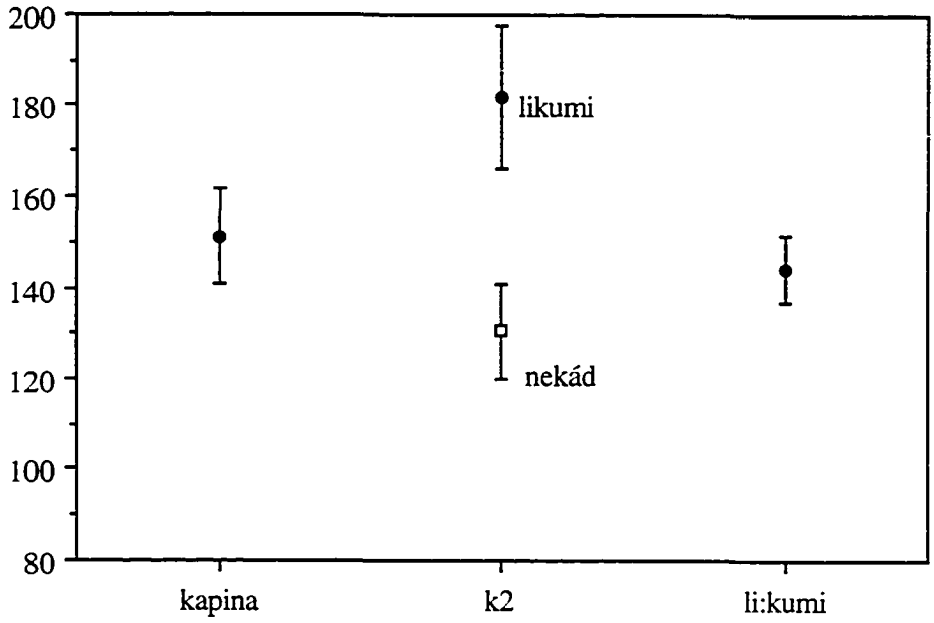


For simplicity of presentation, the figures in (4) - (6) show only data from speaker IL. Speaker LL shows identical patterns.

The figure in (4) illustrates that phonetic lengthening takes place only following a stress. It is not dependent upon the position in the word alone. The word *nekad* 'never' is an exceptional word which has primary stress on the second syllable. In this figure, the mean duration of /k/ in *nekad* is significantly shorter than in all other positions.

Figure (5) shows that when the voiceless consonants /p/ and /t/ occur in the onset of the second syllable before another consonant in a consonant cluster in the words *aplis* 'circle' and *katram* 'for everyone', lengthening clearly does not occur. The situation with the second /k/ in the word *kakliem* 'for the necks' is a little different. While there is no significant difference between /k/ in the onset of the second syllable and /k/ before another consonant, there is a significant difference between initial /k/ and /k/ before another consonant. However, given the results for /k/ in (2), this appears to be an anomalous situation.

(4) Mean duration (in ms) of /k/ in four words. Speaker IL. Error bars show standard deviation.



(5) Mean duration (in ms) of the consonant in initial position (p1), onset of 2nd syll (p2), and in the onset of the 2nd syll before a following consonant (pC). Speaker IL.

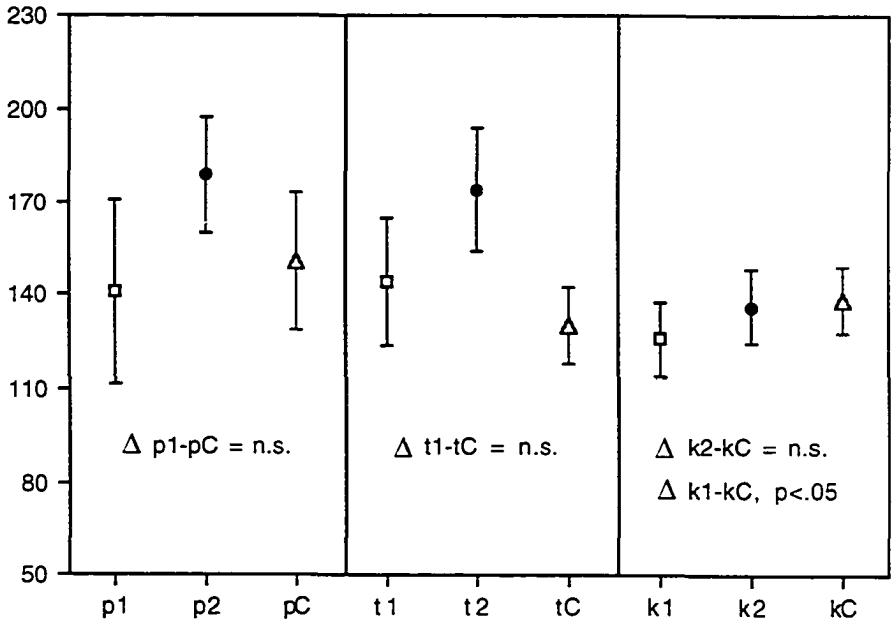
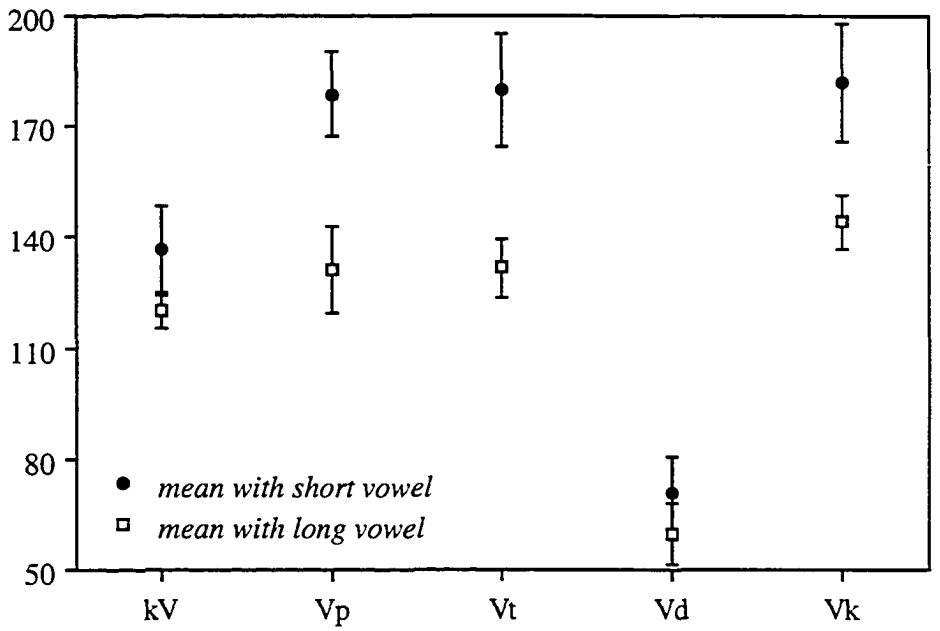


Figure (6) shows that a voiceless consonant does not lengthen if preceded by a long vowel in the first syllable or if followed by a long vowel in the second syllable. All differences of mean duration between the consonant occurring with a long versus a short vowel are significant.

(6) Mean duration (in ms) of various consonants in the onset of the 2nd syll. preceding and following long and short vowels . Speaker IL[3]



[3] It is noteworthy that there is a significant difference in duration between /d/ occurring in the words *pudeɭu* 'the bottles'' and *pūdeɭu* 'the poodles'', since only the voiceless consonants are expected to lengthen in the onset of the second syllable following a short vowel. An explanation for this could be that the language has a tendency to maintain words of equal syllable length equal in duration, in addition to lengthening voiceless consonants in the onset of the second syllable. Thus, the difference in the durations of the /d/ could be because of the former tendency in the language. If the first syllable of a word has a long vowel, then the onset of the second syllable will be shortened to "compensate" for the extra length present in the first syllable. This question does merit further research.

(7) Mean duration (in ms) of /i/ for both speakers in *nesalipina:t*. Third and fourth syllables.

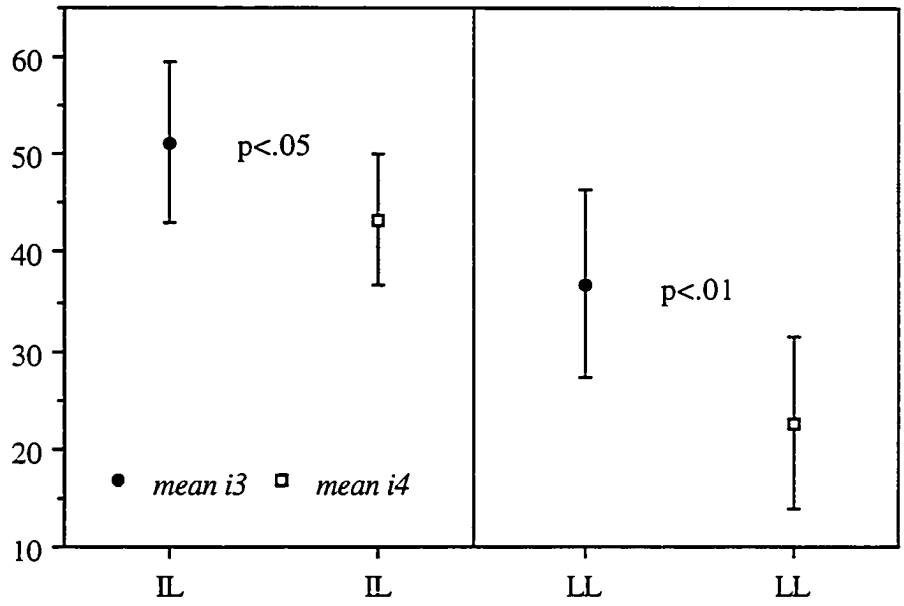
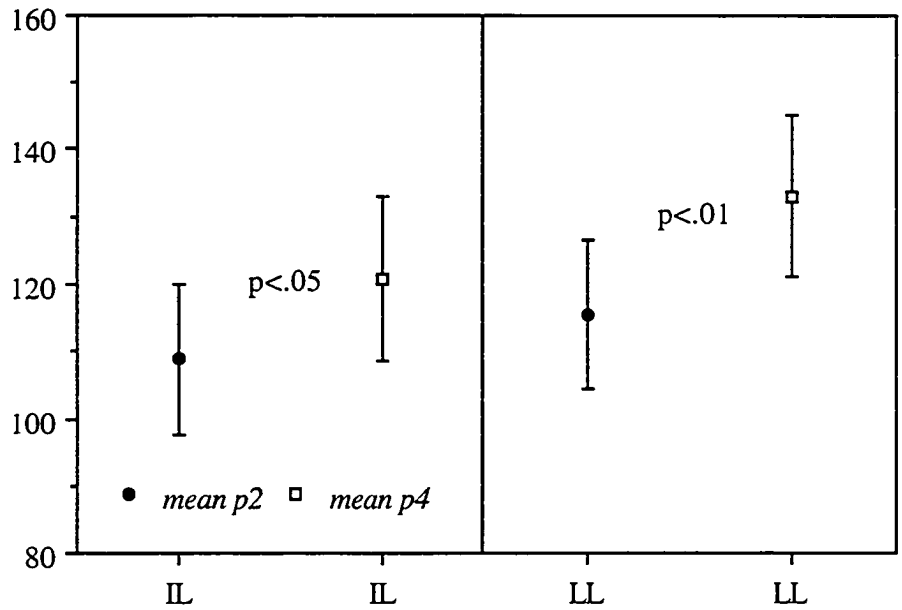


Figure (7) shows that there is a significant difference for both speakers in the duration of /i/ in the third and fourth syllables of *nesalipina:t* 'to not stick together'. As Bond (1991) suggests, this could indicate a secondary stress on the third syllable, since stressed vowels are longer in duration than their unstressed counterparts. This could, however, also indicate the general shortening of successive syllables, also discussed in Bond (1991) (see also Ekblom, 1933). More evidence is needed to help to decide what is causing the observed difference in duration in this figure.

Such evidence is provided in (8), which shows that for the words *nepametams* 'not discardable' and *nesalipina:t*, the /p/ in the onset of the fourth syllable is longer in duration than in the onset of the second. Given that the default expectation is that successive segments in words become shorter, not longer (see Bond, 1991), there must be a secondary stress on the third syllable causing the phonetic lengthening of the consonantal onset of the fourth syllable.

(8) Mean duration (in ms) of /p/ in *nepametams* (p2) and *nesalipina:t* (p4) for both speakers.



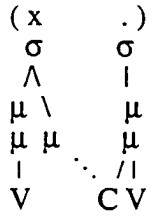
4.2.3 Experimental conclusion

The above experiment demonstrates that in the Riga variety of standard Latvian, voiceless obstruents lengthen between two phonemically short vowels following stress.[4] The distribution of the phonetically lengthened voiceless obstruents in Latvian demonstrates that the language does indeed have secondary stress, apparently occurring on the third syllable. This indicates that, contrary to the claims in Halle (1987a), Halle & Vergnaud (1987) and Goldsmith (1990), the language builds trochaic (strong-weak) stress feet. As previously mentioned in Chapter 3, the phonetic lengthening of a voiceless obstruent

[4] Based upon my results, I believe that there is no reason to suspect that this process also does not occur between a short stressed vowel and a following short syllabic resonant (see Liepa, 1968).

between two stressed syllables must be something like that shown in (9) (see Halle & Vergnaud, 1987; Hayes, 1995). More is said about this below.

(9)



Before turning to a phonological analysis to account for the patterns uncovered in this experiment, I discuss additional evidence for the existence of secondary stress patterns in the language, namely, from the prosodic constraints on variable vowel deletion in the language, and from the distribution of word shapes in various positions of metered traditional Latvian folksongs.

4.3 Additional evidence for the stress pattern of Latvian

4.3.1 Evidence from the metrical constraints on variable vowel deletion

As a warning to his German readers endeavoring to learn Latvian, Rehehusen (1644:9) writes:

> N.B. In all words, a Latvian absorbs the final vowel and therefore one has difficulty in determining whether in the genitive or some other case there is an *a*, *e*, *u*, or *o*.[5]

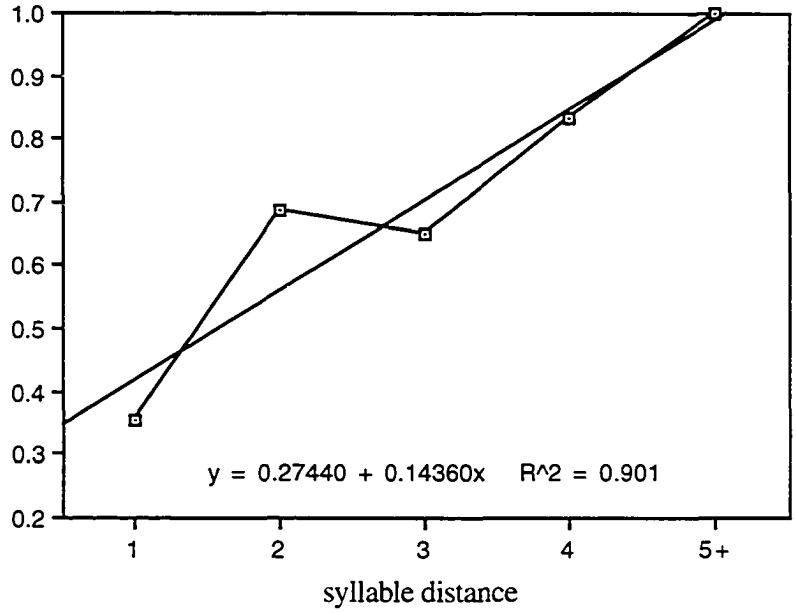
As Fennell (1982:124) points out, this shows that final vowel deletion has been going on in Latvian for at least 350 years.

[5] This can be read in Fennell (1982:19). The translation from Latin is Fennell's.

As reported in Kariņš (1995b), I conducted a series of sociolinguistic interviews in Riga during the summer of 1991 together with Ingrīda Kariņa in order to collect data on variable short vowel deletion in unstressed final syllables. The results were subjected to a variable-rule analysis using the GOLDVARB 2.0. program for the MacIntosh. Among other factors, the analysis of this phenomenon reveals that there is a direct correlation between syllable distance from main word stress and the probability of vowel deletion. The further the candidate vowel is from the main word stress, the higher the probability of deletion.

The anlysis also reveals a faint but fairly consistent pattern across individuals which provides a reflection of the secondary stress patterns in Latvian. Namely, there is a slight dip in the probability of deletion of final short vowels when they are in the third syllable following main word stress than when they are in the second syllable following main word stress, which is shown in (10). In many cases, this would correspond to an unfooted final syllable in words such as *adata* 'needle' and *gra:mata* 'book'. While the variable process of vowel deletion in Latvian appears to reflect the metrical structure of the language, the pattern remains inconclusive: when these tokens are split up into two groups where the candidate vowels are classified as either footed or unfooted, the resulting factor group is not a significant constraint on vowel deletion.

(10) Probability of vowel deletion according to the syllable distance from the main word stress. Source: Kariņš (1995b)



Thus, although there is concrete evidence that secondary stress exists in the language (see above), the secondary stresses are very weak when compared with the strong (initial) primary stress, and do not have the ability to preserve syllabic content at the ends of words.

4.3.2 Evidence from the metrical structure of traditional folksongs

If the phonetic evidence for the existence of secondary stress is indeed accurate, one might expect to find stronger evidence for the stress patterns elsewhere in the language. Such evidence presents itself in the metrical structure of traditional Latvian folksongs. One of the often-occurring metrical patterns found in the folksongs is called the Folk Trochee (Halle, 1971; Zeps, 1963, 1973, 1989). As analyzed in Zeps (1989), this trochee consists

of a number of distychs (lines of a song), which in turn consist of four cola each, the cola being groupings of two trochaic feet. While the trochaic feet have the expected strong-weak alternation, the cola have a weak-strong alternation. This is contrary to the preditction of Hayes (1995:119), who writes that all bound cola are said to consist of a strong+weak branch, analogous to the syllabic trochee. This is clearly an area of linguistic typology which has not been investigated thoroughly enough. The sample trochaic song provided by Zeps (1989) is shown in (11).

(11) Sample folksong composed in the meter of a folk trochee (from Zeps, 1989)

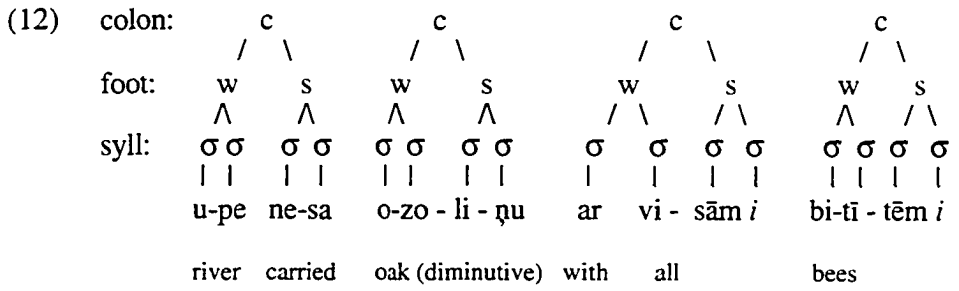
Upe nesa ozoliņu ar visām bitītēm.
Dravinieka līgaviņa tek gar malu raudādama.
Ziedu svārki mugurā, vaska cimdi rociņā.
Trūka, trūka, tev, bitīte – ja tev trūka, trūkst man ar.
Ja tev trūka sila ziedu – trūkst man vaska ritenīša.

The river carries an oak with all the bees.
The bee-keeper's bride runs along the shore crying.
Wearing a flower petal skirt and wax gloves.
You are in need, dear bee – and if you are in need, so am I
If you lack your forest blossoms, I lack my wheel of wax.

Evidence for the colon in the metrical structure of such folksongs is twofold, following Zeps (1989). First, Zeps found a condition whereby the third and the fourth syllables of a grouping of two trochaic feet cannot be separated by a word break. This is easily explained by a statement that the right branch of a colon cannot contain a word break. Second, the placement of epenthetic vowels to fill up metrical space is readily explained by the existence of four cola in a distych or line of a folksong. If a colon lacks the necessary syllabic content, a vowel can be inserted to fill in the empty (but existing) place in the metrical structure. This is shown with the italicized vowel *i* in (12).[6]

[6] In describing the hierarchical structure above the segment, Zeps (1989) claims that a two-syllable stretch (a foot) is metrically irrelevant, and that what he calls a colon (a four-syllable stretch) should actually be called a foot. However, while Zeps refrains from discounting the existence of the foot altogether, he does not further include it in his description of the folk trochee.

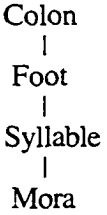
(12)



"The river carries an oak with all the bees"

Zeps (1989) investigated 1,000 Latvian folksongs containing the metrical pattern of the folk trochee, and found that only 42.5% of the cola in these songs contained a word break between the weak and the strong branches. Examples of this would be the first cola as shown in (12) above. A break between the weak and the strong branch of a cola would be expected if the language did not have secondary stress. However, a majority of the cola investigated, 57.5%, did *not* have a word break between the weak and the strong branch of the colon. Clear examples of this are the second and fourth colon shown in (12) above. Of course, if the strong branch of a colon does not occur on a new word, then it is a strong indication that it is falling on a secondary stress within a word. If one accepts that folk poetry, in this case, folksongs, are composed out of metrical elements existing in the language, then the data provided by Zeps (1989) further supports the existence of secondary stress in Latvian. In addition, the folksongs point to the existence of the hierarchy above the level of the mora and syllable in Latvian, shown in (13) below.

(13) Proposed prosodic hierarchy of Latvian



Given the experimental evidence for the existence of secondary stress (section 4.2), coupled with the secondary evidence for the prosodic structure of the language from the metrical structure of folksongs discussed in this section, it seems that the patterns of secondary stress discussed in the traditional grammars (Endzelīns, 1922) should indeed be taken seriously, and reexamined within a phonological framework. The following sections do that.

4.4 A restatement of the stress patterns claimed in the traditional grammars

Endzelīns (1922) provides what I refer to as the traditional account of the secondary stress patterns of Latvian. In his discussion of secondary stress, Endzelīns provides various forms of words of 2 - 5 syllables in length, and simply states on which syllables secondary stress falls. The forms that he provides appear to be representative of words with certain patterns of long and short vowels. Endzelīns claims nothing about foot structure or whether unstressed syllables are footed. The data in (14) are taken directly from Endzelīns (1922:20); the syllable boundaries are not found in the original, but have been added in by me based upon the criteria discussed in Chapter 3.[7] In (14), a grave accent indicates the presence of a secondary stress over a syllable. In all of the stated forms, the primary stress is found on the first syllable. The generalizations (if any) are found in Endzelīns (1922). In the examples, generalizations which refer to a "word stem" are relevant for nouns and verbs with morphological prefixes, which are often (but not only) in the shape of a light syllable. The example which Endzelīns uses is the verbal prefix of negation *ne-*.

[7] Endzelīns (1938) gives a practically identical list of stress patterns and examples.

(14) Examples of secondary stress patterns from Endzelīns (1922:20)

a. Two syllable words: i) secondary stress if second syllable is long

ma:.jà:	in the house'

ii) secondary stress on word stem if first syllable is short

ne.sìt	'do not hit'

b. Three syllable words: i) secondary stress on long syllable next to short syllables

a.da.tà:m	'for the needles'
la.bì:.ba	'grain'

ii) secondary stress on short word stem between short syllables

ne.sì.ti	'did not hit'

c. Four syllable words: only examples are given

a.da.tì.ņa	'little needle'
mei.te.nì:.te	'little girl'
la.si:.tà:.ji	'the readers'
la.si:.tà:.jiem	'for the readers'
la.si:.šà.na	'the reading'
mei.te.nì:.te:m	'for the little girls'
a.da.tì.ņa:m / a.da.ti.ņà:m	'for the little needles'
pa.è:.di.nàt	'to feed'

d. Five syllable words: only examples are given

nuo.svi.li.nà:.ta	'singed'
nuo.svi.li.nà:.ta:m	'for the singed'
pa:r.è:.di.nà:.ti	'overfed'
pa:r.è:.di.nà:.tiem	'for the overfed'
mi:.li.nà.ša.nà:s	'snuggling'
ga.vi.lè:.da.mi / ga.vi.le:.dà.mi	'rejoicing'
ja:.pa.slù.di.na	'must announce'
ap.rau.dzì:.da.mi[8]	'observing'
ie.drau.dzè:.da.mà:s	'getting acquainted'

Endzelīns does not state the stress patterns of words more than five syllables in length, mentioning the rarity of such forms as the reason for them having a less stable stress system. Although Endzelīns mentions that the stress pattern of five syllable words is not as clear as for shorter words, he nevertheless gives examples of their stress patterns. Sokols *et al.* (1959), the other well-known traditional grammar of Latvian, also cites the instability of the stress patterns of forms of more than four syllables, and does not provide the stress patterns of five and six syllable words.

4.5 A rule-based phonological analysis of Endzelīns' (1922) patterns

In metrical phonology, stress is associated with the presence of a metrical foot (see Liberman & Prince, 1977; McCarthy & Prince, 1986, 1990, 1993; Hayes, 1995). Hayes (1995) presents a very thorough investigation of what can generally be referred to as a "rule-based" (as opposed to constraint-based) approach to metrical structure. The

[8] As discussed in Chapter 2, Liepa (1968) would divide the word into syllables as shown here. Again, my own intuition divides the first two syllables differently as *a.prau*. An investigation of segment duration could resolve this uncertainty: if the *p* is in the first syllable, it would here be predicted to be dominated by a layer 1 mora, and hence be longer than if it were solely in the onset of the second syllable. Future research could investigate durations in clear cases such as *ap.mesties* 'to reside' and *ap.vainuot* 'to offend', and compare these with words such as *aprinda* 'circle of society' and *apraudzi:t* 'to observe, visit'.

discussion below is based upon what is called parametric metrical stress theory. Various principles of this theory are expounded upon in Hayes (1995), Halle & Vergnaud (1987), Prince (1985), and elsewhere. As could be expected, not all researchers agree upon what the universal metrical parameters are from which a particular language has to choose. One of these issues is in the type of foot allowed. I am here adopting the useful and well-grounded classification set up in Hayes (1995), where there are only three types of bounded feet, shown in (15).

(15) Basic bounded foot inventory after Hayes (1995:71)

a. Syllabic trochee (x .)
σ σ

b. Moraic trochee (x .) or (x)
˘ ˘ –

c. Iamb (. x) or (x)
˘ σ –

Accepting this typology of foot types, I now return to the Latvian data. The data in (16) include two and three syllable words from (14a) and (14b) above. The first column in (16) includes bracketing to indicate foot structure; the second column contains the same information in an abstract representation of heavy and light syllables, the third column indicates the apparent type of foot being constructed from (15) above, including the direction of foot construction. Finally, the last column in (16) provides the gloss of the form.

(16) Examples of secondary stress patterns including foot structure: 2 - 3 syllable words
['˘' = *light syllable*, '–' = *heavy syllable*]

a.	(má.na)	(˘ ˘)	trochee, L–>R	'my (N. fem. sg.)'
b.	(má.nas)	(˘ ˘)	trochee, L–>R	'my (N. fem. pl)'
c.	(né).(sìt)	(˘)(˘)	stressed stem	'do not hit'
d.	(má:).(jà:)	(–)(–)	moraic trochee, L–>R	'in the house'
e.	(á.da).ta	(˘ ˘)˘	moraic trochee, L–>R	'needle'
f.	(á.da).(tà:m)	(˘ ˘)(–)	moraic trochee, L–>R	'for the needles'
g.	(lá).(bì:.ba)	(˘)(– ˘)	moraic trochee, L–>R	'grain'
h.	(lá).(bì:.bas)	(˘)(– ˘)	moraic trochee, L–>R	'for the grain'
i.	(né).(sì.ti)	(˘)(˘ ˘)	stressed stem	'did not hit'

What the data in (16) show is that Latvian builds moraic trochees from left to right. In other words, the forms show that the language is "quantity sensitive" on the moraic layer 2 discussed in Chapter 3. The crucial forms for stating this are (16d), (16g), and (16h). There are two exceptions to the general pattern, (16c) and (16i), which have a secondary stress on the word stem where it would not be predicted phonologically. Such forms could arguably be excluded from a phonological account of stress in the language, since they invoke morphology (see Hayes, 1995).[9]

One puzzling aspect of the two and three syllable words remains. Endzelīns (1922:20) writes that in three syllable words, words which have long (read: heavy) second and third syllables do not have an audible secondary stress, just as words with three short (read: light) syllables have no audible secondary stress. The lack of a secondary stress on either of the heavy syllables in such a word would not be predicted by the theory utilized here, as shown in (17) below.

(17) Sample analyses of a three-syllable word with two long final syllables

a.	(lá.bi:).ba:	(˘–)–	?	'in the grain'
b.	(lá.).(bì:).(bà:)	(˘)(–)(–)	moraic trochee, L–>R	'in the grain'

[9] The basis of a metrical (phonological) analysis of stress systems is that stress is a rhythmic property of language, as opposed to a linguistic feature (see Liberman & Prince, 1977). If stress is determined by structure beyond the phonology, those structures are properly outside the scope of a phonological investigation. Thus, Latvian apparently has a "mixed" phonological/morphological stress system.

The analysis in (17a) is not accounted for in the foot inventory shown in (15) above. Instead, the unattested (17b) would be predicted. An explanation for this could be related to the fact that secondary stresses are quite weak in the language (see for example Halle, 1987a denying their existence to begin with). Since stress in Latvian is related to prominence of a syllable in relation to the adjacent ones (see Chapter 2), it is conceivable that there could indeed be two phonological stresses as in (17b) above, and that Endzelīns, who was working purely within a desciptive framework, could not hear them, since logically two equally prominent syllables next to one another will sound equally unprominent. Since the experiment described in section 4.2 above unfortunately cannot shed any light on this issue, I will move on, accepting that it is indeed possible that there are secondary phonological stresses on such words as shown in (17b), and that they are simply not salient. I now turn to words of longer duration.

The forms in (18) illustrate the stress patterns of words four syllables in length, taken from (14c) above. The format of the table is identical to that of (16) above.

(18) Examples of secondary stress patterns including foot structure: 4 syllable words

a.	(á.da).(tì.ŗa)	(˘˘)(˘˘)	syll. trochee, L–>R	'little needle'
b.	(á.da).(tì.ŗa:m)	(˘˘)(˘-)	syll. trochee, L–>R	'for the needles'
c.	(á.da).ti.(ŗà:m)	(˘˘) ˘ (-)	moraic trochee, L–>R	'for the needles'
d.	(méi.te).(nì:.te)	(˘-)(˘˘)	syll. trochee, L–>R	'little girl'
e.	(méi.te).(nì:.te:m)	(˘-)(˘-)	syll. trochee, L–>R	'for the little girls'
f.	(lá.si:).(šà.na)	(˘˘)(˘˘)	syll. trochee, L–>R	'the reading'
g.	(lá.si:).(tà:.ji)	(˘˘)(˘˘)	syll. trochee, L–>R	'the readers'
h.	(lá.si:).(tà:.jiem)	(˘˘)(˘-)	syll. trochee, L–>R	'for the readers'
i.	(pá).(é:.di).(ná:t)	(˘)(˘-)(-)	stressed stem	'to feed'

The pattern in (18) is completely unexpected. Whereas in (16) the language was building moraic trochees, here for the longer words the language is building rhythmically alternating syllabic trochees, disregarding syllable quantity. The strongest argument for a syllabic trochee analysis is in forms (18f), (18g) and (18h), where the first foot has a light

followed by a heavy syllable: impossible in a system which builds moraic trochees. One possible explanation could be that the heavy syllables in these forms are indeed (originally) stressed, and have simply undergone a sort of three-syllable destressing, whereby *(lá).(sì:.).(tà:.ji)* (with three consecutive stresses) would become *(lá.si:).(tà:.ji)* (with alternating stress).[10] While such an analysis is appealing, it does not account for the form (18f) *(lá.si:).(šà.na)*, which (in principle) could surface as *(lá).(sì:.ša).na* with two consecutive stresses as witnessed by (16g) *(lá).(bì:.ba)*. A process of three-syllable destressing in Latvian does not account for all of the forms in (18) via a moraic analysis.

There are still two clear exceptions to a syllabic trochee analysis here, forms (18c) and (18i). Form (18c) is given by Endzelīns (1922) as an alternate form, without any explanation. It could be analyzed as being built of moraic trochees from left to right. As such, it more properly would fit in with the forms in (16). However, since it is one of two possible forms, it does not constitute a clear exception to the pattern here. Similarly, form (18i) is different from the other forms insofar as morphologically it is composed of a prefix+stem, and therefore can qualify as a morphologically conditioned stress pattern, which by definition lies outside the scope of a purely phonological inquiry (see above). Thus, there is already a split in the construction of metrical feet in Latvian between long and short words. I turn to the five syllable forms in (19) below to complete the picture.

The five-syllable words in (19) are similar to the forms in (18) insofar as they have a tendency to form syllabic (as opposed to moraic) feet.

[10] This suggestion was put forth by Juliette Blevins (personnal communication).

(19) Examples of secondary stress patterns including foot structure: 5 syllable words

a.	(já:.pa).(slù.di).na	(--)(--)-	syll. trochee, L–>R	'must announce'
b.	(áp.rau).(dzì:.da).mi	(--)(--)-	syll. trochee, L–>R	'observing'
c.	(ié.drau).(dzé:.da).(mà:s)	(--)(--)(-)	syll. trochee, L–>R	'getting acquainted'
d.	(mí:.li).(nà:ša).(nà:s)	(--)(--)(-)	syll. trochee, L–>R	'snuggling'
e.	(gá.vi).(lè:.da).mi	(--)(--)-	syll. trochee, L–>R	'rejoicing'
f.	(gà.vi).le:.(dà.mi)	(--)-(--)	alternate form	'rejoicing'
g.	(núo.svi).li.(nà:.ta)	(--)-(--)	ternary pattern	'singed'
h.	(núo.svi).li.(nà:.ta:m)	(--)-(--)	ternary pattern	'for the singed'
i.	(pá:r).(è:.di).(nà:.ti)	(-)(--)(--)	stressed stem	'overfed'
j.	(pá:r).(è:.di).(nà:tiem)	(-)(--)(--)	stressed stem	'for the overfed'

The forms (19c) and (19d) at first appear not to be forming pure syllabic trochees, since the final (heavy) syllable is footed as well. Kager (1992, 1993)[11] would analyze such stress systems as building "generalized trochees", stated in (20). Thus, by (20), syllabic trochees are formed where possible, and moraic trochees are formed elsewhere.

(20) The generalized trochee (Hayes, 1991; Kager, 1992)

Construct (x .) else (x)
σ σ $\sigma_{\mu\mu}$

Hayes (1995) suggests an alternative analysis to the generalized trochee. He does this by adding three conditions to the theory. First, he formulates the degenerate foot for all foot types as being a single light syllable, shown in (21). Thus, in a syllabic trochee system, a long monosyllable would be a proper (as opposed to degenerate) foot (see Hayes, 1995:103).

(21) Degenerate foot (after Hayes, 1995:102)

(x)
-

[11] Kager's discussion of the "generalized trochee" apparently builds upon a suggestion in an earlier 1991 draft version of Hayes (1995).

Second, Hayes formulates the strong and weak prohibition against degenerate feet, shown in (22). He links the existence of the degenerate foot to the smallest possible word in a language. Thus, if a language can have a word consisting of a light syllable, then the language can allow degenerate feet.

(22) Prohibition on degenerate feet (after Hayes, 1995:87)

a. Strong prohibition: absolutely disallowed
b. Weak prohibition: allowed only in strong position, i.e. when dominated by another grid mark

Since Latvian can have words consisting of light monosyllables (*tu* 'you', *nu* 'well', *še* 'here', *re* 'see!', etc.), by Hayes' analysis Latvian would be expected to have the weak prohibition against degenerate feet. From this it follows that a stressed final heavy syllable as in the forms (19c) and (19d) does not constitute a degenerate foot, and can be scanned as a noncannonical (imperfect but not degenerate) foot . Only a light final syllable, such as that in (19a) and (19b) would constitute a degenerate foot, and hence is not footed. This is exactly what is found. Thus, the forms in (19a) - (19e) are accounted for as syllabic trochees.

Of the remaining forms in (19), (19f) does not pose a problem, since this is given by Endzelīns (1922) as an alternate form (see above).[12] Forms (19i) and (19j) also do not appear to represent problems for the analysis, since they arguably have a stressed stem, and thus are subject to a morphologically sensitive rule (see above). The two remaining forms, (19g) and (19h), however, do constitute an apparent problem for the syllabic trochee analysis, since they have a pseudo-ternary stress pattern with a light syllable skipped between two well-formed feet.

[12] Wheras the alternate form (18c) seems possible to me, form (19f) seems very unnatural.

Hayes (1995) accounts for ternary stress via the metrical parameter of strong/weak local parsing. The relevant parameter for describing a ternary pattern is Weak Local Parsing, shown in (23).

(23) Weak Local Parsing (from Hayes, 1995:308)

> When a foot has been constructed, align the next foot by skipping over a light syllable where possible

One of the languages which has acquired a lot of attention because of its optional ternary system is Estonian (see Hint, 1973; Hayes, 1995; Kager, 1994; Prince, 1980). However, unlike Latvian, for a given form of sufficient length, Estonian can apparently build a syllabic trochee with weak or strong local parsing, that is, the given word can have either alternating or ternary stress. The same appears to be true of some other Finno-Ugric languages (see Hayes, 1995 for discussion).

The Latvian ternary system, then, is unexpected. The five-syllable forms are split between an alternating and a ternary stress pattern, apparently dependent upon the phonological shape of the word. It is clear that Weak Local Parsing is not active in a form such as (19a). It apparently is, however, in forms (19g) and (19h). These last two forms, then, remain somewhat anomalous.

4.5.1 Summary of rule-based analysis of Latvian stress

The findings of a rule-based analysis of Latvian metrical structure are summarized in (24).

(24) Summary of rule-based analysis of Latvian metrical structure

1. For two and three syllable words
   i) build moraic trochees left to right
   ii there is a weak prohibition against degenerate feet

2. For four and five syllable words
   i) build syllabic trochees left to right
   ii) there is a weak prohibition against degenerate feet
   iii) for some forms, allow weak local parsing

The metrical analysis in (24) is somewhat disturbing, since to my knowledge, no language has been described with a split system between long and short words. At any rate, such an analysis is outside of the broad typology presented in Hayes (1995). Given that the rule-based theory of parametric metrical phonology would have to be mended in order to account for the stress pattern of Latvian, it seems appropriate to first question whether the theory itself is the best framework within which to describe metrical phenomena, or whether some other theory should be considered.

From the standpoint of language processing, it seems unlikely that speakers would have to learn two sets of parameters for words of differing lengths (although in principle this could indeed be possible). From the standpoint of phonological theory, a unified approach is generally preferred over a segmented approach. For both of these reasons, and primarily for the second one, I turn to another phonological theory, Optimality Theory (Prince & Smolensky, 1991, 1993) to account for the stated and observed patterns of stress in Latvian.

4.6 An Optimality Theory account of the stress pattern of Latvian

4.6.1 General overview of Optimality Theory

Optimality Theory (OT), introduced by Prince & Smolensky (1991, 1993), represents a markedly new approach to the study of linguistic phenomena. Generative Phonology since Chomsky & Halle (1968) has been concerned with the linguistic derivation, whereby a linguistic form enters the given system, undergoes a number of changes via a series of ordered rules, and then emerges as the surface phonetic form. While various theories have come and gone in the past 30 years, they have generally accepted the notion of the derivation to account for the linguistic data.[13]

Prince & Smolensky's (1993) OT approach introduces the idea of *constraint ranking*: in the grammar, there are a number of ordered (universal) constraints, which affect the realization of a surface candidate. There is no derivation, since all possible candidate forms enter the system simultaneously. The forms which violate the higher ranked constraints do not surface, while the form which violates the lowest ranked constraint (or lower than all the other candidates), or violates no constraints surfaces as the optimal form. In a broad sense, this theory takes parameters such as a Weak prohibition on degenerate feet, and makes it into a constraint in the system, ranked in relation to the other constraints.

With the stress pattern of Latvian, two things have to be taken into account. First, the stated secondary stress patterns from Endzelīns (1922) must be considered and explained. Second, the results of the phonetic experiment in section 4.2 have to be

[13] For some other recent exceptions, see Goldsmith *ed.*, (1993)

considered, and it must be remembered that voiceless obstruents lengthen between a short stressed and a short unstressed vowel. In the sections below, these phenomena will be considered and accounted for within OT.

4.6.2 An OT account of rhythmic stress

In order to account for the fact that in Latvian the first syllable receives primary stress regardless of syllabic weight and that rhythmic stress is alternating with the strong beat first, two general and undominated constraints shown in (25) need to be posited.[14]

(25) a. ALIGNHEAD (Head (PrWd), L; PrWd, L)
every PrWd begins with the main stress foot
b. TROCH-FT feet are trochaic

Considering the attested metrical structure of the Folk Trochee (section 4.3) and the stress pattern of two and three syllable words in (16) above, it seems reasonably clear that Latvian has a metrical tendency to have words consisting of four syllables, or two feet. Building upon Zeps (1989), this translates into words ideally (optimally) consisting of one colon, as shown through the constraint in (26).

(26) COLON the PrWd consists of at least one colon

The constraint COLON helps to explain the apparent split between short and long words discussed above. Long words have enough syllables to form a colon, and thus can support an alternating stress pattern, while short words (having less than four syllables) resort to stressing heavy syllables in order to satisfy the COLON condition.

[14] For the exceptional forms with non-initial stress (see Endzelīns, 1922), a different set of constraints altogether must apply. I am here considering only the common initially-stressed words.

The constraint COLON is not undominated, as forms such as *(má.na)* 'my' show. One of the additional constraints shown in (27) must be operative in the language, which would of necessity have to dominate COLON.

(27) a. FTBIN feet are binary in a syllabic or moraic analysis (Prince & Smolensky, 1993)
b. SWP, *Stress-to-Weight Principle*: every stressed syllable must be heavy

The constraint FTBIN is posited by Prince & Smolensky (1993), following earlier work by McCarthy & Prince (1986) and Prince (1985, 1990). The constraint requires simply that all feet are either bisyllabic or bimoraic. The SWP is a mirror image of the *Weight-to-Stress Principle* (WSP) (Prince, 1990; Prince & Smolensky, 1993), which states that all heavy syllables must receive stress. The WSP would not help to rule out a form such as **(á.da).(tà)*, since there is not heavy syllable in the word which could be constrained by the WSP. The constraint which can is the SWP, which is in effect a restatement that stressed syllables are "obligatorily branching" (see for example Hayes, 1995; Prince, 1985 following earlier work of Halle & Vergnaud, 1978 and Hayes, 1981). If inviolable, the SWP would guarantee that every stressed syllable has two moras (on layer 2), or is heavy, and FTBIN would guarantee that every foot is either bimoraic (on layer 2), or bisyllabic.

Light-syllabled words such as *(má.na)* 'my' and *(á.da.)ta* 'needle' show that if the SWP is active, it is indeed violable. Similarly, a word such as *(lá).(bì:ba)* 'grain' indicates that if FTBIN is active, it is also violable, since the first syllable has only a light syliable. The constraint ALIGNHEAD therefore would dominate both SWP and FTBIN, allowing the aforementioned forms to surface.

The tableau in (28) and (29) illustrate that both FTBIN and SWP can be ranked above COLON. In tableau (29) and elsewhere, I am not indicating a violation of the SWP

on the initial syllable, since all initial syllables always receive stress by virtue of the inviolable ALIGNHEAD, and each candidate with a light first syllable will have the same SWP violation.

(28)	/a.da.ta/	FTBIN	COLON
a.	(á.da).(tà)	* !	
b. ☞	(á.da).ta		*
c.	(á).(dà.ta)	* !	

(29)	/a.da.ta/	SWP	COLON
a.	(á.da).(tà)	* !	
b. ☞	(á.da).ta		*
c.	(á).(dà.ta)	* !	

However, with the constraint ranking FTBIN >> COLON in the tableau for *(lá).(bì:ba)* 'grain', the improper candidate is selected, as shown in (30). In order for the proper candidate to be selected, both SWP and COLON must dominate FTBIN, as shown in (31).

(30)	/la.bi:ba/	FTBIN	COLON
a. ☞	*(lá.bi:).ba		*
b.	(lá).(bì:.ba)	* !	
c.	(lá.bi:).(bà)	* !	

(31) /la.bi:ba/	SWP	COLON	FTBIN
a. (lá.bi:).ba		* !	
b. ☞ (lá).(bì:.ba)			*
c. (lá.bi:).(bà)	* !		*

From (29) above, we know that SWP dominates COLON, and from (31), we know that both SWP and COLON dominate FTBIN. Through transitivity we therefore know the relative constraint ranking shown in (32) below.

(32) SWP >> COLON >> FTBIN

As shown in (33), the consideration of stress alignment in a four-syllable word such as *(lá.si:).(šà.na)* 'the reading' indicates that the constraint ranking in (32) selects the wrong candidate as optimal. Another constraint must be active in Latvian which is ranked above SWP.

(33) /la.si:.ša.na/	SWP	COLON
a. (lá.si:).(šà.na)	* !	
b. ☞ *(lá).(sì:.ša).na		
c. (lá).(sì:.ša).(nà)	* !	

There are two likely constraints which could help to select the correct candidate in (33), presented in (34) below.

(34) a. PARSE-S every syllable must be parsed by a foot (see Prince & Smolensky, 1993)
b. *CLASH no adjacent strong beats (see Kager, 1994)

The constraint PARSE-S as discussed by Prince & Smolensky (1993) is a member of the PARSE "family" which requires all segments to be parsed into higher prosodic structure. In this instance PARSE-S requires that all syllables be parsed into the metrical structure. The constraint *CLASH is rooted in metrical grid theory, and the idea behind it is discussed in numerous places (see Halle & Vergnaud, 1987; Hayes, 1995; Kager, 1993, 1994; Prince 1983). The idea of the constraint is rooted in the observed fact that many languages shift stress in order to avoid a potential stress clash.

Tableau (35) illustrates that if PARSE-S is ranked above SWP, the correct candidate (35b) is barred from surfacing for the word *(á.da).ta* 'needle', originally shown in (29) above. In order to select the correct candidate for this word, the relative ranking must be SWP >> PARSE-S, as illustrated in (36).

(35) /a.da.ta/	PARSE-S	SWP	COLON
a. ?☞ *(á.da).(tà)		*	
b. (á.da).ta	* !		*
c. ?☞ *(á).(dà.ta)		*	

(36) /a.da.ta/	SWP	PARSE-S	COLON
a. (á.da).(tà)	* !		
b. ☞ (á.da).ta		*	*
c. (á).(dà.ta)	* !		

Although unnecessary in (36) because of COLON, (37) shows that PARSE-S (ranked below SWP) is indeed necessary in order to properly account for a two syllable word such as *(má.nas)* 'my'.

(37) /ma.nas/	SWP	PARSE-S	COLON
a. (má).(nàs)	* !		
b. ☞ (má.nas)			*
c. (má).nas		* !	*

Returning to the stress pattern of the word *(là.si:).(šà.na)* 'the reading' shown in (33) above, (38) illustrates that if the constraint *CLASH if ranked above SWP, the correct candidate is selected as optimal.

(38) /la.si:.ša.na/	*CLASH	SWP	PARSE-S	COLON
a. ☞ (lá.si:).(šà.na)		*		
b. (lá).(sì:.ša).na	* !		*	
c. (lá).(sì:.ša).(nà)	* !	*		

However, by having *CLASH >> SWP, the *wrong* candidate is selected for the word *(lá).(bì:ba)* 'grain', discussed above in (31), and shown again with the constraint *CLASH in (39) below. Regardless of whether *CLASH is posited to be operative on the syllabic or moraic layer, the result is the same, since whatever version selects *(lá.si:).(šà.na)* as optimal similarly wrongly excludes *(lá).(bì:.ba)*.

(39) /la.bi:ba/	*CLASH	SWP	PARSE-S	COLON
a. ☞ *(lá.bi:).ba			*	*
b. (lá).(bì:.ba)	* !			
c. (lá.bi:).(bà)		* !		

Indeed, if *CLASH is operative in Latvian, it must be ranked below SWP and PARSE-S, as shown in (40) below.

(40) /la.bi:ba/	SWP	PARSE-S	*CLASH	COLON
a. (lá.bi:).ba		* !		*
b. ☞ (lá).(bì:.ba)			*	
c. (lá.bi:).(bà)	* !			

Since we know from (40) that *CLASH must be ranked below PARSE-S and SWP, and from (31) that FTBIN must be ranked below *COLON, we know the partial constraint rankings in (41).

(41) a. SWP >> {PARSE-S, COLON} >> FTBIN
b. {SWP, PARSE-S} >> *CLASH

As shown in (42), the constraint ranking in (41) also selects the correct candidate for the pseudo-ternary pattern word *(núo.svi).li.(nà:ta)* 'singed' shown in (19g) above. Where a rule-based account of the stress pattern of Latvian fails to account for these forms in a straightforward manner, an OT account does not. However, this set of constraints still cannot account for the stated stress pattern of the word *(lá.si:).(šà.na)* 'reading' (see (33)).

(42) /nuo.svi.li.na:.ta/	SWP	PARSE-S	COLON
a. ☞ (núo.svi).li.(nà:.ta)		*	
b. (núo.svi).(lì.na:).ta	* !	*	
c. (núo.svi).(lì.na:).(tà)	* !		

Although PARSE-S and *CLASH fail to dominate SWP in Latvian, there must be another constraint active in the language which does. Considering the forms in (43), the relevant constraint appears in some way to affect the alignment of the stress feet over the duration of the word. If possible, the language does not wish to leave unfooted segmental material while building the colon.

(43) a. (lá).(bì:.ba) (˘) (– ˘)
b. *(lá).(sì:.ša).na (˘) (– ˘) ˘
c. (lá.si:).(šà.na) (˘ –) (˘ ˘)

A possible active alignment constraint is presented in (44).[15]

(44) ALIGNEDGE feet are aligned next to the edge of the PrWd

The tableau in (45) shows that with ALIGNEDGE >> SWP, the correct candidate surfaces for *(lá.si:).(šà.na)*. In addition, the correct candidate for *(lá).(bì:ba)* and *(á.da).ta* is also

[15] This is perhaps not an ideal constraint. One alternative (suggested by Sean Erwin at the 22nd Annual Berkeley Linguistics Society meeting) is to posit a constraint which would not allow word-internal feet. Unfortunately, such a constraint cannot be ranked higher than the SWP, since the wrong candidate for *(ie.drau).(dzè:.da).(mà:s)* would be selected (see (46)). A second approach could be to incorporate Juliette Blevins' suggestion about three-syllable clash avoidance into an OT analysis (see above). Such an analysis would have to begin with the WSP (*Weight-to-Stress Principle*), which would need to be ranked below both *CLASH-3 and PARSE-S, as seen in the tableau (i) below. However, tableau (ii) shows that if PARSE-S is ranked above these constraints, the correct candidate (iib) *(á.da).ta* is ruled out. As discussed above, FT-BIN cannot be ranked above PARSE-S, but must be ranked below it.

(i)	/la.si:.ta:.ji/	PARSE	*CLASH-3	WSP
a.	(lá).(sì:).(tà:.ji)		* !	
b. ☞	(lá.si:).(tà:.ji)			*
c.	(lá).(sì:.ta:).ji	* !		*

(ii)	/adata/	PARSE	*CLASH-3	WSP
a.	(á.da).(tà)			
b.	(á.da).ta	*		
c.	(á).(dà.ta)			

selected, since the surface forms do not violate ALIGNEDGE. Such an alignment constraint is relevant to words four or more syllables long.

(45) /la.si:.ša.na/	ALIGNEDGE	SWP	PARSE-S	COLON
a. ☞ (lá.si:).(šà.na)		*		
b. (lá).(sì:.ša).na	* !		*	
c. (lá).(sì:.ša).(nà)	* !	*		

Unfortunately, we see that the inclusion of ALIGNEDGE >> SWP predicts the incorrect candidate for (19c), as shown in tableau (46) below.

(46) /ie.drau.dze:.da.ma:s/	ALIGNEDGE	SWP	PARSE-S	COLON
a. (íe.drau).(dzè:.da).(mà:s)	* !			
b. (íe.drau).(dzè:.da).ma:s	* !		*	
c. ☞*(íe.drau).dze:.(dà.mas)		*	*	
d. (íe).(dràu).(dzè:.da).(mà:s)	* * !			
e. (íe).(dràu.dze:).da.(mà:s)	* !		*	

If the stress pattern of Latvian is to be accounted for with the inclusion of ALIGNEDGE (which is still open to question), there must be another (undominated) constraint active in the language which rules out two adjacent unstressed moras from surfacing unfooted. Green & Kenstowicz (1995) provide a constraint, shown in (47), which would block adjacent unstressed moras from surfacing in the same foot.

(47) LAPSE-M adjacent unstressed moras must be separated by a foot boundary (Green & Kenstowicz, 1995)

However, this constraint cannot be ranked higher than ALIGNEDGE in Latvian, for long syllables (with two moras) can indeed surface in the weak branch of a foot, as can be seen in forms (18e) - (18h), (19b), and (19c). A different constraint is needed.

Kager (1994) provides the constraint PARSE-2, shown in (48), which also constrains the metrical parse of syllables. Crucially, Kager (1994) writes that a stress unit can be either a syllable or mora.

(48) PARSE-2 one of two adjacent stress units must be parsed by a foot (Kager, 1994)

With the addition of this inviolable and hence undominated constraint, the correct candidate is selected for (19c), as shown in (49).

(49) /ie.drau.dze:.da.ma:s/	PARSE-2	ALIGNEDGE	SWP	PARSE-S	COLON
a. ☞(íe.drau).(dzè:.da).(mà:s)		*			
b. (íe.drau).(dzè:.da).mà:s	* !	*		*	
c. (íe.drau).dzè:.(dà.ma:s)	* !		*	*	
d. (íe).(dràu).(dzè:.da).(mà:s)		* * !			
e. (íe).(dràu.dze:).da.(mà:s)		*		* !	

The combination of ALIGNEDGE and PARSE-2 also helps to select the correct candidate in (50). Importantly, the illicit candidate **(núo.svi).li.(nà:).(tàm)* is ruled out by ALIGNEDGE. We know that *CLASH could not help to rule out the illicit candidate, since SWP, PARSE-S >> *CLASH, as seen in (40) above.

(50) /nuo.svi.li.na:.ta:m/	PARSE-2	ALIGNEDGE	SWP	PARSE-S	COLON
a. ☞(núo.svi).li.(nà:.ta:m)				*	
b. (núo.svi).(lì.na:).ta:m	* !	*	*	*	
c. (núo.svi).li.(nà:).(tà:m)		* !			

From the data in (16), (17), (18), and (19), two forms emerge which apparently contradict PARSE-2 being undominated in Latvian. One of these is (19f), which is given as one of two alternate forms for *gavile:dami* 'rejoicing'. Since this is an alternate form, it does not in itself constitute an unquestionable violation of the constraint PARSE-2. I will note the possibility of a violation here, and proceed with the investigation.[16] The second form is (17a), *(lá.bi:).ba:* 'in the grain' which Endzelīns (1922) implies has no secondary stress on either the second or third syllable. As discussed above, the stress pattern for such a form is under question, and is a topic for future research.

As could be expected, all is still not clear with ALIGNEDGE. The form in (19a) *(já:.pa).(slù.di).na* 'must announce' does not align its feet at the word edge, and also does not have a heavy syllable which could be subject to PARSE-2. Tableau (51) below shows that the current set of constraints predicts the wrong candidate for this word.

(51) /ja:.pa.slu.di.na/	ALIGNEDGE	SWP	PARSE-S	COLON
a. (já:.pa).(slù.di).na	* !	*	*	
b. ☞ *(já:.pa).slu.(dì.na)		*	*	
c. (já.pa).(slù.di).(nà)	* !	**		

[16] My own intuition is that *(gá.vi).le:.(dà.mi)* is a most improbable stress pattern for the word. However, lacking experimental support, this must remain for now an area of uncertainty, just as Endzelīns (1922) indicates that it is (by virtue of presenting two alternate stress patterns for the same word).

A consideration of the form in (16c), (16i), (18i), (19a), (19i), and (19j) suggests that there is some sort of interaction between the phonology and morphology in the metrical system of Latvian. What all of these forms have in common is that the stem of the word has a stress. For (16c) and (16i), this is in contradiciton to the prediction of similar words with the same phonological shape. This suggests that there must be a constraint such as that shown in (52) active in the language. This constraint is parallel to the syllabic constraint ALIGN posited for the alignment of the left edge of a word stem with the left edge of a syllable boundary discussed in Chapter 3.

(52) ALIGN-S $[_{Stem} = [_{Foot}$ the left edge of the word stem corresponds to the left edge of a foot (see McCarthy & Prince, 1993)

A quick look at all of the words with morphological prefixes in (16), (18), and (19) reveals that this constraint as stated would force the incorrect candidate to surface for some forms. The relevant forms from (16), (18), and (19) above are listed in (53).

(53) Metrical stress patterns and morphological boundaries

	surface metrical structure	bracketed stem edge	gloss
a.	(íe.drau).(dzè:.da).(mà:s)	ie.[drau.dze:.da.ma:s	'getting acquainted'
b.	(áp.rau).(dzì:.da).mi	ap.[rau.dzi:.da.mi	'scrutinizing'
c.	(núo.svi).li.(nà:.ta)	nuo.[svi.li.na:.ta	'burned Fem. sg.
d.	(núo.svi).li.(nà:.ta:m)	nuo.[svi.li.na:.ta:m	'burned Fem DAT pl.
e.	(já:.pa).(slù.di.).na	ja:.pa.[slu.di.na	'must advertize'
f.	(pá).(è:.di).(na:t)	pa.[e:.di.na:t	'to feed'
g.	(pá:r).(è:.di).(nà:.ti)	pa:r.[e:.di.na:.ti	'overfed'
h.	(pá:r).(è:.di).(nà:.tiem)	pa:r.[e:.di.na:.tiem	' for the overfed'
i.	(né).(sìt)	ne.[sit	'do not hit'
j.	(né).(sì.ti)	ne.[si.ti	'did not hit'

As can be seen, forms (53a)- (53d) violate the constraint ALIGN-S, while foms (53e) - (53j) do not. Unfortunately, the traditional grammars do not provide more example forms, so any generalization drawn from these examples must remain tentative. The pattern which emerges is that some morphological prefixes are in some sense "extrametrical" (see Hayes, 1995 and references therein), and hence not counted while placing rhythmic stress, while others are readily included in the metrical structure, and hence counted while placing rhythmic stress. Note that for forms (53f) - (53h), the words have (the expected) alternating stress except for the morphological prefix.

This raises a very interesting question for Latvian morphology: which morphological prefixes are visible to ALIGN-S, and which are not? This question must be pursued elsewhere. For now, I am accepting that different verbal prefixes have different degrees of incorporation into the prosodic word. Some prefixes apparently in some sense become part of the word stem and are thus subject to the regular phonological constraints, while others remain outside of the word stem, and thus leave the word open to the constraint ALIGN-S. If one accepts that the notion of "stem" is subject to both morphological and phonological conditioning, then the constraint ALIGN-S as stated appears to be undominated in Latvian.

With the addition of the undominated constraint ALIGN-S, the correct candidate for *(já:.pa).(slù.di).na* is selected, as shown in tableau (54) below.

(54) /ja:.pa.slu.di.na/	ALIGN-S	ALIGNEDGE	SWP	PARSE-S	COLON
a. ☞ (já:.pa).(slù.di).na		*	*	*	
b. (já:.pa).slu.(dì.na)	* !		*	*	
c. (já.pa).(slù.di).(nà)		*	**!		

Turning to the remaining alternate stress patterns given by Endzelīns in (18b) and (18c) for *adatiņa:m* 'for the needles', the posited constraints in this analysis predicts that (18c) is the optimal form which would surface, as shown in (55).

(55) /a.da.ti.ɲa:m/	PARSE-2	ALIGNEDGE	SWP	PARSE-S	COLON
a. (á.da).(tì.ɲa:m)			* !		
b. ☞ (á.da).ti.(ɲà:m)				*	
c. (á.da).(tì).ɲa:m	* !	*	*		

Finally, as shown in tableau (56), the aforementioned constraints properly select the observed stress pattern of the word *nesalipina:t* 'to not stick together' from section 4.2 above. The constraint ALIGN-S is crucial in the selection process.

(56) /ne.sa.li.pi.na:t/	ALIGN-S	PARSE-2	ALIGN EDGE	SWP	PARSE-S	COLON
a. ☞ (né.sa).(lì.pi).(nà:t)			*	*		
b. (né.sa).(lì.pi).na:t		* !	*	*	*	
c. (né.sa).li.(pì.na:t)	* !			*	*	
d. (né.sa).li.pi.(nà:t)	* !	*			* *	

Although the constraint ALIGNEDGE is, as discussed, somewhat problematic, the constraints which are required to dominate it are generally motivated by the stress pattern of Latvian, as discussed above. Accepting that ALIGNEDGE is indeed part of the constraint hierarchy, Latvian has the active constraints shown in (57) which account for the rhythmic stress patterns stated in Endzelīns (1922). As seen above, although *CLASH and FTBIN

can be placed in the constraint hierarchy, they do not appear to play an active role in Latvian.

(57) Undominated: ALIGN-HEAD (25a), TROCH-FT (25b), PARSE-2 (48), ALIGN-S (52)
Dominated: ALIGN-EDGE (44) >> SWP (27b) >> {PARSE-S (34a), COLON (26)}

I leave it to future research to investigate the intricacies of the somewhat puzzling application of the constraint ALIGN-S, along with the questions raised above about finding an empirical bases upon which to assert the actual secondary stress patterns of some of the questionable forms in (16), (17), (18), and (19) above. In addition, I accept the possiblility that another constraint (or constraints) are active in Latvian in place of the troublesome ALIGNEDGE, especially considering the lack of attested forms in the language that have the stress pattern (˘ ˘) ˘ (˘ ˘). This warrants further investigation.[17]

In the last section of this Chapter, I turn to an OT account of the observed voiceless obstruent lengthening, discussed in Chapter 3, and investigated empirically in section 4.2 above.

4.6.3 An OT account of phonetic consonant lengthening

As discussed in Chapter 3, the phonetic lengthening of a consonant following stress has the effect of creating an ambisyllabic consonant (see Liepa, 1968). The relevant data, shown as (25) in Chapter 3, are repeated below as (58) for convenience.

[17] As pointed out to me by Anthony Kroch, it is interesting to note that the apparent "split" in the metrical system between long and short words in a rule-based analysis (see above) is in a sense mirrored in the OT analysis by the necessity of positing a constraint such as ALIGNEDGE. The stress patterns in the words *(lá).(bì:.ba)* and *(lá.si:).(šà.na)* are simply problematic for a phonological analysis of the stress pattern of Latvian.

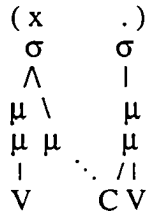
(58) Phonetically lengthened obstruents and lexical geminates with their syllabification following Liepa (1968) and Laua (1969)

underlying form	syllabification	gloss
a. upe	up.pe	'river'
b. aka	ak.ka	'water well'
c. ritms	rit.tms	'rhythm'
d. katls	kat.tls	'pot'
e. kanna	kan.na	'can'

From a structural point of view, we know that the /p/ in *upe* is phonemically short from the fact that it surfaces as such in the locative singular *upe:* (section 4.2 above; also Laua, 1969). Similar arguments apply for the other obstruents. The experimental results in section 4.2 above confirm that a phonetic lengthening of a voiceless obstruent takes place between two phonemically short vowels. Lacking any evidence to the contrary, I am also assuming that a similar process also takes place preceding (short) unstressed syllabic resonants, as discussed in Liepa (1968) and Laua (1969).

As discussed in Chapter 3 and illustrated in (9), the ambisyllabic nature of the phonetically lengthened consonants suggests the prosodic representation shown in (59) below.

(59)



As mentioned in Chapter 3 and discussed in greater detail in Chapter 5, only vowels and resonants are individually dominated by a layer 2 mora, since heavy syllables (which attract tone in Latvian) are only those with a long vowel, diphthong, or vowel+resonant nucleus. Thus, the lexically geminate resonant in the word *kanna* 'can' is originally

dominated by a layer 2 mora in the first syllable, as well as the first mora in the second syllable. Indeed, the word surfaces with the level intonation on the first syllable, attesting to the fact that it is interpreted as heavy in the phonological system.

As discussed in Chapter 3, words such as *lapa* 'leaf' and *aka* 'water well' with a phonetically lengthened obstruent are not considered heavy in the language, since these syllables do not attract tone. However, it seems quite clear that the first syllable in these words has two moras, since the obstruents are observed to lengthen as shown in (58) above. If the syllable is considered light in the phonology, where is the second mora of the first syllable coming from?

As indicated above and in Chapter 3, the second mora in the first syllable must be coming from the fact that stressed syllables in Latvian always have two moras on layer 1. Within a rule-based system such as that described above, a word with a light initial syllable such as *lapa* 'leaf' would acquire the second mora in the first syllable from the word layer (see Halle & Vergnaud, 1987; Hayes, 1995). That is, after the creation of the word layer, the second mora would be inserted if the primarily stressed syllable were light. This would allow the lengthening in (58) to occur.

The derivationally-based theory of Lexical Phonology (Kiparsky, 1982, 1985; Mohanan, 1986) makes an insightful distinction between rules which apply lexically, and those which apply postlexically, or on "surface" forms. In the case of obstruent lengthening, an analysis within the framework of Lexical Phonology would state that this is a postlexical process affecting only surface, not underlying, forms after stress has already been determined.

Within an OT analysis, this generalization can be captured by a constraint which guarantees that the stressed syllable has a second mora on layer 1, regardless of the quantity of the syllabic nucleus. Such a constraint is posited in (60). With this constraint,

the phonology does not have to resort to levels of constraint (as opposed to rule) application as in the theory of Lexical Phonology.

(60) HDBIN-1 the heads of feet are binary on layer 1

Just as the SWP, HDBIN-1 requires that heads are "obligatorily branching", although this is required only on the first moraic layer, which is not deterministic for syllabic weight. In order to assure that all stressed syllables have the additional mora on layer 1, the constraint HDBIN-1 must be undominated in Latvian.

The constraint HDBIN-1 raises the issue of how the additional unfilled mora of the stressed syllable is to be filled by segmental material. The first of the constraints to address this is shown in (61), which requires that all mora positions are filled with segmental material.

(61) FILL-M mora positions are filled with segmental material
(see Prince & Smolensky, 1993:25)

This constraint is in effect like Paradis' (1988) *segmental licensing*, which requires that a timing unit be attatched to a segment or else be deleted (see also Buckley, 1994:90), and is practically the opposite of *moraic licensing* (Bagemihl, 1991), which requires all segments to be dominated by a mora. If in a given syllable the nucleus is already dominated by a mora because of FILL-M, the still empty mora will dominate the onset consonant of the second syllable, hence lengthening it phonetically. As discussed below, this constraint is indeed violable.

It is not possible for a vowel in the syllable nucleus to be affected by the mora guaranteed by HDBIN-1, since that mora is by definition found only on the moraic layer 1. In a two-tiered moraic analysis, when [+sonorant] segments (vowels and resonants) head a

mora, they must head a mora on layer 2. We know this because such segments can have a distinctive syllable intonation, as discussed in Chapter 5. In onset position, a consonant does not head the mora; this function is fulfilled by the syllabic nucleus. This generalization is captured in the undominated constraint shown in (62).

(62) SON-HD[M] If heading a mora, a [+son] segment must head a mora on layer 2

The tableau in (63) illustrates how the two undominated constraints HDBIN-1 and SON-HD[M], together with the dominated constraint FILL-M, selects the correct candidate for *mana* 'my'. In the correct surface candidate (63c), the second mora of the first syllable in layer 1 is simply unfilled in the output of this tableau (Prince & Smolensky, 1993).

(63) /mana/	HDBIN-1	SON-HD[M]	FILL-M
a. σ σ Λ | μ | μ μ μ μ / V /| m a n a		* !	
b. σ σ Λ | μ | μ μ μ μ /| \/| m a n a		* !	
c. ☞ σ σ Λ | μ | μ μ μ μ /| /| m a n a			*
d. σ σ / | μ μ μ μ /| /| m a n a	* !		

These constraints still leave it possible for obstruents to be affected by FILL-M. As discussed above in section 4.2, not all obstruents are lengthened phonetically following a stressed syllable. In standard Latvian, only the voiceless obstruents undergo such a lengthening. In order for phonetic lengthening not to affect voiced consonants, a constraint must be posited which prevents segments specified as [+voice] to be geminate (linked to two moras on layer 1). This undominated constraint is shown in (64).[18] It is crucial that [+son] segments are also not redundantly specified for voicing.

(64) *GEMVOI [+voice] segments cannot be geminates

The tableaux in (65) and (66) illustrate the lengthening of a consonant in *lapa* 'leaf', and the non-lengthening of the consonant in *laba* 'good'.

[18] As discussed in Chapter 3, the Tamian dialect (at least around Dundaga) allows for the phonetic lengthening of voiced as well as voiceless obstruents. Hence, this constraint is apparently not active in this dialect. In the High Latvian dialect, there is apparently no lengthening of any consonant following stress between two short vowels. This suggests that the constraint HDBIN-1 is not active in the dialect. Further research on this dialect would be necessary to ascertain the stress patterns encountered there, to see to what extent they are different from standard Latvian.

(65) /lapa/	HDBIN-1	SON-HD[M]	*GEMVOI	FILL-M
a. σ σ Λ | μ i μ μ μ μ / \ / /| l a p a		* !		
b. ☞ σ σ Λ | μ | μ μ μ μ /| \ /| l a p a				
c. σ σ Λ | μ | μ μ μ μ /| /| l a p a				* !
d. σ σ / | μ μ μ μ /| /| l a p a	* !			

(66) /laba/	HDBIN-1	SON-HD[M]	*GEMVOI	FILL-M
a. σ σ Λ | μ | μ μ μ μ / V /| l a b a		* !		
b. σ σ Λ | μ | μ μ μ μ /| \/| l a b a			* !	
c. ☞ σ σ Λ | μ | μ μ μ μ /| /| l a b a				*
d. σ σ / | μ μ μ μ /| /| l a b a	* !			

The fact of the non-lengthening of *p* in words such as *lapa:* 'in the leaf' must also be accounted for. From the constraints discussed above, the *p* would indeed be predicted to lengthen, since otherwise FILL-M would be fatally violated in the first syllable if it were not (see (65) above). An additional constraint must therefore be active in the language prohibiting this.

We know that the word *(lá).(pà:)* has a secondary stress on the second syllable, since it contains a phonemically long vowel and thus would not violate the SWP (see (37) above). We know that any phonetic lengthening of the onset of the second syllable of *(lá).(pà:)* would be taking place across a foot boundary. Itô & Mester (1994) propose the general constraint that prosodic categories have crisp edges, meaning that segmental

material cannot be linked to more than one prosodic category (syllable, foot, etc.). Thus, I propose that the general undominated constraint in (67) is active in Latvian.

(67) CRISPEDGE[F] Feet have crisp edges

The tableau in (68) illustrates how this undominated constraint prevents the incorrect candidate to surface for the word *lapa:*.

(68) /lapa:/	CRISPEDGE [F]	HDBIN-1	SON-HD[M]	*GEMVOI	FILL-M
a. (x) (x) σ σ Λ Λ μ | μμ μ μ μμ / V /V l a p a			* !		
b. (x) (x) σ σ Λ Λ μ | μμ μ μ μμ /| \/V l a p a	* !				
c. ☞ (x) (x) σ σ Λ Λ μ | μμ μ μ μμ /| /V l a p a					*
d. (x) (x) σ σ / Λ μ μμ μ μμ /| /V l a p a		* !			

There is still a potential problem with this analysis. As discussed in section 4.2, phonetic lengthening of voiceless obstruents is expected to take place only between two short syllabic nuclei. Thus, one would not expect phonetic lengthening of the *s* in a word such as *(lá.si:).(šà.na)* 'the reading', since it is followed by a phonemically long vowel. However, the constraint CRISPEDGE[F] would not rule this lengthening out, since there is no foot boundary between the first and second syllable of this word (see above). In (6) above, the word with a phonemically long vowel in the onset of the second syllable which does not exhibit phonetic lengthening of the preceding voiceless obstruent is *saka:pa* 'climbed' (see Appendix C). From the discussion of the metrical structure of Latvian, we know that this word has the metrical structure *(sá).(kà:.pa)*, with a secondary stress on the second syllable. Thus, the non-lengthening of the *k* in this example can be accounted for via the constraint CRISPEDGE[F]. Further experimental work must be conducted to see if there is or is not an observable phonetic lengthening of the onset of the second syllable of a word such as *(lá.si:).(šà.na)* which has no foot boundary separating these syllables. For the present, it follows from this phonological analysis that the *s* in this word could indeed be lengthening phonetically, contrary to the general prediction of Laua (1969). If phonetic investigation shows that this consonant is not lengthening, then another constraint (or constraints) would have to be active in Latvian prohibiting this lengthening.

4.6.4 Conclusion of OT analysis

The above analysis demonstrates that the constraints listed in (69) below are active in generating the observed metrical patterns in Latvian.

(69) The constraint ranking of the Latvian metrical system

Undominated: ALIGN-HEAD, TROCH-FT, PARSE-2, ALIGN-S, HDBIN-1, SON-HD[M], *GEMVOI, CRISPEDGE[F]
Dominated: ALIGN-EDGE >> SWP >> {PARSE-S, COLON}
Dominated but unranked: FILL-M

I now turn to an analysis of the "heavy" syllables in Latvian, and how they are associated with tonal information. The next chapter also discusses the interesting interaction between the metrical system and the tonal system, and how this interaction helps to form the observed phenomena of syllable intonations in Latvian.

Chapter 5

Latvian syllable intonations

Phonological theory can roughly be divided into two complementary areas: theories of representations and theories of rules or derivations (for discussion, see Anderson, 1985; Goldsmith, 1993). Within Generative Phonology, the analysis of tonal phenomena has led to the development of Autosegmental Phonology (Goldsmith, 1976), which posits that different features occupy different autosegmental tiers. One of these tiers is the tonal tier, on which the tonal information of lexical items is encoded. To date, no work within the framework of Autosegmental Phonology has been conducted on the syllable intonations in Latvian. In this chapter, I investigate the phonetic properties of these syllable intonations, and analyze the phonetic results in this broad representational framework within Generative Phonology. The phonological analysis shows an interesting interaction between lexically marked and metrically generated tone, and has implications for the understanding of the historical development of the acute tone from Proto-Baltic to Latvian.

As discussed in Chapter 2, standard Latvian has three possible contrastive syllable intonations on all long syllables: level, falling, and broken. Since these intonations are not written in the orthography, there are only a limited number of sources (besides native speakers) of what intonation(s) is/are found in a given word. The most extensive written source of the syllable intonation patterns is the four-volume Latvian-German dictionary Mühlenbachs (1923-32), which I have relied upon throughout this investigation.[1] While in Riga, I also had the privilege to consult on various occasions with Marta Rudzīte, a leading Latvian philologist/dialectologist. Of course, as indicated in Chapter 2, the intonational patterns which hold in one dialect area do not hold in another. Thus, unless specified

[1] There are also two additional volumes of additions and corrections to the original four.

otherwise, I am here referring to standard Latvian, or the restricted portion of the Middle dialect which still maintains a three-way tonal opposition (see Rudzīte, 1964, 1993).

5.1 Previous research on the Latvian syllable intonations

While a phonological analysis of Latvian syllable intonations within the paradigm of generative linguistics is lacking, there is phonetic description of the patterns along with discussion of these intonations within the broad scope of Baltic philology. The most thorough phonetic investigation of the syllable intonations of standard Latvian to date is Ekblom (1933), who investigates utterances recorded in September of 1926 by Jānis Endzelīns, the Latvian philologist who first described the syllable intonations (Endzelīns, 1899, 1913). Endzelīns grew up in an area of north-central Latvia (just south of Valmiera, see Appendix A) where a three-way distinction among the intonations is maintained. Thus, it must be kept in mind that although Ekblom's subject must have truly kept the three-way distinction among the syllable intonations, he was also acutely aware of them, and could probably enhance them (or alter them) at will.

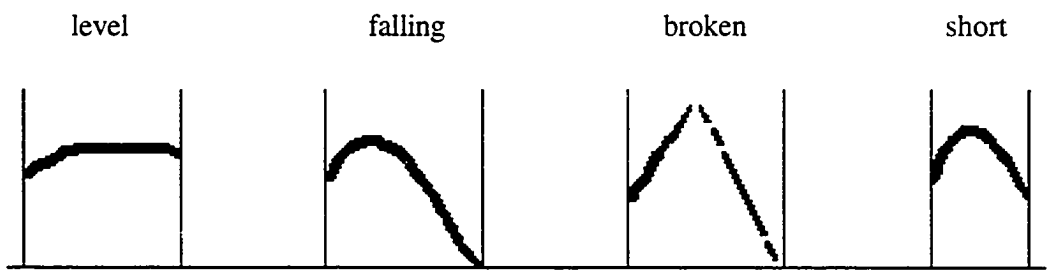
Another, much more limited, phonetic study of just the broken intonation is found in Lehiste (1972). Her study is based upon the speech of the Latvian linguist Valdis Zeps. However, unlike Ekblom's (1933) investigation, Lehiste (1972) focuses on the laryngealization or glottalization of the broken intonation with a comparison of the similar phenomenon of *stød* in Danish.

In the discussion below, I build upon the very broad and thorough phonetic work of Ekblom (1933), adding to the phonetic facts a general phonological interpretation of the phenomenon of the Latvian syllable intonations which to date has not been undertaken.

5.1.1 Tonal curves

All of the F_0 curves of the intonations that Ekblom (1933) describes are characterized by a slight rise in the beginning portion of the syllable. The level intonation maintains a roughly level curve through the end of the syllable, the falling intonation has a fall through the end of the syllable, and the broken intonation has a sharp rise in the beginning of the syllable, followed by a break and a sharp fall through the end of the syllable. In addition, Ekblom (1933:34) shows that a stressed short syllable has a rise towards the middle of the syllable. His summary Figure 110 is represented in (1) below. Lehiste (1972) does not include a discussion of the F_0 curves, writing that "[i]n those parts of the utterances that it could be analyzed, it became clear that the direction of fundamental frequency movement played no part in the realization of the third tone by this speaker".

(1) Tonal characterizations of Latvian syllable intonations following Ekblom (1933:34)



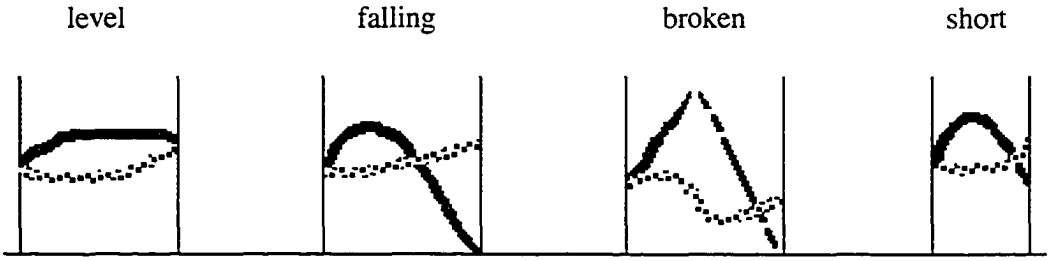
5.1.2 Air pressure

Ekblom (1933:48) finds that oral air pressure patterns roughly follow the tonal curves. That is, as tone increases, so does the pressure, and as tone decreases, the pressure does as well.

5.1.3 Intensity

What Ekblom (1933) describes as the "oral curves" [*Oralkurven*] appears to correspond to signal strength or intensity (amplitude). The patterns described are presented in (2), which is a partial reproduction of Ekblom's (1933:48) summary Figure 123 of the relationship between pressure and intensity. In (2), the dark line is the same tonal curve from (1) (Ekblom describes tone and pressure to be parallel), while the checked line represents signal intensity.

(2) Tonal (solid line) and intensity (dotted line) patterns of the syllable intonations, following Ekblom (1933:48).



As can be seen in (2), the intensity rises slightly for the level, falling, and short intonation, and has a marked decrease with a following rise for the broken intonation. While the tonal curve for all three (four) intonations is distinct, the intensity curve is distinct only for the broken intonation.[2]

[2] While there are only three contrastive syllable intonations in Latvian, Ekblom includes a fourth non-contrastive tone for short or light syllables. The reason may be in order to have a closer parallel with Lithuanian (see Chapter 2).

5.1.4 Segmental duration

Although Ekblom (1933) does not make a strong claim based upon statistical significance, he does describe a general pattern whereby a syllable with the level intonation is longest, followed by one with a falling intonation, with the syllable with the broken intonation having the shortest duration. Some sample words containing the diphthongs /uo/ and /au/ with the corresponding durational values of the intoned long syllable taken from Ekblom (1933) are provided in (3) and (4).

(3)

duration of /uo/ before voiced segment			duration of /uo/ before voiceless segment		
level	falling	broken	level	falling	broken
luode 29.8	ruoba 26.4	luoga 23.9	luoka 22.5	luoka 22.1	duota 23.4
	duobe 32.3	luobu 25.3	kuopa 26.5	tuopu 25.2	
		duoba 30.8			
$\bar{x}$ 29.8	29.4	26.7	24.5	23.7	23.4

source: Ekblom (1933:10)

(4)

duration of /au/ before voiced segment			duration of /au/ before voiceless segment		
level	falling	broken	level	falling	broken
rauga 34.2	bauda 33.3	rauga 25.0	lauka 30.6	tauta 26.7	rauta 25.5
	baudu 33.0	nauda 31.4		lauka 30.2	
$\bar{x}$ 34.2	33.2	28.2	30.6	28.5	25.5

source: Ekblom (1933:11)

The same relationship also holds for the diphthong /ai/. Ekblom (1933) does not provide a statistical analysis of significance on his measurements. Indeed, since he apparently does not have more than one repetition per word, and the environments are not evenly distributed across tokens, any test of significance would be difficult to make. Thus,

the durational differences that he provides can only indicate a general tendency. Note, however, that the differences are not very large.

5.1.5 Summary of previous experimental findings

Of the four characteristics of the syllable intonations that Ekblom (1933) discusses, tone, pressure, intensity, and duration, tone and duration appear to be the easily measurable indicators of distinct differences in the syllable intonations. Each intonation is described as having a distinct tonal curve, and the durations of the intoned syllables are described as having the pattern: level > falling > broken. I therefore turn to a phonetic reanalysis of the tonal and durational patterns described by Ekblom, in order to confirm that the patterns observed in the speech of Jānis Endzelīns 70 years ago still hold today among speakers who are not trained as linguists, and who are generally unaware of the intonational patterns that they are exhibiting.

5.2 A phonetic investigation of the intonational patterns

5.2.1 Experimental design

To acquire data on the syllable intonations of standard Latvian, I traveled to the town of Smiltene in central Vidzeme during the summer of 1995, where works such as Endzelīns (1922) and Rudzīte (1964, 1993) report that there are still speakers who maintain the older three-way syllable intonation distinction. While I interviewed a number of people who lived in the town itself, it was only in the surrounding countryside that I encountered people who maintained an audible three-way intonational contrast. On the whole, the town dwellers appear to maintain only a two-way distinction between a level and a falling

intonation. It is my growing suspicion that the broken intonation is socially stigmatized, and therefore (some) people have a motivation for avoiding its use. This is a topic for future research.[3]

The speakers that I have chosen for investigation come from the countryside immediately outside of the town limits proper. I was introduced to them through some helpful people in the Smiltene County Council, one of whom accompanied me on my first trip. The history of the countryside surrounding Smiltene mirrors that of many other rural areas in the country. Due to the forced collectivization of farms during the Soviet era, and the subsequent disbanding of small private farms, most people living in the countryside today are "newcomers" who have returned to the land to take up private farming, often coming from different parts of the country. The linguistic consequence of this is that the speech patterns can vary from household to household. However, I was able to locate two adjacent farms, where the people that I interviewed had grown up and spent most of their lives.

The first speaker is JP, a 67 year old man who was born on the farm where I interviewed him. His father had acquired the farm during the land reforms of the early 1920's. JP has a 6th grade education, and has spent his life living in his father's farmstead, working as a farmer. The second speaker is DJ, the 51 year old daughter of JP, who also grew up on the same farm, and currently lives about 2 km away on the very outskirts of the town of Smiltene. DJ has a 7th grade education, and has spent her life as a worker in the area. Both JP and DJ were interviewed during midday under generally quiet conditions in the farmhouse where they grew up. The third speaker is SO, a 31 year old woman who grew up and lived in the neighboring farm until she was 17 years old. She

[3] In the town of Alūksne (in the northeastern corner of Latvia, an area which maintains a two-way distinction between the falling and broken intonation), I experienced a crowd's negative response (laughter, whispers, murmuring) to a fifth or sixth grader speaking publicly at his school's last day of classes. The unfortunate boy did not have the "good sense" not to use the broken intonation, as all of his older schoolmates who had spoken before him had done. Perhaps this stigma extends further west into the area surrounding Smiltene.

has a college education as a mathematics teacher, and works in the town of Smiltene. Speaker SO was interviewed at her workplace in her office during her lunch break at work. Although the room was generally quiet, there was occasional noise of automobiles in the courtyard outside of the window. At these times the interview was halted, and restarted once the automobile had left.

All speakers were recorded using the same equipment described in Chapter 4, that is, with a Sony WM-D6C recorder and a Sony ECM-121 stereo microphone on regular magnetic tape. The analysis was also similar, where the signal was digitized at 8,000 Hz and analyzed using the Xwaves acoustic-phonetic analysis program on a Sun workstation. The tonal curves were extracted in Xwaves using a program written by Mark Liberman. The syllable durations were extracted and analyzed in the same manner described in Chapter 4, utilizing the statistical package Splus and a t-test algorithm that I set up in Microsoft Excel. As before, claims of statistical significance are set at the $p<.05$ level.

The interviews consisted of two separate parts. The first part of the interview was conducted in a sociolinguistic style, the goal being to elicit free speech. The second part of the interview is the portion utilized in this study, and consisted of a series of six individual reading tasks, taking from about a half hour to forty-five minutes to read. Portions of two of the reading tasks are analyzed here, and are presented in full in Appendix E. Both of these consisted of various words placed within the carrier phrase shown in (5), repeated six times, and randomized in order. The words under investigation were taken from Mühlenbachs (1923-32), chosen both for the intonational patterns and for maximal sonority. The patterns described in the dictionary were also confirmed by Marta Rudzīte (personal communication) as those that one would expect to hear.[4]

(5) Nu _____ labi lien. 'Well _____ crawls (sounds) good/well'

[4] I of course accept all responsibility for any errors which may be found in the experimental data.

While the carrier phrase is somewhat odd semantically, it was chosen because it consists of all sonorous segments. Once the idea of the phrase was explained, I did not encounter any protestations from the speakers.

Of all of the intonational patterns recorded, I here analyze only words with one syllable intonation (that is, one heavy syllable), both in the primarily stressed position, as well as in a position with secondary stress (see Chapter 4). The analysis of the effect of neighboring syllable intonations must be left for future investigation.

5.2.2 Experimental results

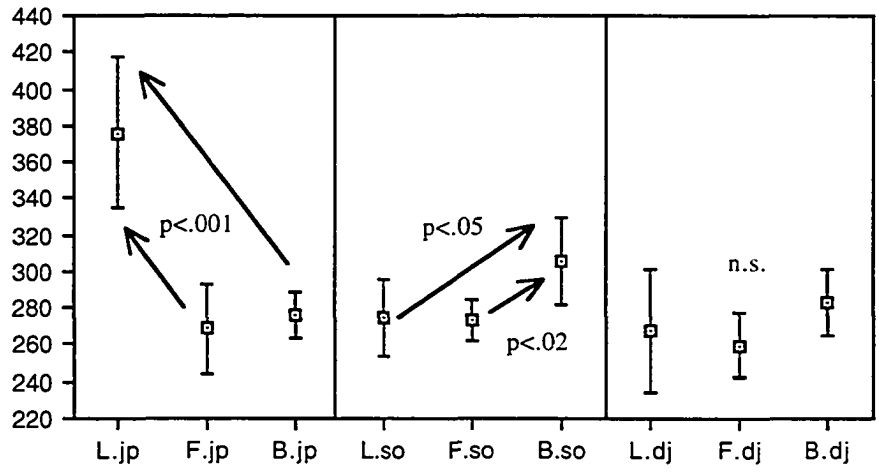
One of the more curious aspects of what I discovered is that under the experimental situation of reading prepared sentences, speaker DJ avoided using the broken intonation which readily occurs in her more casual speech. It is unclear if this was a conscious effort or not. Instead of the broken intonation, she used the falling intonation, as will be seen below. Of the other two speakers, not every instance of the broken intonation was clearly "broken", and sometimes appeared as a simple falling intonation. This could be an indication of the fact that the three-way distinction is indeed disappearing, with speakers replacing the broken intonation with the (similar) falling intonation. A broad-based sociolinguistic investigation would be needed to determine to what extent this is or is not true.

5.2.2.1 Syllable durations

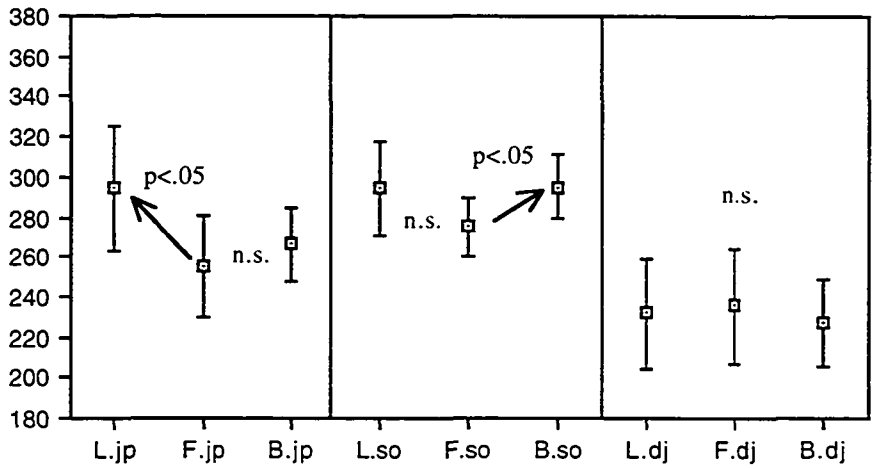
The figures in (6) and (7) below show that there is no consistent pattern across speakers associated with syllable intonation and syllable nucleus duration. For speaker JP, the diphthong /ie/ is significantly longer with a level intonation than with either of the other

two intonations. For the long monophthong /i:/, when it has the level intonation it is significantly longer only than the falling intonation, but not the broken. For speaker SO, the diphthong /ie/ is longest when it has the *broken* intonation. With the long monophthong /i:/, this relationship holds only between the broken and the falling intonation. For speaker DJ, there is no statistically significant distinction between the duration of either syllable nucleus with any of the intonations. The raw data for figures (6) and (7) are provided in (1) and (2) of Appendix F.

(6) Mean duration in milliseconds of /ie/ in *liela* (level), *diena* (falling), and *mieru* (broken) for three speakers. Significant differences are indicated by an arrow.



(7) Mean duration in milliseconds of /i:/ in *mi:ļi* (level), *gri:da* (falling), and *dzi:ve* (broken) for three speakers. Significant differences are indicated by an arrow.



Thus, the conclusion is that although for a given speaker there may be predictable durational differences between the same syllable nucleus with different intonations, there is no observed cross-speaker agreement on the durational relationships between the three syllable intonations. What Ekblom (1933) observed in the durational relationships between the three syllable intonations appears to be an (idiosyncratic?) tendency at best.

5.2.2.2 F_0 curves of intonations in primarily stressed syllables

Unlike the insignificant durational differences between the syllable intonations, there are distinct patterns in the fundamental frequency curves for each syllable intonation. The data in (1) - (3) in Appendix G show the F_0 contours of the phrases including the word *liela* 'large' with the level intonation for all three speakers (six repetitions each). The data in (4) - (6) in Appendix G show the same contour for the phrase including the word *mi:ļi* 'dear', also with the level intonation. Note that for all resulting 36 instances of a syllable

with the level intonation, the F_0 curve is either steady or noticeably rising for all three speakers. Thus, I find that the level intonation is similar to what Ekblom (1933) describes (shown in (1) above), with the difference that the general tendency is more of a rising nature for the intonation than a level one.

The F_0 curves for the falling intonation are provided in (7) - (12) in Appendix G. The two words examined for all three speakers are *diena* 'day' and *gri:da* 'floor'. For all speakers, the falling intonation is characterized by a rise in pitch through about the mid portion of the syllable, followed by a fall in pitch through the end. For speaker SO, the rise in pitch is much sooner, apparently already beginning in the previous syllable *nu* 'well'. These data confirm the finding of Ekblom (1933) for the falling intonation, which is summarized in (1) above.

Finally, the F_0 curves for the broken intonation in the words *mieru* 'peace ACC' and *dzi:ve* 'life' are shown in (13) - (18) in Appendix G. As can be seen in these figures, the broken intonation has a similar F_0 curve to the falling intonation. It differs from the falling intonation in that it also often has a small rise towards the end of the syllable after the fall. However, this does not occur for all tokens for each speaker. Sometimes one hears what sounds like the falling intonation instead of the expected broken.[5] It is also noteworthy that for speaker SO, there is often a dramatic fall-rise towards the end of the target syllable. While JP and SO characteristically have the rise-fall-rise pattern over the syllable, DJ (the daughter of JP) does not. Indeed, her F_0 curves for the broken intonation are not distinguishable from her F_0 curves for the falling intonation. This also matches the perception of the intonations. The lack of difference in F_0 curves corresponds to the lack of an audible distinction between these two intonations in these words. As mentioned above, although DJ does readily use the broken intonation in free speech, she tends not to

[5] Based upon the phonological interpretation to follow, this could be explained as the LH contour on the second mora of the intoned syllable merging phonetically to something like a M (mid) tone. This is a topic for future research.

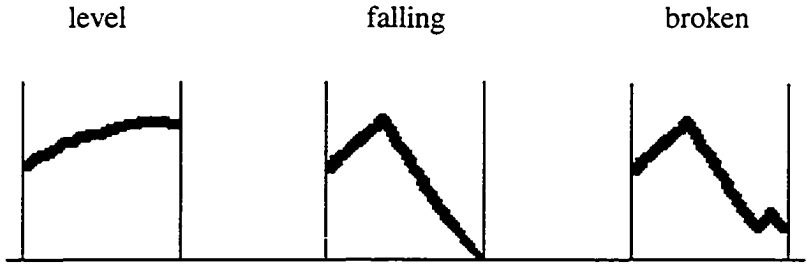
do so on a primarily stressed syllable under experimental conditions. Indeed, in only one instance of a word with primary stress on a syllable with the broken intonation do we find a clear broken tone in the experimental data for DJ: in one repetition of the word *ogai* 'for the berry' with a broken intonation in the first syllable, followed by a falling intonation in the second. This is shown in (19) of Appendix G (the repetition labeled djtr113).

Upon examination of spectrograms of the broken tone made by speakers JP and SO, it becomes clear that there is generally no clear break or stop feature in the vocalic signal during the syllable with the broken intonation. Lehiste (1972) finds that her speaker sometimes includes a glottal stop in the broken intonation, and sometimes has just a laryngealization of the latter part of the syllable. Figures (1) and (2) in Appendix I show spectrograms of the broken intonation of one sample utterance of speakers JP and SO, where the final fall-rise nature of the tonal contour corresponds more to laryngealization rather than a complete glottal closure. According to Ladefoged (1982:129), such a laryngealization commonly occurs in Hausa and other Chadic languages as a contrastive feature. He writes that this is "a very low-pitched sound that occurs at the ends of falling intonations for some speakers of English". However, the "laryngealization" of the broken intonation in Latvian is not a striking feature in the spectrograms shown in Appendix I. As the figures in (3) and (4) of Appendix I show, the spectrograms of the falling intonation are not strikingly different from the spectrograms of the broken intonation. There is much to be gained from a study which compares the broken intonation in Latvian and *stød* in Danish with the apparently similar phenomena occurring in languages such as Hausa, Vietnamese, Burmese, and others (see for example Comrie (ed.) 1990; Cornyn & Roop, 1968; Okell, 1969; Thompson, 1965). However, I leave such a comparative study open for future research.

Thus, while my findings for the level and broken intonation are similar to the F_0 curves described in Ekblom (1933), the broken intonation differs. As shown in (1) above,

Ekblom (1933) describes the broken intonation as having a sharp rise, followed by a break and a sharp fall through the end of the syllable. Instead of this, I find that the broken intonation has no break in the middle, but has a rise, then sharp fall from about the middle of the syllable with a slight rise towards the very end of the syllable. The findings of this investigation are summarized in (8) below.

(8) Characterizations of the three syllable intonations under main word stress



5.2.2.3 F_0 curves of intonations in non-primarily stressed syllables

The data in Appendix H show the F_0 curves for the same three speakers when a syllable intonation occurs in the second syllable of a word, where it is not under primary word stress. Figures (1) - (6) in Appendix H show the tonal contours of phrases containing the words *neliela* 'not large, small' and *deri:ba* 'testament', both of which are said to have a level intonation on the second syllable. Note that in all 36 instances of this intonation, it is always *decreasing* in tone over the duration of the syllable. The peak in the tonal curve occurs over the short stressed syllable, which is not claimed to have any intonation. For speakers JP and DJ, there is only a steady fall throughout the entire syllable. For speaker SO, some instances have either a leveling off or even a slight rise at the end of the syllable. This appears to be attributable to the fact that SO has a marked rise

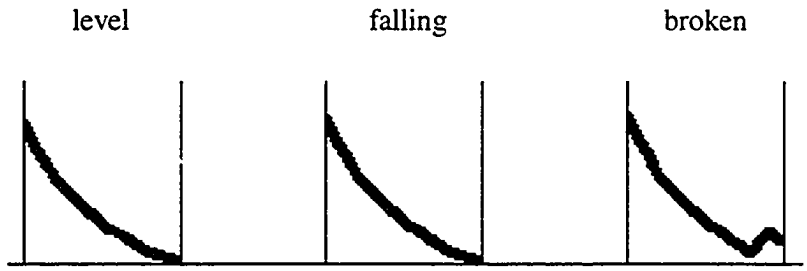
in pitch on the last two words of the phrase *labi lien*, which corresponds to a stress of these words. JP and DJ do not stress the final words in the phrase. Thus, the leveling off or rise of the final portion of the level intonation in second-syllable position for speaker SO appears to be a phrasal effect of the rising pitch towards the next stress on the word *labi*.

Figures (7) - (12) in Appendix H show the tonal contours of phrases containing the words *nediena* 'bad day and *pagri:de* 'underground', both of which have the falling intonation on the second (secondarily stressed) syllable. Again, for speakers JP and DJ, the tone is falling throughout the duration of the target syllable, while for SO (as above) it sometimes levels off or even rises slightly at the end in anticipation of the following stress on the word *labi*.

Finally, figures (13) - (18) in Appendix H show the tonal contours of phrases containing the words *nemieri* 'unrest' and *zini:gi* 'knowingly', with a broken intonation on the second syllable. Again, primary word stress in all of these words occurs on the first syllable. Unlike the level and falling intonation in this non primary-stressed position, these speakers show a slight rise in pitch towards the end of the syllable in many of the tokens, which corresponds to what one hears as a broken syllable. It is most interesting to observe this for speaker DJ, who tends to not distinguish the falling from broken intonation in primarily stressed syllables, but does sometimes make this distinction in non primary-stressed syllables, especially for the word *zini:gi* 'knowingly'. Speaker JP has a broken intonation more often for the word *nemieri* than for the word *zini:gi*. Although speaker SO has a tendency to level off or even slightly increase pitch in the second syllable in anticipation of the rise in pitch of the following word, the words with the broken intonation in the second syllable are markedly different from both the level and falling intonations in this position insofar as there is quite often a dramatic fall-rise towards the end of the syllable, just as she has when the broken syllable occurs in the primary-stress position.

Thus, in non-primary stress position, there is a slight difference in the realization of the syllable intonations. While the falling and broken intonations remain roughly similar in nature, the level intonation becomes practically indistinguishable from the falling intonation. This is summarized in (9) below.

(9) Characterizations of the three syllable intonations in non-primary stressed position



In addition to these facts, it is also noteworthy to note that when a short (light) syllable receives primary word stress, it has a corresponding peak in the F_0 curve. This is illustrated in (10) below, and supports the finding in Ekblom (1933), shown in (1) above. As shown in (19) of Appendix H, this also occurs when the primarily-stressed syllable is in second position.[6]

(10) Characterization of the tonal contour over a light syllable with primary word stress

[6] Figure (19) in Appendix H is one token of the word *nekad* 'never' (with primary stress on the second syllable) placed in the carrier phrase *Ari:* ____ *ir va:rds* 'Also ____ is a word'. The speaker is IL, one of the two informants discussed in Chapter 4.

5.3 Phonological analysis of the phonetic facts

5.3.1 Are the syllable intonations tonal?

In her recent work on the historical development of Latvian phonetics, Rudzīte (1993:99) writes that the syllable intonations are "a change in the intensity and duration of sound in a syllable which is able to differentiate otherwise identical words or forms".[7] Others hold the view that the syllable intonations are tonal in nature. Thus, Sokols *et al.* (1959:66) writes that the syllable intonations are "a peculiar pronunciation or special voice modulation in certain degrees of height [pitch] or loudness over long syllables".[8] Similarly, Laua (1969:109) writes that a syllable intonation is "a voice modulation in the sense of the intensity and tone of the syllable".[9] Endzelīns (1922) also appears to assume that this is a tonal phenomenon, although he does not explicitly say so. Ekblom (1933) and Markus (1994) also discuss in particular the tonal or melodic qualities of the syllable intonations. Markus (1994) even refers to the syllable intonations as "tonemes" (as opposed to a phenomenon describable purely in terms of duration or intensity).

The experimental data provided above, together with the work of Laua (1969), Markus (1994) and others, indicates that the different syllable intonations can indeed be characterized by differences in F_0 or tonal contours. Given this observable phonetic fact, I am assuming that the phenomenon of Latvian syllable intonations can be explained *phonologically* purely in terms of tonal association.

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[7] The translation from Latvian is my own. The original: "Intonācija ir skaņas stipruma un ilguma maiņa zilbē, kas spēj šķirt citādi vienādus vārdus vai formas".

[8] My translation. Original: "...vārda garās zilbes īpatnējā izruna jeb balss modulējums zināmās augstuma vai skaļuma pakāpēs".

[9] My translation. Original: "Par intonāciju sauc balss modulējumu zilbē intensitātes un toņa ziņā".

An alternative view could be that the observed oppositions are a result of differing syllable intensity and duration, as suggested by Rudzīte (1993), who is apparently following the work of Anna Ābele (see Liepa, 1968:324). Indeed, one analysis of the pitch-accent system of neighboring Lithuanian does indeed analyze the phenomenon as stress-based (Halle & Vergnaud, 1987), although a more recent analysis uses a tone-based system (Blevins, 1993). However, a quick view of Appendix G reveals that there are no clear patterns in the amplitudinal curves for each intonation. In addition, figures (6) and (7) above show that there is no statistically significant correlation between syllable intonation and syllable duration which holds across speakers.

Assuming the tonal nature of the phonological structure of Latvian syllable intonations, the array of basic phonological elements at the disposal of an analysis would be the placement of high (H), mid (M), and low (L) tones (see, for example, Goldsmith, 1990). In principle, these tones could be combined in various ways in order to account for the observed patterns.

5.3.2 Stress and edge tones

In the only phonological work on a Baltic language using (aspects of) the Autosegmental approach within Generative Linguistics, the pitch-accents of Lithuanian are analyzed as being H tones lexically associated with moras in the relevant syllables (Blevins, 1993). Since Latvian is so closely related to Lithuanian, it seems feasible to begin with a similar analysis, and see in what ways Latvian differs from Lithuanian. The Lithuanian pitch-accent system requires only a H tone.

Lithuanian is always described as having contrastive contour tones on long stressed syllables, and a non-contrastive accent or tone on short stressed syllables (see, for example, Senn, 1966). Latvian, on the other hand, is only described as having intonations

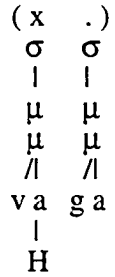
on its long or heavy syllables (see Endzelīns, 1922). The "short" accent discussed in Ekblom (1933) is included more for the sake of thoroughness than for the sake of adding a fourth contrastive syllable intonation. Whatever tonal contour exists over short stressed syllables is not considered relevant to accounting for the syllable intonational system.

However, as discussed above, if a light syllable receives a prominent word stress, there is a noticeable rise in pitch over that syllable in relation to the other (unstressed) syllables. This occurs regardless of whether the stressed syllable is at the left edge of the word or not. Ekblom (1933:29) notes the same phonetic rise in pitch over a short stressed vowel. What has not been considered is that this rise in pitch associated with stress could be interacting in any way with the phonologically (or lexically) determined tonal contours over the heavy syllables. Thus, light-syllabled words with primary stress on either the first or second syllable arguably have representations such as those indicated in (11) below. Following Hayes (1995), the stress-bearing unit here is the syllable. The H tone in (11) would be associated with the first (in this case, only) mora of the primarily stressed syllable.[10] For practical purposes of displaying the metrical, tonal, and segmental structures in these words, the H tone association line is drawn to the vowel segment, and not to the mora, where it is actually attached. In Latvian, primary word stress is associated with a H tone. Indeed, as will be shown below, this metrical H tone is what is responsible for the initial rise in pitch of all of the intonational contours illustrated in (8) above.

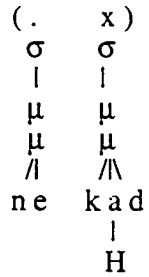
[10] Remember that as indicated in Chapter 4, the stressed syllable would indeed have a second mora associated with it, which is simply unfilled in the output, and is therefore not present in these representations.

(11) Phonological representations of the words *vaga* 'furrow' (primary stress on the first syllable) and *nekad* 'never' (primary stress on the second syllable)

a.



b.

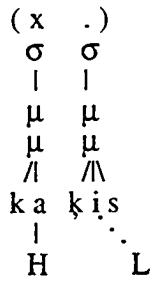


The fundamental frequency curves in 5.2 above support this phonological analysis, since a primarily stressed syllable does indeed have a marked rise in pitch when compared to the neighboring syllables. However, as seen in Appendixes G and H, there is also a noticeable drop in frequency following the primarily stressed syllable. If there is a H tone associated with the primarily stressed syllable, then there must be a L tone associated with the word (or phrase) edge. This addition is illustrated in (12) below. Note that figure (19) in Appendix H of the word *nekád* does indeed have a sharp decline over the stressed syllable from a peak at the beginning, as predicted in (12b) below.

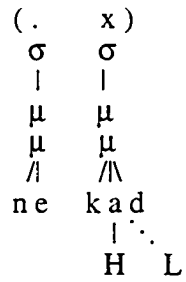
Further investigation would be needed to determine whether the L tone shown in (12) is a word-level phenomenon or phrase-level phenomenon (or perhaps both). Revealing data could consist of a phrase containing a phrase-final falling intonation vs. a phrase-final level intonation (see below on the phonological interpretation of the falling and level intonations). If the L tone is a phrasal-level phenomenon, one could expect the lexically marked falling intonation to fall more abruptly in pitch than the phrasally marked level intonation. However, if the L tone is a word-level phenomenon, one could expect to find a similar decline in pitch for both intonations. I leave such an investigation for future research.

(12) Boundary L tone association

a.



b.



The evidence for the L tone being a phrasal tone is that, generally speaking, phrases also end with a decrease in pitch, as can be seen in Appendixes G and H. Research on phrasal-level tonal phenomena would be needed to shed more light on this issue. If the phonological phrase consists solely of, or ends with, the phonological word, then it seems that the L tone will occur at the end of the phonological word.

The association of a H tone with the syllable receiving metrical prominence helps to provide a phonological explanation of the fact that for many speakers, there are no tonal contrasts to be found in non primary-stressed syllables (see Endzelīns, 1922). Namely, the H stress tone provides the rise in pitch which is required for the (latent) intonation contours to be realized. Without the rise in pitch, there is not enough frequency range within which to make contrasts.

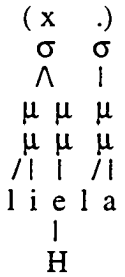
While the H and L tones in (12) above do not appear to be part of the lexical representation of Latvian words, the tones associated with the syllable intonations on heavy syllables must be: the syllable intonations are in no way predictable based upon metrical, phonological, morphological or syntactic structure. They are as (synchronically) unpredictable as an initial /p/ vs. an initial /g/ in a given word. I turn now to a phonological analysis of the distinctive syllable intonations, and how the metrical/phrasal tones interact with the lexically specified tones.

5.3.3 The syllable intonations

5.3.3.1 The level intonation

As noted in section 5.2, when under primary word stress, the level intonation is marked by either a gradually rising or level tone over the duration of the intoned syllable. This could be represented in two ways, as illustrated for the word *liela* 'large' in (13) below.

(13) Possible lexical representations of the level intonation

a.


b.


In (13a), the level intonation is interpreted as a H tone associated with the second mora of the first syllable. Given the tendency for this intonation to rise towards the end of the stated syllable, this seems to be empirically plausible. In (13b), there is no lexically marked tone. This representation in effect states that the level tone is the unmarked or default case. As shown in (15), the H tone for (13b) would come from the metrical structure, rather than being lexically specified. I am assuming that the metrical H tone (which is "free" from the lexical representation) docks on the rightmost free mora of the

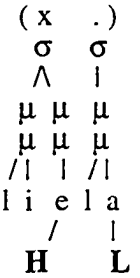
stressed syllable.[11] This generalization can be captured in the constraint shown in (14).[12] The tone bearing unit in Latvian is crucially a mora on layer 2.

(14) RIGHTMOST Free tones (non-lexical) attach to the rightmost free tone bearing unit

(15) Lexical (H) and phrasal/metrical (**H**) tones and the level intonation

a.

b.



Given the representations in (15), only (15b) readily represents the observed facts of the level intonation, since the tonal peak occurs towards the end of the syllable, not in the beginning. Of course, (15a) could be ruled out by the Obligatory Contour Principle (OCP) whereby two successive H tones could not surface next to one another (see Goldsmith, 1976, 1990; Van der Hulst & Smith, 1984). In an OT analysis, the relevant constraint on the surface forms could be that shown in (16).

(16) OCP No adjacent identical tones

---

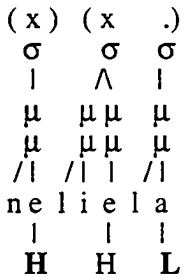
[11] Another approach could be to consider that "free" tones align with domain edges, in which case preference for the left or right edge would also have to be specified (see (15b)).

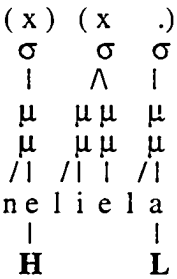
[12] While the lexically specified tonal information presented in this chapter always seems to be on the rightmost mora in Latvian, the "rising" intonation described for the Eastern Latgalian dialect (see Chapter 2) could be an exception. The rising intonation could be interpreted as having a lexical L tone specification on the first mora of the syllable, followed by a metrical H tone on the second mora (see below).

Thus, while the level intonation could indeed have a lexical specification for a H tone on the second mora, the OCP could prohibit that form from surfacing, and instead select the form with only one (metrical) tone.

A consideration of the fundamental frequency of the word *neliela* 'not large, small' in section 5.2 above reveals more on this issue. In this word, the pitch peaks on the stressed short syllable *ne-*, and steadily decreases over the remaining duration of the word. Figure (17) shows the predictions made by both of the representations in (13) above. Remember that any underlying marked syllable intonation would be expected to surface on the stem unchanged, even in a derived form. This stipulation is not difficult to accept, considering that the same phenomenon is observed for the word *deri:ba* 'testament', which also has a level intonation on the second syllable, and is preceded by a stem syllable (not a morphological prefix).

(17) Predictions of tonal association on the word *neliela* 'not large, small', after the inclusion of lexical (H) and phrasal (**L**) tones

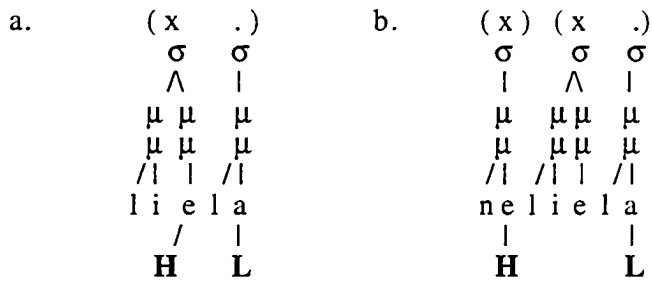
a.


b.


Of the two representations in (17), (17a) would not be expected to surface because of the OCP. Indeed, the observed facts point to the tonal structure in (17b), since the pitch peaks on the stressed first syllable, and there is a steady decline in pitch through the third syllable. As mentioned above, we find that the pitch contour for *neliela* with a level intonation is practically identical with *nediena* with a falling intonation. Thus, the representation of the level tone in (15b) and (17b) appear to be the most accurate. While it could be the case that

the level tone is indeed marked lexically with a H tone on the second mora as shown in (15a) and (17a), the OCP bars such a form from surfacing. Therefore, for the sake of simplicity, it seems possible to omit the underlying H tone in the lexical representation. Figure (18) summarizes the phonological analysis of the level intonation.

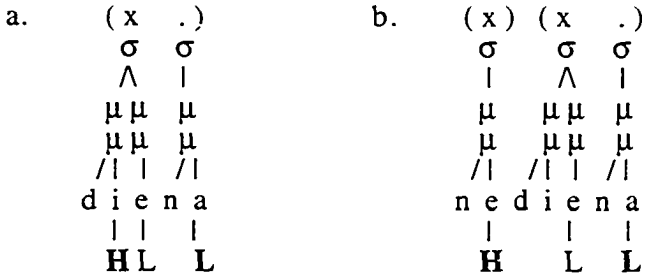
(18) Final analysis of the representation of the level tone in the words *liela* 'large' and *neliela* 'not large, small'



5.3.3.2 The falling intonation

The falling intonation is marked by a gradual decline in pitch over the duration of the intoned syllable (see section 5.2 above). We already know that for a given word, there is a H tone associated with main word stress, and a L tone associated with the right edge of a word (phrase). Unlike the level intonation, the falling intonation appears to have a L tone target on the second mora of the intoned syllable. Thus, the representation of the falling intonation is that shown in (19) below for a word with the intoned syllable in initial and second position. I continue to use **H** as a representation of metrically determined phrasal tone.

(19) Apparent representation of *diena* 'day' and *nediena* 'bad luck' with the falling intonation



The first problem which arises for both of the representations in (19) is that they both violate the OCP constraint by having two successive L tones. However, we know that the representation of the falling tone is different from the level tone, for there is a marked tonal contrast between the two when they are under primary word stress. Given the constraint RIGHTMOST shown in (14) above, we know that there must be a L tone specification on the second mora of the stressed syllable, otherwise the metrical H tone would attach to the (free) second mora of the first syllable, resulting in a perceived level intonation. This points to the existence of another constraint, shown in (20).

(20) MAX-T Every tonal element of the input has a correspondent in the output (see McCarthy & Prince, 1995)

Given the incompatibility of the OCP and MAX-T in (19) above, it must be the case that the relative ranking of the constraints is that shown in (21).

(21) MAX-T >> OCP

The HL sequence on the first syllable of *diena* is what is responsible, then, for the noticeable drop in fundamental frequency, as opposed to the observed steady or rising tone for the level intonation.

Given the observed pitch contours of the level intonation, the undominated constraint MAX-T indicates that the level intonation does not have an underlyingly specified H tone, since it is not observed to surface when the syllable is not under main word stress.

5.3.3.3 The broken intonation

The broken intonation differs from the falling intonation in that, regardless of its relation to main word stress, it always has a slight rise in F_0 towards the very end of the syllable. This corresponds to a characterization of a laryngealization or "creaky voice" element on the latter part of the intoned syllable with the broken intonation (see Ladefoged, 1982; Lehiste, 1972). One way to account for this would be to stipulate that the broken intonation has a L tone associated with it just like the falling intonation, with the addition of some feature such as [laryngeal] present on the second mora of a broken syllable. Such a representation of the word *mieru* 'peace ACC' is provided in (22) below. While this may indeed be the best phonetic characterization of this intonational melody, such a stipulation would not necessarily be part of a phonological representation.

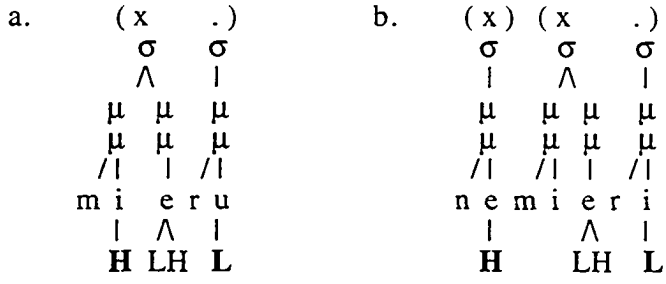
(22) Possible combined tonal and feature representation of *mieru* 'peace ACC' with the broken intonation on the first syllable

The feature analysis of the broken intonation in (22) above misses the phonological nature of the tonal aspect of this phenomenon. While it may be true that the second mora becomes laryngealized, this may indeed be a phonetic repercussion of tonal interaction on the second mora, and not necessarily part of the phonological representation.

If the laryngealization is indeed a phonetic effect of the phonology, then the tonal analysis of the broken intonation must include a H tone responsible for the observed slight rise in pitch towards the end of the syllable. Such a tonal representation of the broken intonation is provided in (23).[13]

[13] While the LH contour over a single mora seems to call for a tonal node (see Chan, 1991; Yip, 1989), I am not including one here for purposes of simplicity. Indeed, since I am not discussing any contour-tone spreading phenomenon, the inclusion or exclusion of a tonal node does not have any visible repercussions in this investigation.

(23) Reanalysis of *mieru* 'peace ACC' and *nemieri* 'unrest' with the broken intonation as a purely tonal phenomenon

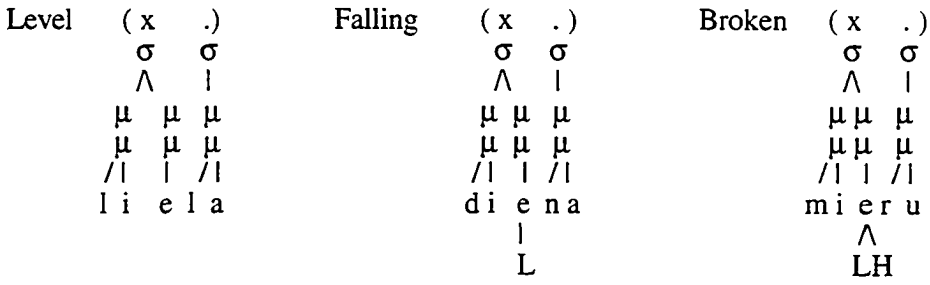


The phonetic interpretation of a LH contour over a single mora is that the pitch drops rapidly to hit a valley before the immediately following H, resulting in a laryngealization of the latter part of the vowel. The pitch contour shows that after the sharp drop in pitch, there is still a slight rise at the very end of the syllable, aiming towards the second H tone. The L tone associated at the word edge, however, causes the pitch to drop once more. Note that for the broken intonation, there is also no violation of the OCP.

5.3.4 Summary of the phonological analysis of the syllable intonations

From a phonological perspective, Latvian has two complementary aspects of tonal information in the representation of words (and phrases). First, as shown above, there are tones associated with the phrasal structure (see Pierrehumbert & Beckman, 1988). The first of these is a H tone associated with the rightmost mora of a primarily stressed syllable. The other is a L tone associated with the phrase boundary (or perhaps word boundary, see above). Second, lexical representations can have their own tonal specifications on the second mora of heavy syllables. A summary of the lexical representations of the syllable intonations is provided in (24) below.

(24) Summary of the lexical tonal specifications for the three Latvian syllable intonations



The prediction that the representations in (24) have is that in a non primarily-stressed syllable (a syllable lacking a metrically induced H tone), the level and falling intonations would not be clearly distinguishable from one another given the word-final L tone. As shown in section 5.2 above, this is indeed what we find. Of these three intonations, only the broken intonation is distinguishable on a syllable lacking primary stress. This is of course due to the fact that the second mora in the syllable has a LH contour, instead of a simple L target at the word edge or the second mora as is the case for the level and falling intonations.

5.4 Implications for arguments of historical development

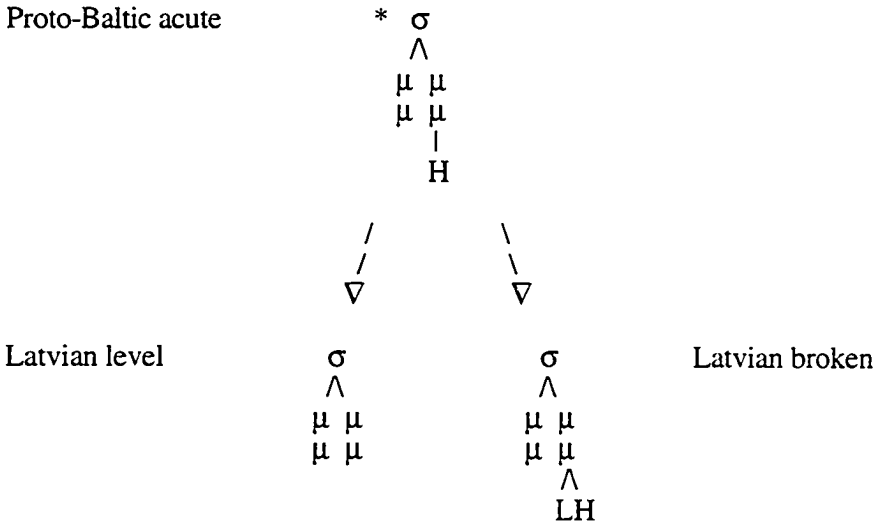
Ekblom (1933) writes that for the broken intonation, his experimental results indicate a sharp rise in the beginning of the syllable, followed by a "break" in the tonal curve, and finally a sharp decline on the latter part of the syllable. He remarks that he has encountered a similar intonation in the northwestern dialects of Lithuanian, which he did not get a chance to investigate experimentally. Ekblom writes that the "break" in the tonal curve is due to the fact that historically, the Baltic acute rose so high that it went off the tonal register of speakers, and consequently "broke" and declined sharply towards the end

of the syllable (p. 65-66). Thus, Ekblom (1933) concludes that the broken intonation in Latvian was indeed originally rising, and became broken over time. He reasons that in Latvian, this became the broken intonation, while in Lithuanian, the falling nature of the (post-broken) intonation was generalized, and the Baltic acute became falling.

A difference in the phonetic findings between this investigation and Ekblom (1933) is that I do not observe a "break" in the tonal curve of the broken intonation at the peak of the tone as Ekblom describes. Instead, the closest thing to a break comes in the very end of the syllable, on what I analyze as the LH contour on the second mora. As mentioned above, Lehiste (1972) does not find the fundamental frequency curves to play any part in the realization of the broken tone.

From an historical perspective, the original Proto-Baltic acute is generally claimed to have been rising (see Endzelīns, 1922; see also the intonations of the conservative Eastern Latgalian dialect, Chapter 2, Table 11). This is similar to what I find for the level intonation described in section 5.2 above. The synchronic analysis of the level intonation in Latvian allows for no lexical specification of tone, since the H tone associated with word stress is enough to account for the observed pattern. However, the uniformitarian principle notwithstanding (see Christy, 1983; Labov, 1994:20-25; Labov, Yaeger, & Steiner, 1972:1), there is nothing which would definitely rule out the possibility that historically, Proto-Baltic acute did indeed have a H tone associated with the second mora of the syllable. A phonological representation of the development of Proto-Baltic acute into the Latvian level and broken intonation (not including the metrical H tone) is thus provided in (25).

(25) Possible "analysis" of a reconstructed rising Proto-Baltic acute syllable and its split into the level and broken tone in Latvian via the traditional analysis (Endzelīns, 1922; Rudzīte, 1993)

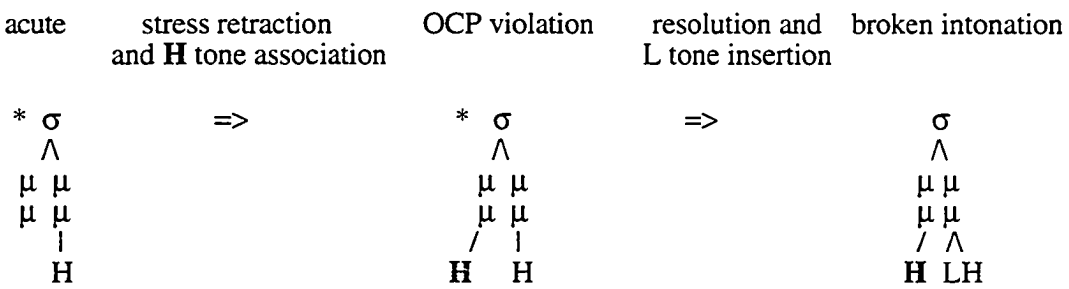


How can this historical change be understood? While Ekblom's (1933) phonetic argumentation is suggestive, the facts of fundamental frequency of the broken intonation that I observe differ from Ekblom's account by not having a "break" at the expected position--at the peak of the pitch contour. Of course, this could be due to an older pronunciation of the broken intonation represented in Ekblom (1933). However, because of the two differing descriptions of the tonal contours over syllables with the broken intonation, a phonetic explanation of the historical split of the Proto-Baltic acute remains unclear. There is, on the other hand, a possible phonological explanation for the development of the acute into the broken intonation.

Figure (26) illustrates the possible historical development of a Proto-Baltic acute syllable into the present-day broken intonation. When primary stress was retracted onto an acute syllable, a *metrical* H tone could have been introduced onto the (still free) first mora of the syllable. This would have lead to an OCP violation, which could be resolved in a

number of ways. One way would be to delete the lexically specified H tone, another way would be to delete the metrical H tone, while a third way would be to introduce an intervening L tone on the second mora.[14] It could be argued that this last possibility is what happened in Latvian: the Latvian broken tone could have arisen out of the Proto-Baltic acute in order to avoid an OCP violation. The lack of lexical representation of the H tone in the level intonation today could also be the result of avoidance of the OCP historically after the time when stress became associated with a H tone.

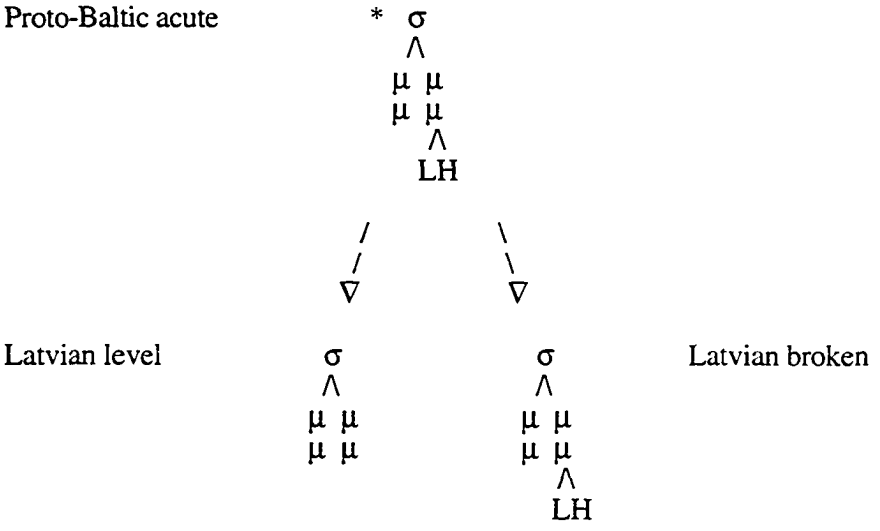
(26) Possible development of Proto-Baltic acute into the Latvian broken intonation



The other view of the development of the broken intonation in Latvian, discussed in Kortlandt (1975) and Young (1994) (here called the "laryngeal" analysis; see Chapter 2) posits that such a split never occurred, since the Proto-Baltic acute *was* originally broken. That is, the Proto-Baltic acute (and hence the Latvian broken tone) is the inherited Indo-European laryngeal. Under the laryngeal analysis, the historical development of the Latvian level and broken is that shown in (27) below.

[14] For discussion of similar strategies in other languages, see Goldsmith (1984) and Odden (1986).

(27) Possible "analysis" of a reconstructed broken Proto-Baltic acute syllable and its split into the level and broken tone in Latvian via the laryngeal analysis (Kortlandt, 1975; Young, 1994)



The principle of Occam's Razor suggests that given two equally plausible alternative analyses, the simplest one should be chosen (see Hock, 1986: 538). However, while the posited historical development in (27) appears to be more simple and straightforward than the traditional explanation in (25), the laryngeal analysis lacks a phonological motivation for the disappearance of the tonal contour in the level intonation. What would motivate the disappearance of the L tone in the LH contour on the second mora of the acute syllable posited in (27)? With the introduction of the H tone associated with main word stress, there would be no OCP violation, since a HLH contour over the duration of the syllable would result.

While it seems clear that there are difficulties with the traditional analysis of the development of the Latvian broken intonation (see especially Steinbergs, 1975), the laryngeal analysis put forth by Kortlandt (1975) and Young (1994) also has its difficulties. For one thing, there is no clear phonological motivation why the laryngeal acute tone would

have developed into the level tone at all. Of course, this analysis cannot be considered a decisive resolution of this issue. What it does, however, is introduce phonological reasoning into the discussion of the historical development of Proto-Baltic acute in Latvian.

5.5 Conclusion

In this Chapter, I have examined the three syllable intonations of standard Latvian. While my phonetic findings are similar to Ekblom (1933), there is one noticeable difference. Whereas Ekblom finds that the broken intonation has a "break" at the tonal peak of the syllable, I find no break there, but instead find a dip-rise tonal pattern at the very end of the syllable. In addition, I examined the realization of the syllable intonations in non-primarily stressed syllables, and find that the level intonation is falling in a non-stressed syllable. What this indicates is an interesting interaction between metrically-induced stress tone and lexically specified tone. The metrical H tone is what is responsible for the (tonally unmarked) rising nature of the level intonation in a primary stressed syllable. Unlike the level intonation, the falling and broken intonations are indeed lexically specified for tone on the second mora of the syllable, with a L and LH tone respectively.

Finally, the phonological analysis of the Latvian syllable intonations provides a reasonable explanation for why the Proto-Baltic acute could have split into the level and broken intonation in Latvian: in order to avoid an OCP violation due to stress retraction and the introduction of a metrical H tone onto the acute syllable. The analysis also suggests that there is little phonological motivation for the view that the Proto-Baltic acute was originally broken (laryngeal), since there is no reason for such an intonation to split into the level and broken intonation in standard Latvian.

While this investigation by no means answers all of the questions concerning the historical development of the Proto-Baltic acute in Latvian, it does introduce a phonological

dimension into our reasoning on this matter which is well grounded in observed phonetic facts.

Chapter 6

Conclusion

In this dissertation, I have provided an original analysis of the prosodic structure of Latvian within the framework of generative linguistics, which in turn provides the linguistic community with an analysis of a language which is somewhere between a pure stress language, a pure tone language, and a language with pitch-accents. It has investigated the interesting interaction between lexically specified tone and metrically specified tone in Latvian, giving in-depth analyses of the syllabic, metrical, and tonal structures of the language.

There are a number of linguistically interesting findings in this dissertation. Among them are the following:

i) A language such as Latvian justifies a two-layer moraic analysis to account for the distinction between heavy syllables which attract tone vs. long syllables which do not.

ii) An OT analysis of the metrical system of Latvian provides for a unified account of the system whereas a rule-based account of the metrical system must settle for a segmented account.

iii) There is an interesting phonetic lengthening of voiceless obstruents following a stressed syllable which can be readily accounted for in an OT analysis, and need not be posited as a specific syllable type.

iv) There is evidence in Latvian suggesting that the prosodic constituent *colon* is found in the hierarchy above the prosodic constituent *foot*.

v) There is no significant correlation between syllable intonations and syllable durations.

vi) The broken intonation is not "broken" at the tonal peak, but instead has a sharp fall with successive rise at the end of the syllable corresponding to a laryngealization of the latter part of the syllable.

vii) Whereas the falling and the broken intonations in Latvian are lexically specified for tone, the level intonation is lexically unspecified for tone.

viii) Lexical tone and metrical tone interact to form distinct intonational contours in stressed and unstressed syllables.

ix) The analysis of the syllable intonations provides a phonological reason for the posited historical split of the Proto-Baltic acute into the level and broken intonations in present-day standard Latvian.

Of course, a number of questions have been raised in this dissertation which require further investigation. The first of these is the visible need to further investigate patterns of syllabification in Latvian. The main question raised on syllabification is: is the constraint of maximizing onsets truly violable as Liepa (1968) suggests? Psycholinguistic evidence could be brought to bear on this issue.

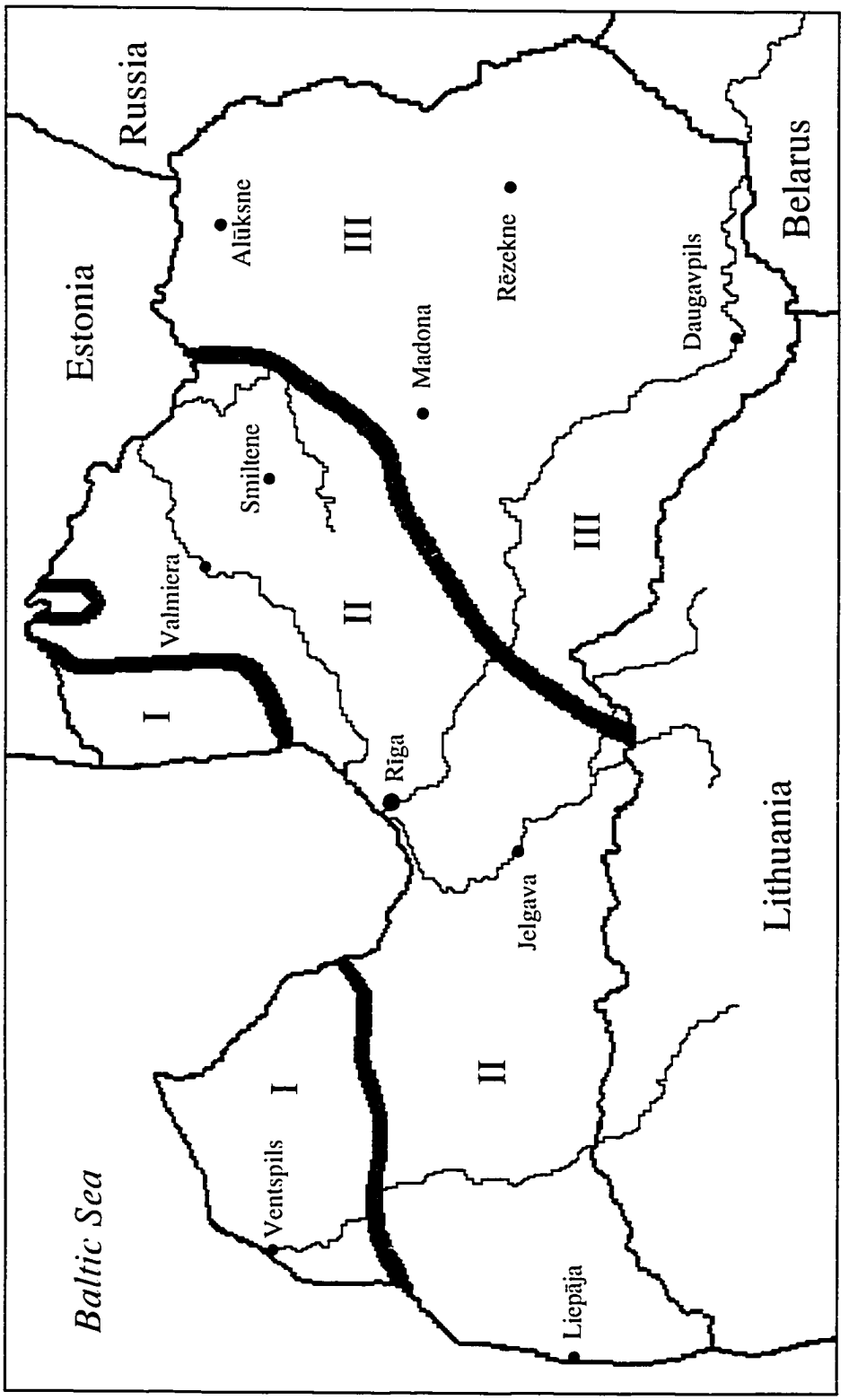
Concerning the phonetic lengthening of voiceless obstruents following stress, various works on the regional dialects of Latvian describe that in some parts of the High Latvian or Latgalian dialect area, the stressed short vowel lengthens instead of the voiceless consonant after the stressed vowel. This is said to occur only before voiceless consonants in some areas, and before all consonants in others (see, for example, Ābele, 1924, 1927; Mengele, 1939; Rudzīte, 1964, 1993; Vīksne, 1937). A dialect in Kurzeme (a Middle dialect area) is also said to lengthen stressed short vowels if the short vowel in the following syllable nucleus is deleted (Senkēviča, 1938). Markus (personal communication) has informed me that in the northeastern corner of Latvia (a High Latvian area), there is also an area where neither the following voiceless consonant nor the stressed vowel lengthens due to stress. All of this raises a number of interesting questions: in the

dialects where stressed short vowels lengthen, does this lengthening still take place if there is a following phonemically long vowel? How is stress realized when the stressed syllable is already long? Does the stressed vowel become overlong? Is there truly no evidence of stress-induced segmental lengthening in the northeastern corner of Latvia?

A number of interesting areas for future research arise in connection with the syllable intonations in Latvian. The first of these would be a more thorough cross-dialectal phonetic/phonological investigation of the syllable intonations to securely establish the patterns in areas outside of the restricted three-way syllable intonation system. Markus (1994), which examines the phonetic aspect of the Latgalian dialect(s), is a step in this direction. Another area for research is the analysis of the interaction of syllable intonations in neighboring syllables. Does the OCP play a role in the realization or non-realization of one intonation next to another?

A third area for future research which is perhaps the most intriguing of all would be an investigation into the similarities and differences of the Latvian broken intonation with Danish *stød* and apparently similar phenomena in Vietnamese, Burmese, Hausa, and other languages. Such an analysis could provide not only a broad-based typological understanding of this phenomenon, but also a better basis by which to judge the phonological interpretation of the Latvian syllable intonations as put forth in this dissertation. Our common goal remains the better understanding of linguistic structure in general. I hope to have provided with this analysis of the prosodic structure of Latvian a solid building block which should help us to better understand the prosodic structure of language.

Appendix A The dialects of Latvia



I = Tamian dialect, II = Middle dialect, III = Latgalian dialect
[adapted from Rūķe-Draviņa (1977:21)]

Appendix B Raw data for durations of /n/ in various positions

1. Mean duration, standard deviation, t-score, and significance level of the duration of *n* in various syllable positions for two speakers of the Riga variety of standard Latvian.

segment 1	$\bar{x}$	stdv	segment 2	$\bar{x}$	stdv	t	d.f.	p<
vanagi (IL)	59.4	12.44	pannina (IL)	146.6	11.93	15.99	18	.001
vanagi (IL)	59.4	12.44	Inga (IL)	131.2	10.25	14.09	18	.001
vanagi (LL)	77	27.33	pannina (LL)	110	48.69	1.87	18	n.s.
vanagi (LL)	77	27.33	Inga (LL)	121.8	46.6	2.62	18	.02
pannina (IL)	146.6	11.93	Inga (IL)	131.2	10.25	3.1	18	.01
pannina (LL)	110	48.69	Inga (LL)	121.8	46.6	0.55	18	n.s.

Appendix C Words investigated in experiment on stress

Part I.

1.	cipari	'numbers'
2.	aplis	'circle'
3.	pasaka	'story'
4.	saka:pa	'climbed'
5.	nepanæsams	'unbearable'
6.	ticami	'believable'
7.	nabagi	'poor'
8.	balodis	'pigeon'
9.	duraki	'fools'
10.	puduri	'clumps'
11.	kakliem	'for the necks'
12.	nepamætams	'not discardable'
13.	nepievædams	'not bringable'
14.	nesalipina:t	'to not paste'
15.	žagata	'magpie'
16.	gabali	'pieces'
17.	zalda:ti	'soldiers'
18.	rætumi	'rarities'
19.	pazare	'lower branches'
20.	vanagi	'hawks'
21.	palagi	'sheets'
22.	lakati	'scarves'
23.	Inga	'Inga'
24.	nesaķærams	'not catchable'
25.	panniņa	'frying pan (dim)'
26.	krelli:tes	'necklace (dim)'
27.	ķerriņa	'wheelbarrow (dim)'
28.	smokinga	'tuxedo's'
29.	katram	'for each'
30.	atduot	'to return'

Part II.

1.	nekád	'never'
2.	likumi	'laws'
3.	li:kumi	'curves'
4.	riteņa	'bicycle's'
5.	ri:teņa	'north wind's'
6.	kapinu	'I chop up'
7.	ka:pinu	'I escalate'
8.	pudeļu	'the bottles''
9.	pu:deļu	'the poodles''

Appendix D Raw data for figures on segmental duration and stress

Figure (2a) Speaker IL; durations of consonants in initial position (p1)

segment 1	$\bar{x}$	stdv	segment 2	$\bar{x}$	stdv	t	d.f..	p<
p1	141.2	29.8	b1	97.6	14.8	4.14	18	.001
t1	144.6	20.5	d1	111.4	15	4.13	18	.001
k1	126.2	12	g1	80.4	13.7	7.97	18	.001
s1	159.6	15.7	z1	107.2	16.2	7.34	18	.001

Figure (2b) Speaker IL; durations of consonants in second position (p2)

segment 1	$\bar{x}$	stdv	segment 2	$\bar{x}$	stdv	t	d.f.	p<
p2	178.8	18.5	b2	80.7	8	15.37	18	.001
t2	174	19.6	d2	68.8	6.7	16.09	18	.001
k2	136.6	12	g2	70.6	8.2	14.41	18	.001
s2	181.6	26.7	z2	101	9.9	8.95	18	.001

Figure (2c) Speaker IL; durations of consonants in initial (p1) vs. second (p2) position

segment 1	$\bar{x}$	stdv	segment 2	$\bar{x}$	stdv	t	d.f.	p<
p1	141.2	29.8	p2	178.8	18.5	3.39	18	.01
b1	97.6	14.8	b2	80.7	8	3.18	18	.01
t1	144.6	20.5	t2	174	19.6	3.28	18	.01
d1	111.4	15	d2	68.8	6.7	8.22	18	.001
k1	126.2	12	k2	136.6	12	1.95	18	NS
g1	80.4	13.7	g2	70.6	8.2	1.95	18	NS
s1	159.6	15.7	s2	181.6	26.7	2.24	18	.05
z1	107.2	16.2	z2	101	9.9	1.03	18	NS
r1	69.2	33.5	r2	26.9	7.3	3.91	18	.002
l1	84.2	19.24	l2	66.6	11.6	2.49	18	.05
n1	80.8	18.5	n2	59.4	12.4	3.04	18	.01

Figure (3a) Speaker LL; durations of consonants in initial position (p1)

segment 1	$\bar{x}$	stdv	segment 2	$\bar{x}$	stdv	t	d.f.	p<
p1	120.2	12.9	b1	89.4	8.8	6.24	18	.001
t1	131	12	d1	106.6	7.83	5.38	18	.001
k1	121.8	10.7	g1	99.4	11	4.62	18	.001
s1	122.6	5.7	z1	100.6	8.2	6.97	18	.001

Figure (3b) Speaker LL; durations of consonants in second position (p2)

segment 1	$\bar{x}$	stdv	segment 2	$\bar{x}$	stdv	t	d.f.	p<
p2	158.8	17	b2	88.4	7	12.13	18	.001
t2	157.4	16	d2	86.8	9.2	12.11	18	.001
k2	141.6	8.21	g2	81.2	6.3	18.5	18	.001
s2	173.8	17	z2	105.6	5.1	12.17	18	.001

Figure (3c) Speaker LL; durations of consonants in initial (p1) vs. second (p2) position

segment 1	$\bar{x}$	stdv	segment 2	$\bar{x}$	stdv	t	d.f.	p<
p1	120.2	12.9	p2	158.8	17	5.73	18	.001
b1	89.4	8.8	b2	88.4	7	0.28	18	NS
t1	131	12	t2	157.4	16	4.17	18	.001
d1	106.6	7.83	d2	86.8	9.2	5.2	18	.001
k1	121.8	10.7	k2	141.6	8.21	4.65	18	.001
g1	99.4	11	g2	81.2	6.3	4.55	18	.001
s1	122.6	5.7	s2	173.8	17	9.06	18	.001
z1	100.6	8.2	z2	105.6	5.1	1.63	18	NS
r1	31.1	9.5	r2	28	7.4	0.82	18	NS
l1	86.8	6.8	l2	77.4	9	2.63	18	.02
n1	90.4	8	n2	83.2	5.7	2.32	18	.05

Figure (4) Speaker IL; duration of /k/ in *kapinu*, *likumi*, and *nekád*

segment 1	$\bar{x}$	stdv	segment 2	$\bar{x}$	stdv	t	d.f.	p<
kapinu	151.2	10.3	nekád	130.6	10.4	4.44	18	.001
likumi	182	15.8	nekád	130.6	10.4	8.61	18	.001
li:kumi	144.2	7.3	nekád	130.6	10.4	3.39	18	.01

Figure (5) Speaker IL; duration of consonant in first and second position before a vowel and in second position before a consonant (pC)

segment 1	$\bar{x}$	stdv	segment 2	$\bar{x}$	stdv	t	d.f.	p<
p1	141.2	29.8	pC	151.2	22.1	0.85	18	NS
p2	178.8	18.5	pC	151.2	22.1	3.03	18	.01
t1	144.6	20.5	tC	130.8	12.2	1.83	18	NS
t2	174	19.6	tC	130.8	12.2	5.92	18	.001
k1	126.2	12	kC	138.8	10.4	2.51	18	.05
k2	136.6	12	kC	138.8	10.4	0.44	18	NS

Figure (6) Speaker IL; duration of consonants in second syllable before and after a long and short vowel

segment 1	$\bar{x}$	stdv	segment 2	$\bar{x}$	stdv	t	d.f.	p<
kV	136.6	12	kVV	120.2	5.1	3.99	18	.002
Vp	178.6	11.5	VVp	131.2	11.6	9.18	18	.001
Vt	179.8	15.1	VVt	131.6	8.3	8.84	18	.001
Vd	71	9.9	VVd	59.6	8.2	2.82	18	.02
Vk	182	15.7	VVk	144.2	7.3	6.89	18	.001

Figure (7a) Speaker IL; duration of vowels in *nesalipina:t*

segment 1	$\bar{x}$	stdv	segment 2	$\bar{x}$	stdv	t	d.f.	p<
e	71.4	11.8	----------	--------	--------	--------	--------	--------
a	40.4	4.9	----------	--------	--------	--------	--------	--------
i3	51.2	8.2	i4	43.3	6.7	2.35	18	.05
a:	156.6	26.6	----------	--------	--------	--------	--------	--------

Figure (7b) Speaker LL; duration of vowels in *nesalipina:t*

segment 1	$\bar{x}$	stdv	segment 2	$\bar{x}$	stdv	t	d.f.	p<
e	79.5	10.1	----------	--------	--------	--------	--------	--------
a	25.4	7.1	----------	--------	--------	--------	--------	--------
i3	36.8	9.5	i4	22.7	8.8	3.34	17	.01
a:	134.1	10.7	----------	--------	--------	--------	--------	--------

Figure (8a) Speaker IL; duration of /p/ in different words and in different positions

segment 1	$\bar{x}$	stdv	segment 2	$\bar{x}$	stdv	t	d.f.	p<
pasaka	141.2	29.8	cipari	178.8	18.5	3.39	18	.01
nepametams	108.8	11.1	nesalipina:t	120.6	12.2	2.27	18	.05

Figure (8b) Speaker LL; duration of /p/ in different words and in different positions

segment 1	$\bar{x}$	stdv	segment 2	$\bar{x}$	stdv	t	d.f.	p<
pasaka	120.2	12.9	cipari	158.8	17	5.73	18	.001
nepametams	115.4	11.1	nesalipina:t	133.1	12	3.41	18	.01

Appendix E Words investigated in experiment on syllable intonation

(1) Words included in list 1.

1.	liẽla	'large'
2.	dièna	'day'
3.	miêru	'peace'
4.	neliẽla	'not large'
5.	nedièna	'bad day'
6.	nemiêri	'unrest'

Other words

7.	gãdãju	'I provided'
8.	mãjã	'in the house'
9.	gãjiêni	'goings'
10.	mĩlîgi	'lovingly'
11.	liẽlaì	'for the big (Fem.)'
12.	mãjaì	'for the house'
13.	ièduõma	'something imagined'
14.	mèlẽ	'in the tongue'
15.	nuògrìeza	'cut off'
16.	mèleì	'for the tongue'
17.	guòdîgi	'honestly'
18.	mìegaîna	'sleepy'
19.	jâjẽji	'the riders'
20.	jaûnã	'in the young'
21.	ârdùrvju	'of the outer door'
22.	uôgaì	'for the berry'
23.	jaûnaûdze	'young trees'
24.	viênâdi	'similar'
25.	ièduõmĩba	'conceit'
26.	nuògãdãju	'I brought over, provided'
27.	ìeduõmaì	'for the imagination'
28.	dàrdzĩbaì	'for the expense'
29.	aìzraĩdît	'to instruct, scold'
30.	ièduõmîgi	'conceitedly'
31.	ièduõmĩbã	'in the conceit'
32.	ièduõmĩbaì	'for the conceit'
33.	ièduõmîgaì	'for the conceited (Fem.)'

(2) Words included in list 2

1.	mĩļi	'loving'
2.	grìda	'floor'
3.	dzîve	'life'
4.	deñība	'testament'
5.	pagrìde	'underground'
6.	zinîgi	'knowingly'

Other words

7.	uguñī	'in the fire'
8.	ģimenèi	'for the family'
9.	nemanît	'to not notice'
10.	varenĩba	'majesty'
11.	vakardìena	'yesterday'
11.	bezdelîga	'sparrow'

Appendix F Raw data for figures on syllable intonation and segmental duration

(1) Duration in milliseconds of the diphthong /ie/ in a primary stressed syllable with a level (L), falling (F), and broken (B) intonation for three speakers.

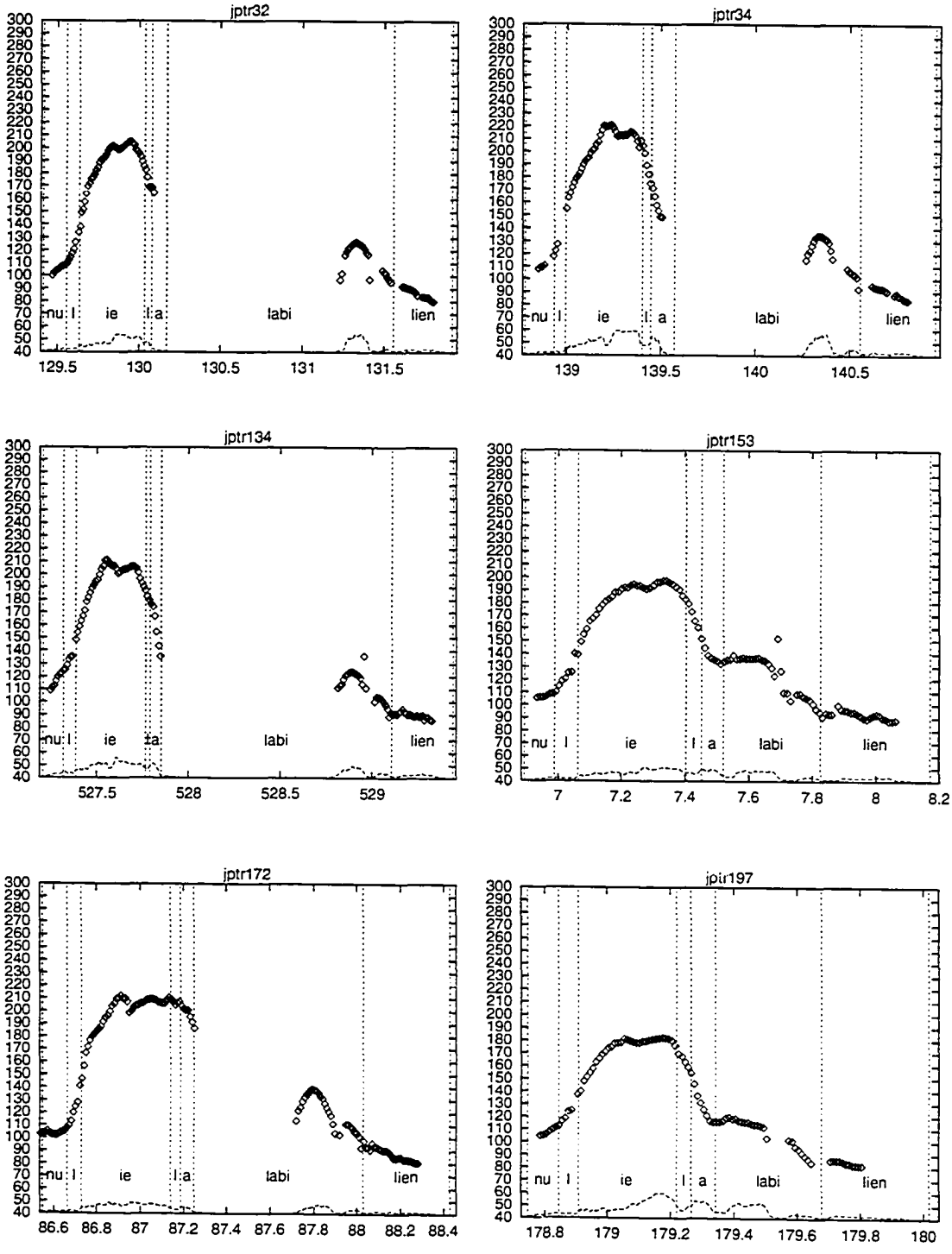
segment 1	$\bar{x}$	stdv	segment 2	$\bar{x}$	stdv	t	d.f.	p<
L.jp	376.06	41.59	F.jp	268.70	24.52	5.45	10	.001
F.jp	268.70	24.52	B.jp	275.74	12.24	0.63	10	n.s.
B.jp	275.74	12.24	L.jp	376.06	41.59	5.67	10	.001
L.so	274.70	21.13	F.so	273.07	11.59	0.17	10	n.s.
F.so	273.07	11.59	B.so	305.51	24.06	2.98	10	.02
B.so	305.51	24.06	L.so	274.70	21.13	2.36	10	.05
L.dj	267.27	33.94	F.dj	259.56	17.59	0.49	10	n.s.
F.dj	259.56	17.59	B.dj	282.65	18.4	2.22	10	n.s.
B.dj	282.65	18.4	L.dj	267.27	33.94	0.92	10	n.s.

(2) Duration in milliseconds of the monophthong /i:/ in a primary stressed syllable with a level (L), falling (F), and broken (B) intonation for three speakers.

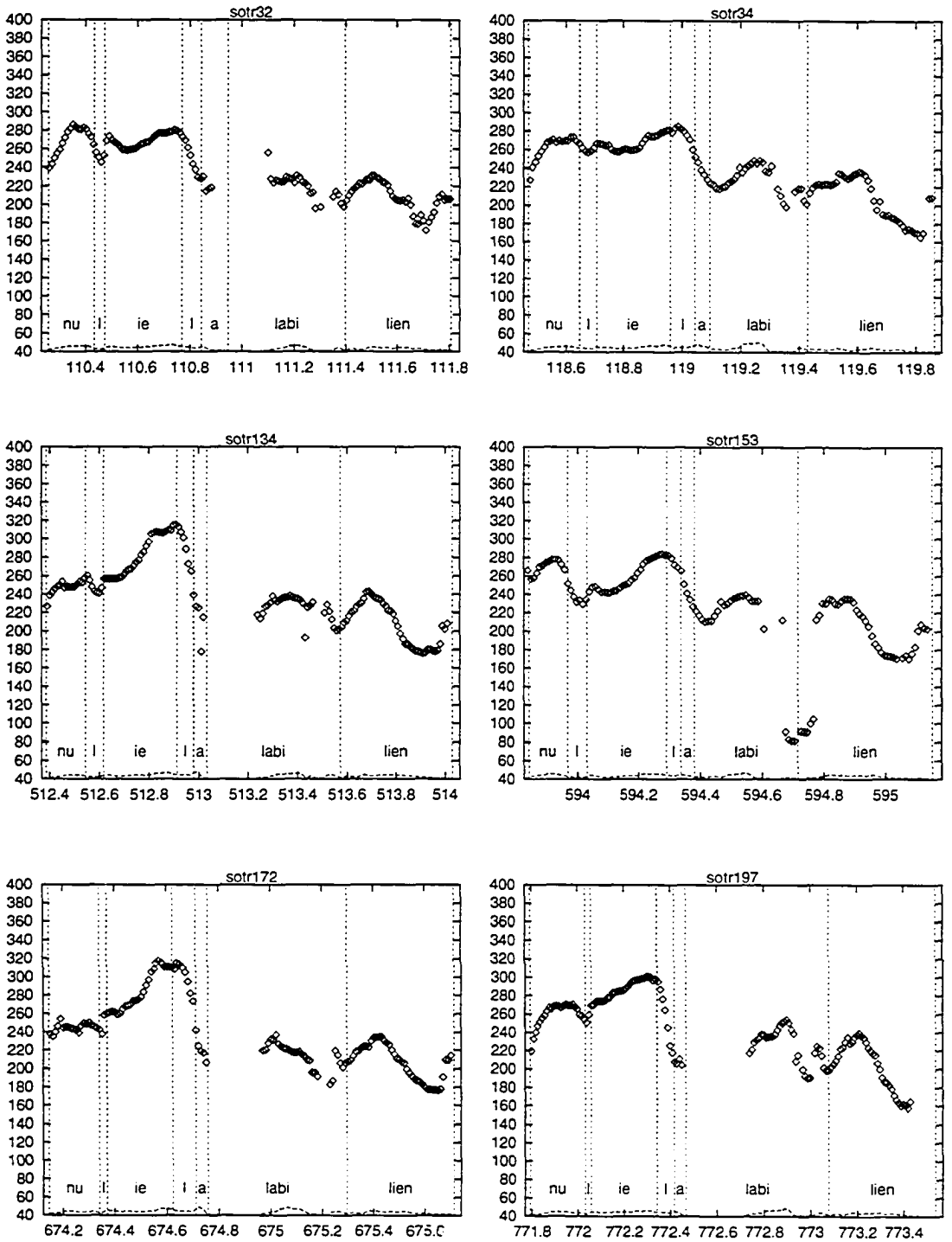
segment 1	$\bar{x}$	stdv	segment 2	$\bar{x}$	stdv	t	d.f.	p<
L.jp	294.26	31.44	F.jp	255.11	25.36	2.37	10	.05
F.jp	255.11	25.36	B.jp	266.15	18.65	0.86	10	n.s.
B.jp	266.15	18.65	L.jp	294.26	31.44	1.88	10	n.s.
L.so	294.28	23.65	F.so	275.11	14.32	1.7	10	n.s.
F.so	275.11	14.32	B.so	294.95	15.72	2.29	10	.05
B.so	294.95	15.72	L.so	294.28	23.65	0.06	10	n.s.
L.dj	231.76	27.21	F.dj	235.60	28.46	0.24	10	n.s.
F.dj	235.60	28.46	B.dj	226.72	21.79	0.61	10	n.s.
B.dj	226.72	21.79	L.dj	231.76	27.21	0.35	10	n.s.

Appendix G Tonal curves for syllable intonations under primary word stress

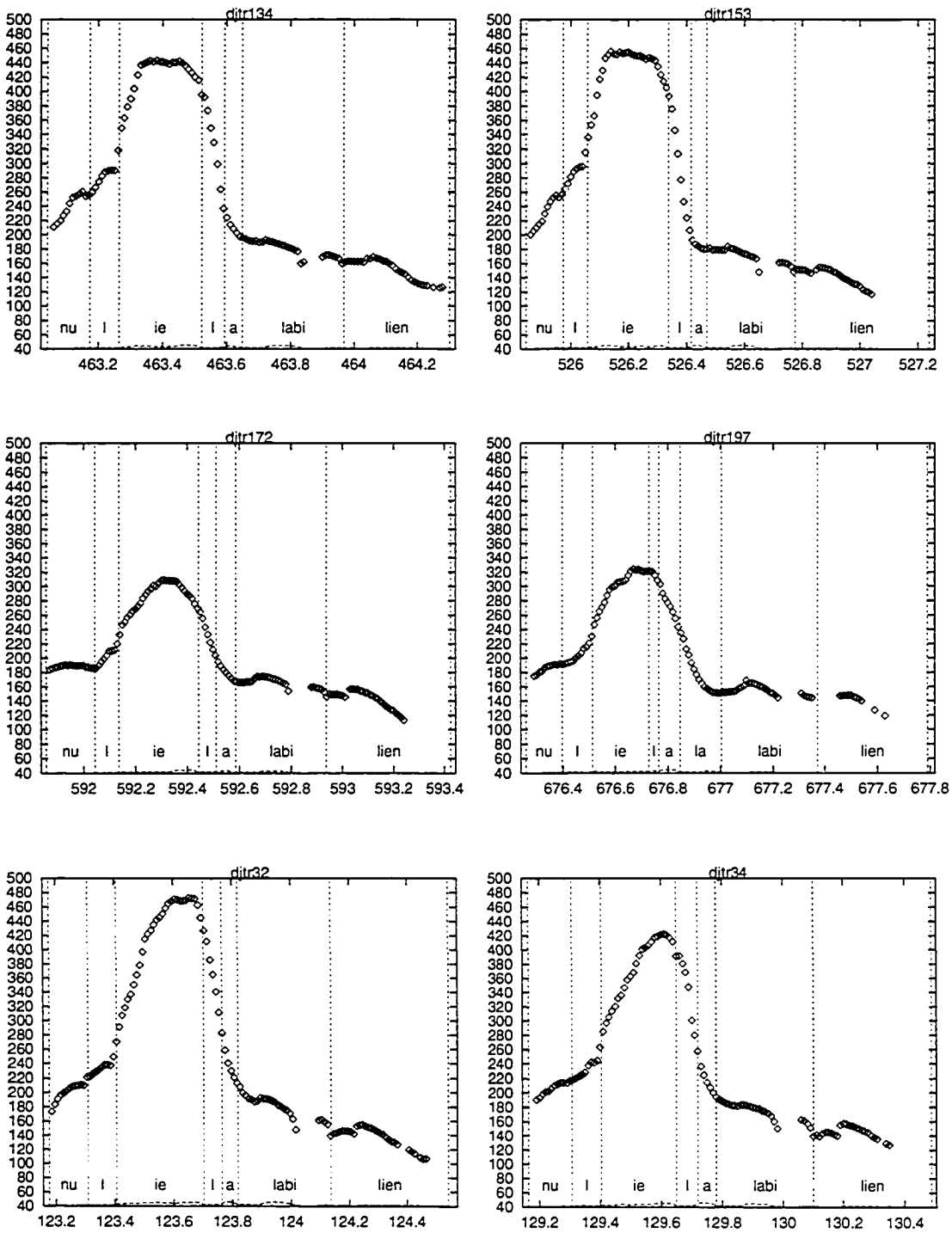
(1) The diphthong /ie/, level intonation, in the word *liela* 'large', speaker JP



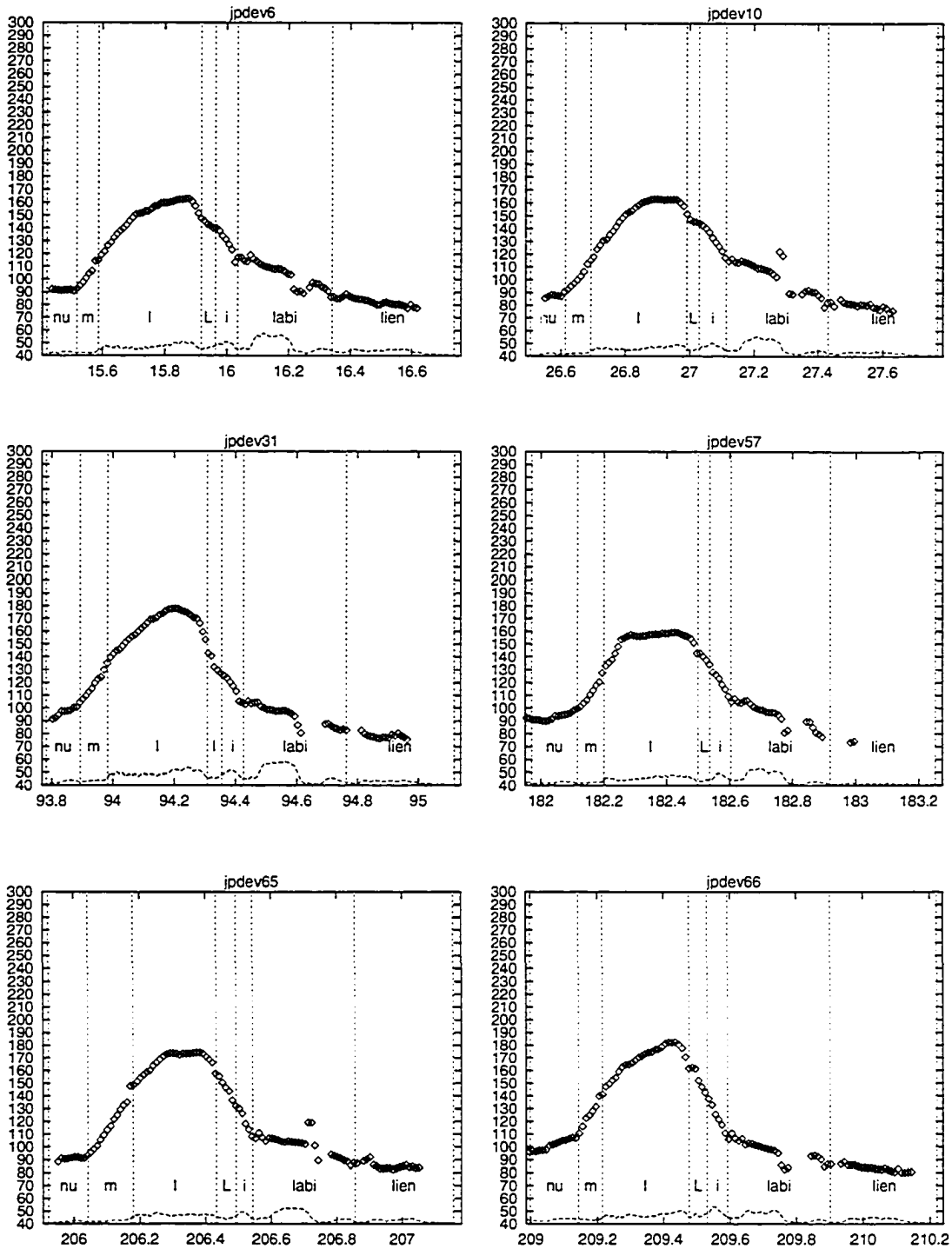
(2) The diphthong /ie/, level intonation, in the word *liela* 'large', speaker SO



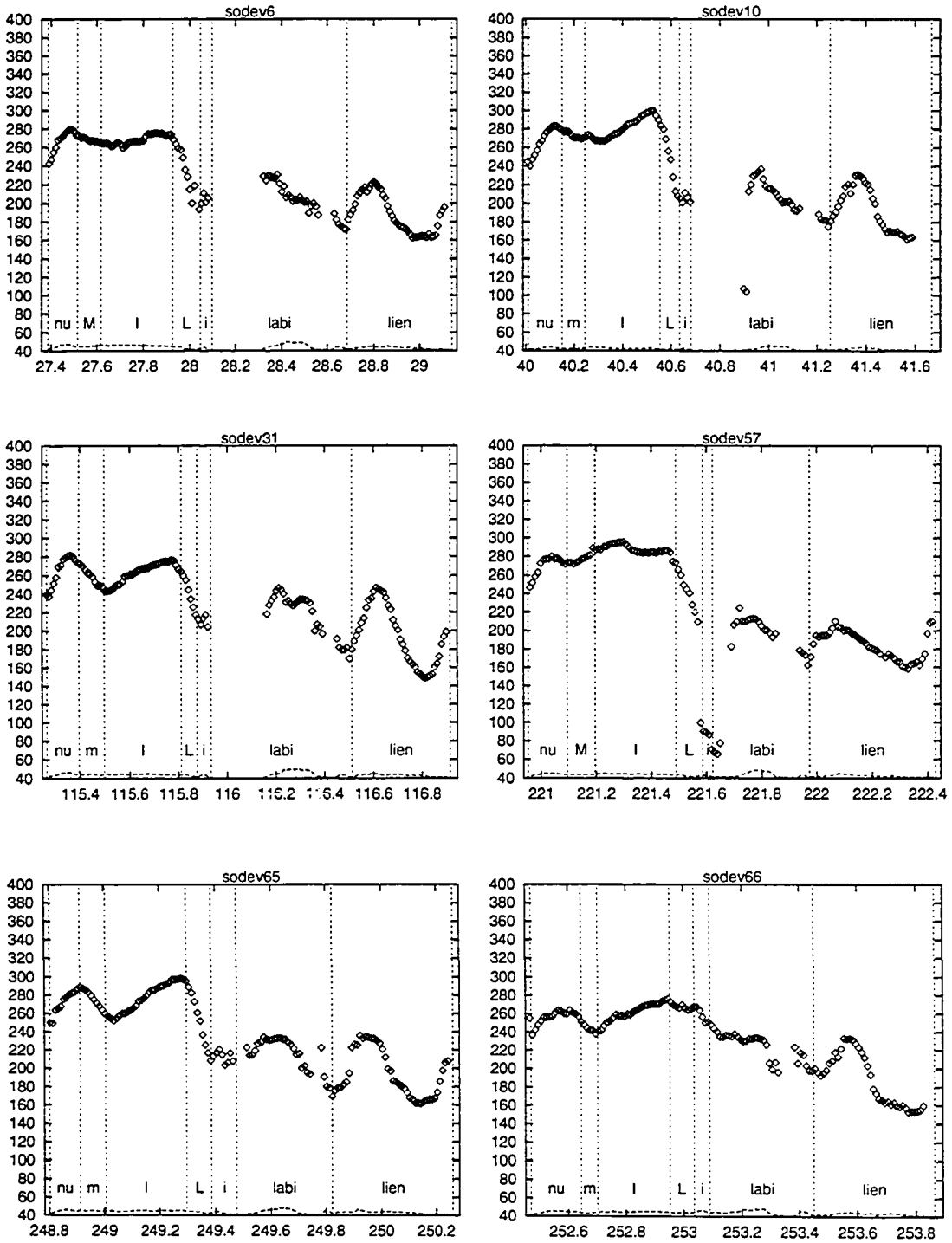
(3) The diphthong /ie/, level intonation, in the word *liela* 'large', speaker DJ



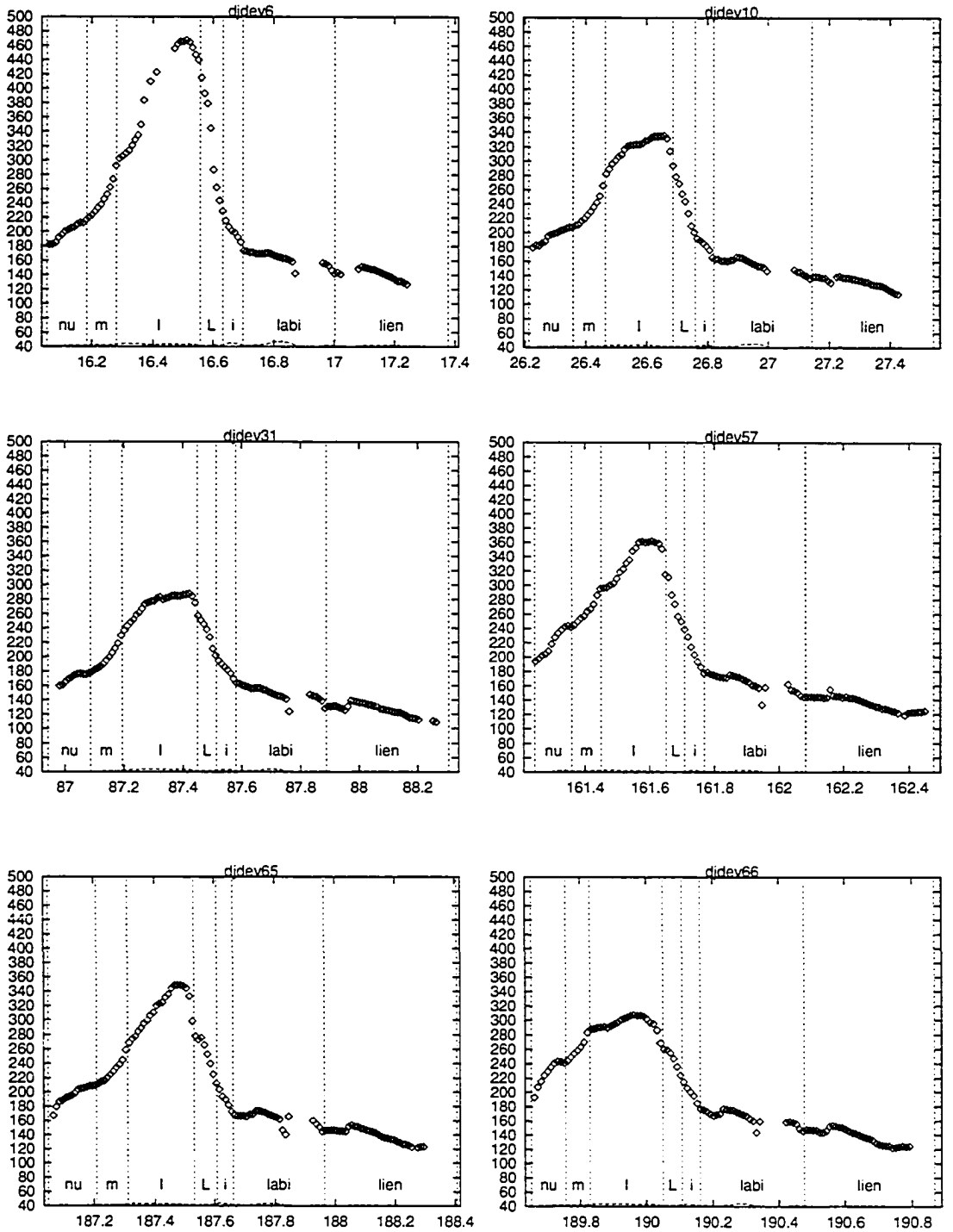
(4) The monophthong /i:/, level intonation, in the word *mi:|i* 'dear', speaker JP



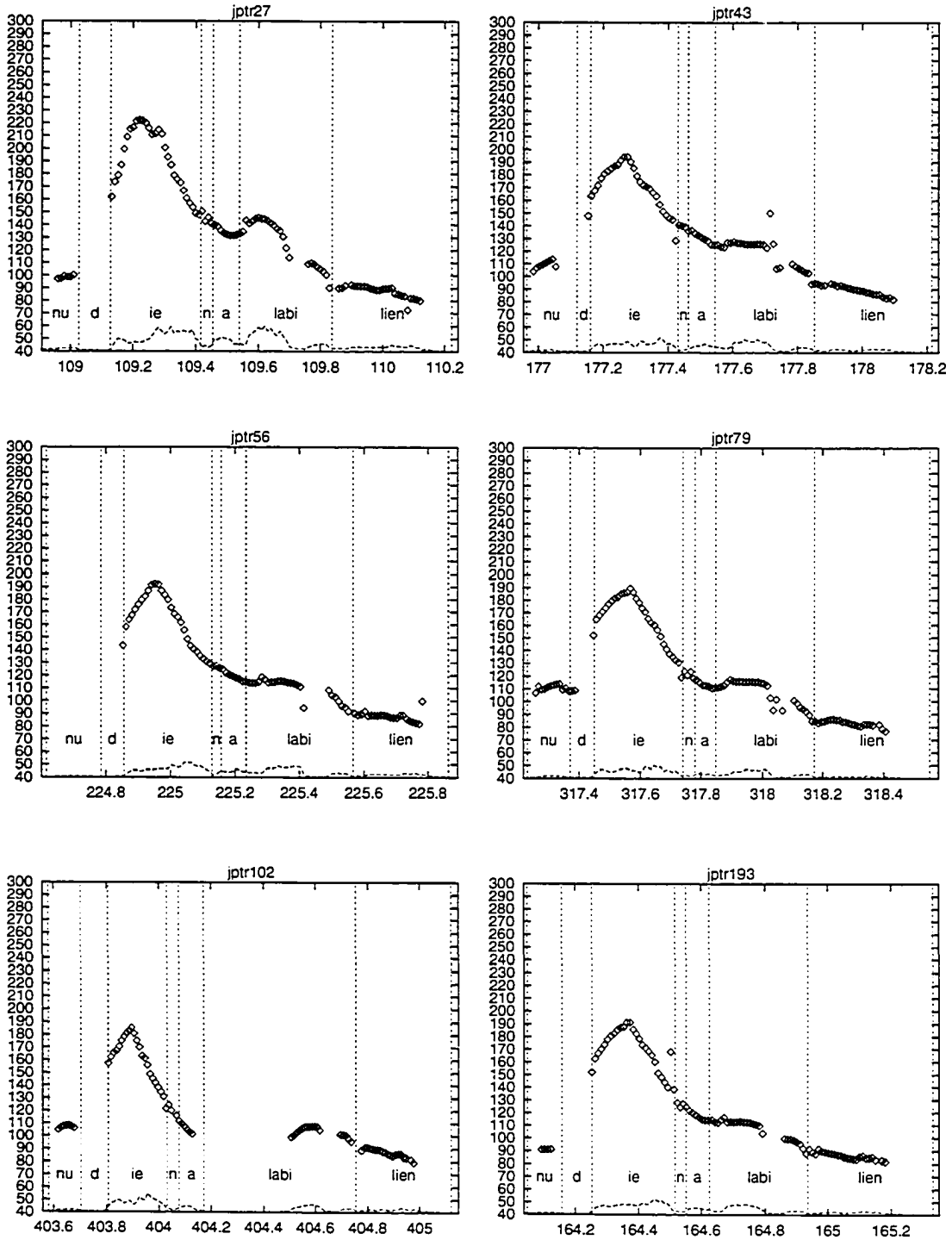
(5) The monophthong /i:/, level intonation, in the word *mi:li* 'dear', speaker SO



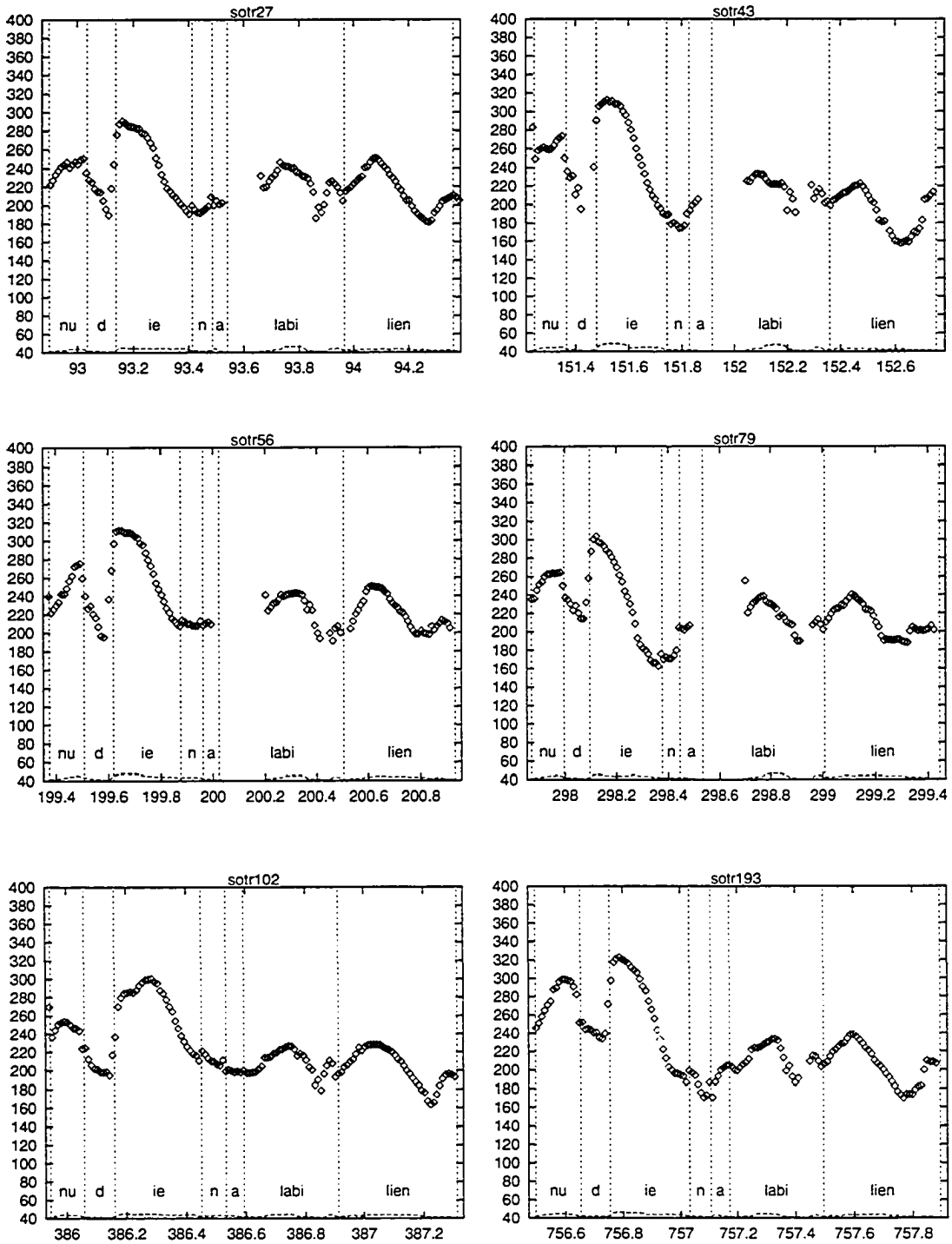
(6) The monophthong /i:/, level intonation, in the word *mi:ʃi* 'dear', speaker DJ



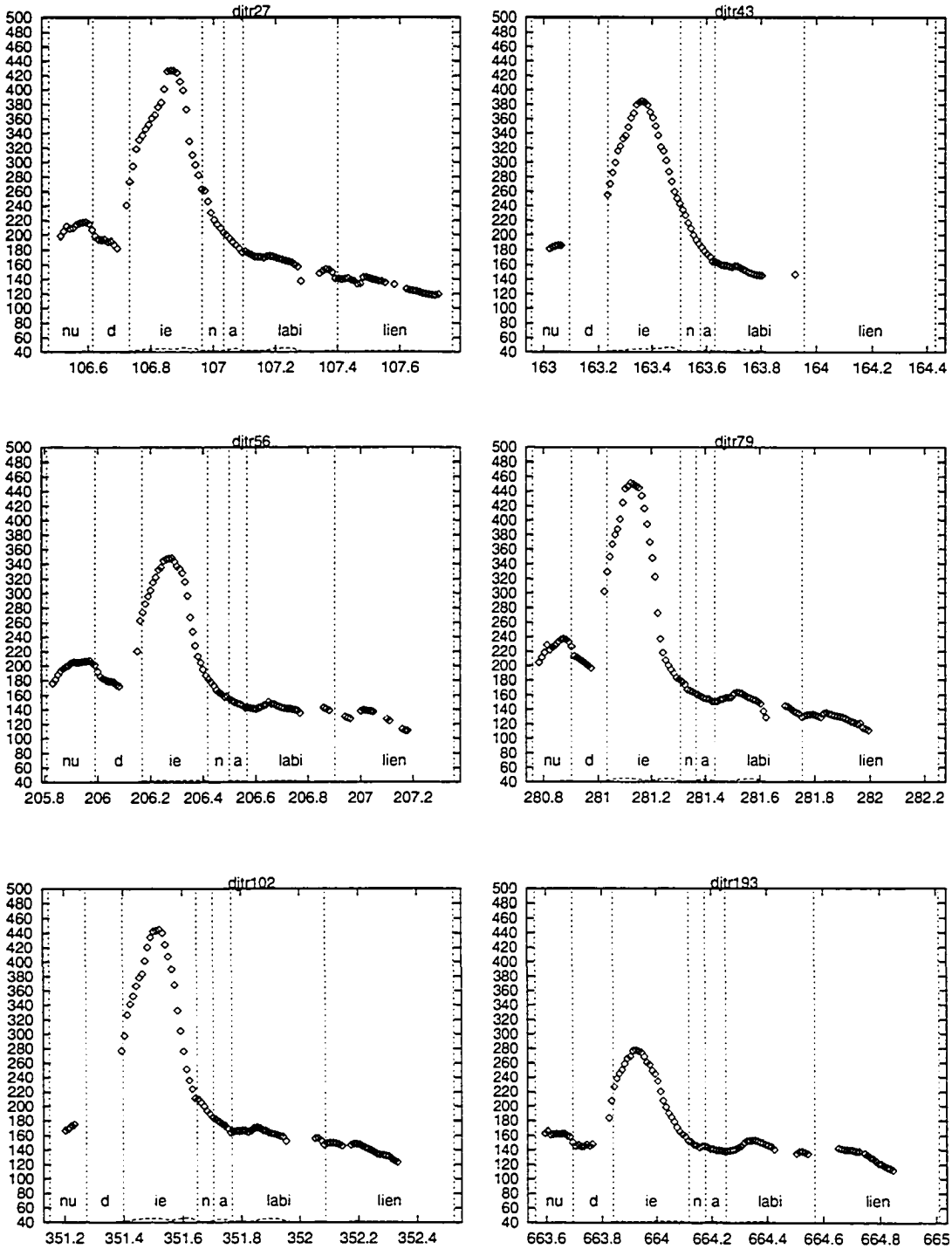
(7) The diphthong /ie/, falling intonation, in the word *diena* 'day', speaker JP



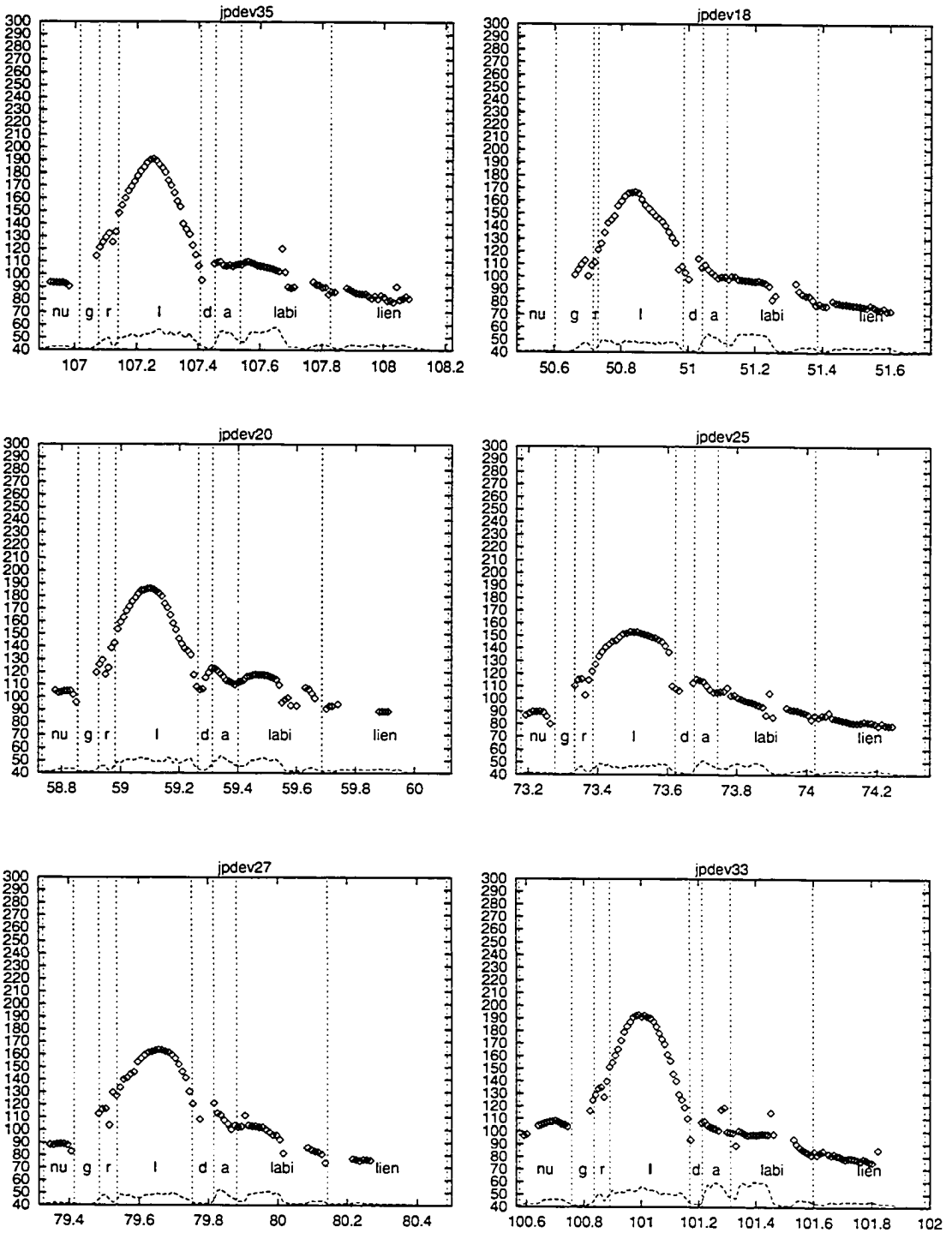
(8) The diphthong /ie/, falling intonation, in the word *diena* 'day', speaker SO



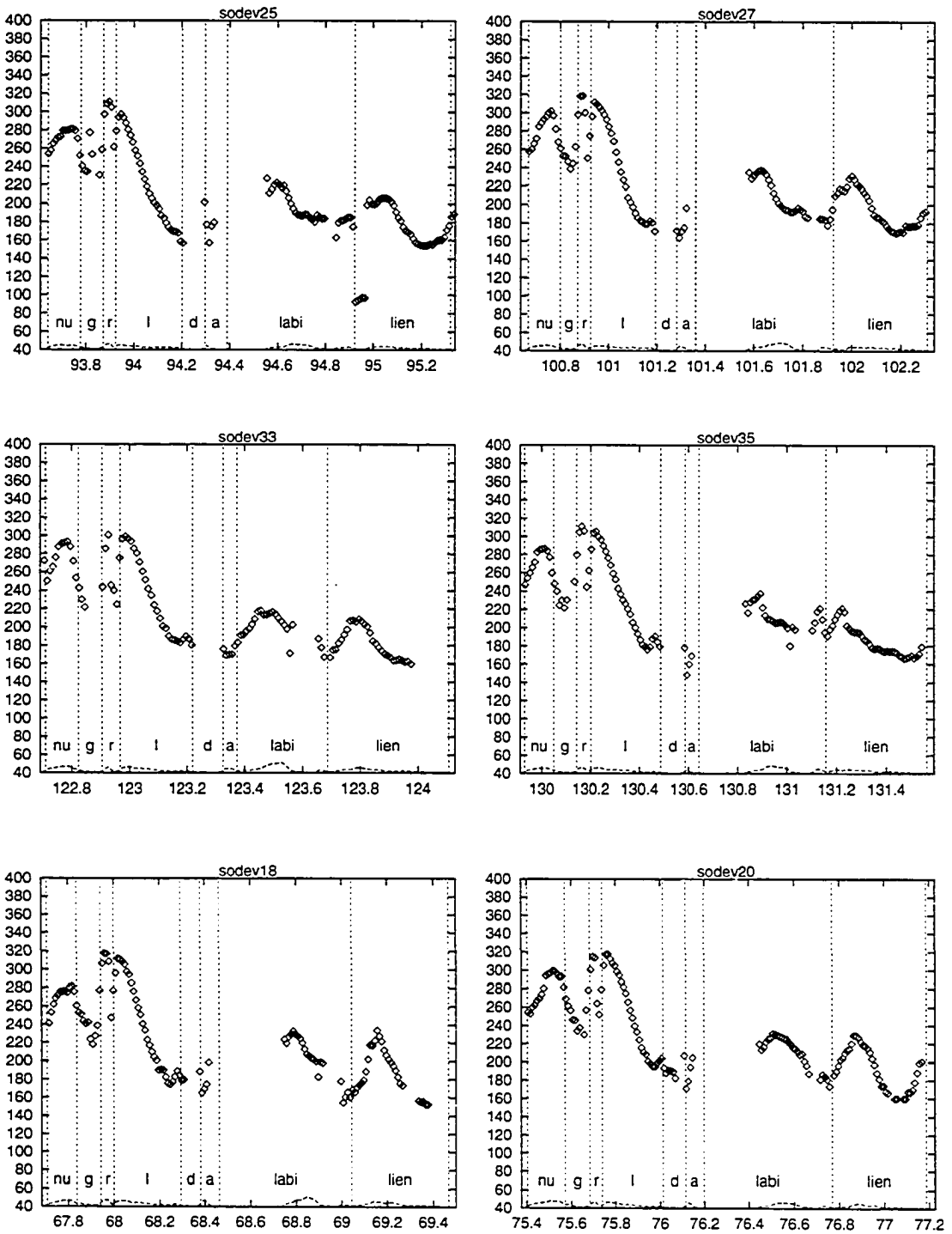
(9) The diphthong /ie/, falling intonation, in the word *diena* 'day', speaker DJ



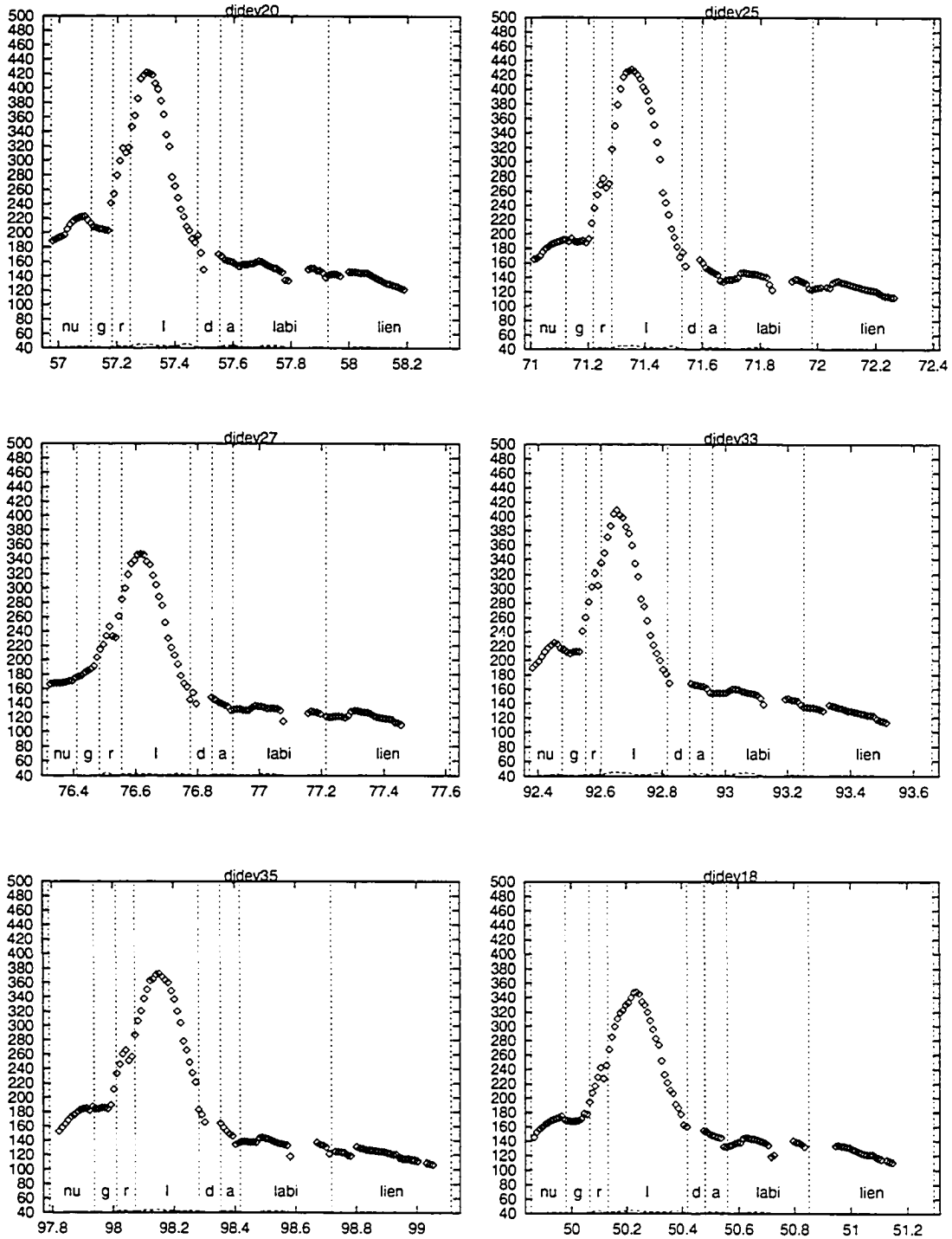
(10) The monophthong /i:/, falling intonation, in the word *gri:da* 'floor', speaker JP



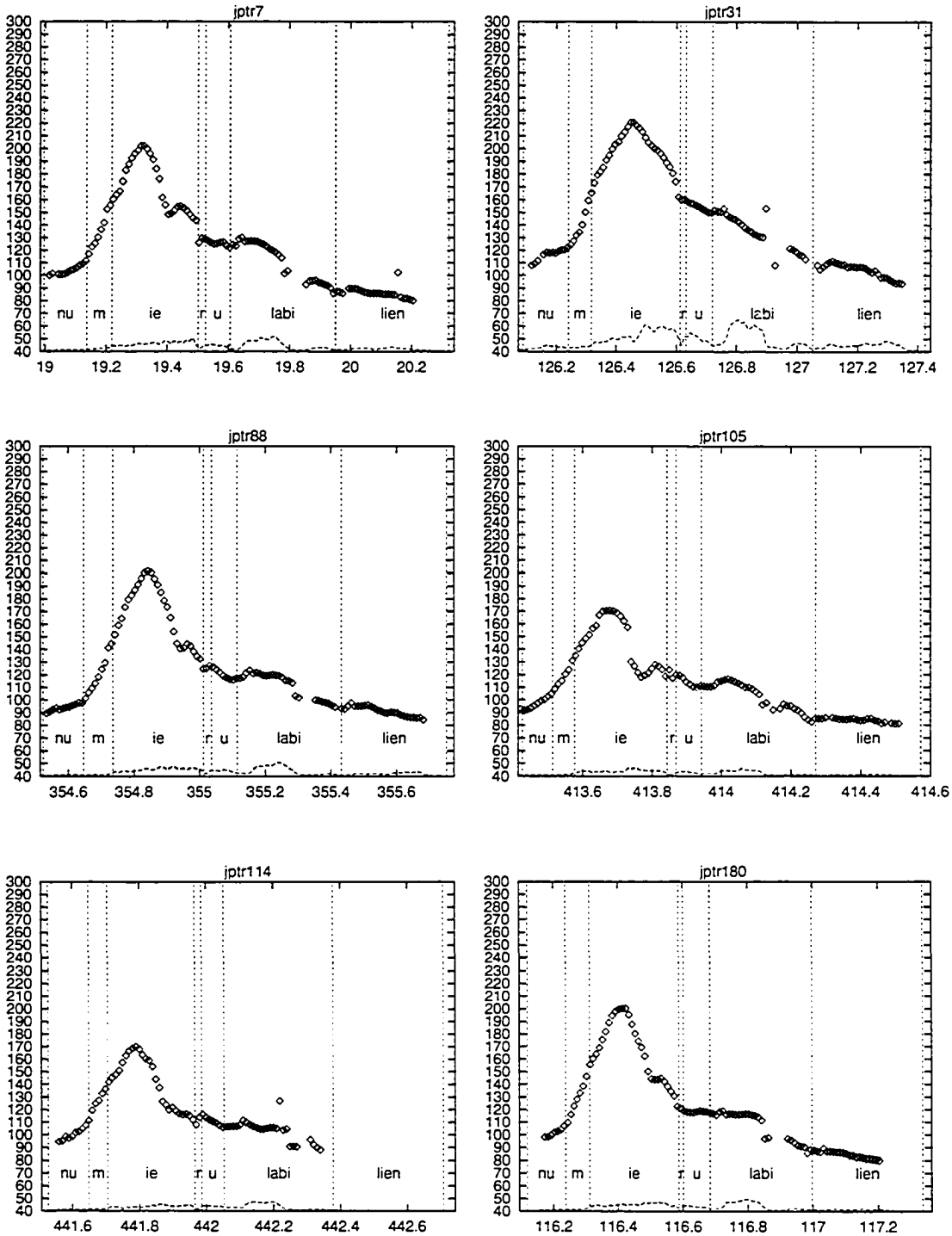
(11) The monophthong /i:/, falling intonation, in the word *gri:da* 'floor', speaker SO



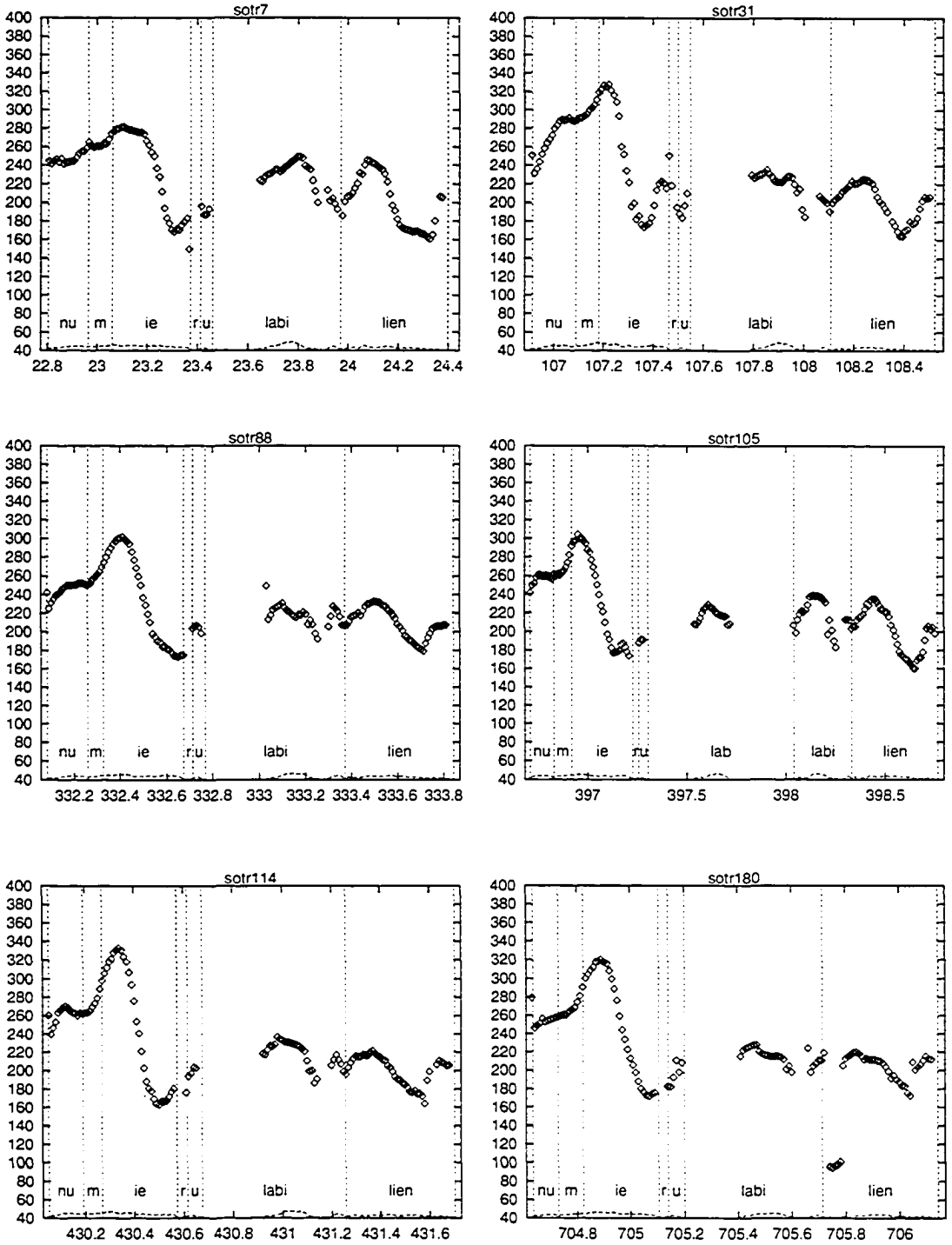
(12) The monophthong /i:/, falling intonation, in the word *gri:da* 'floor', speaker DJ



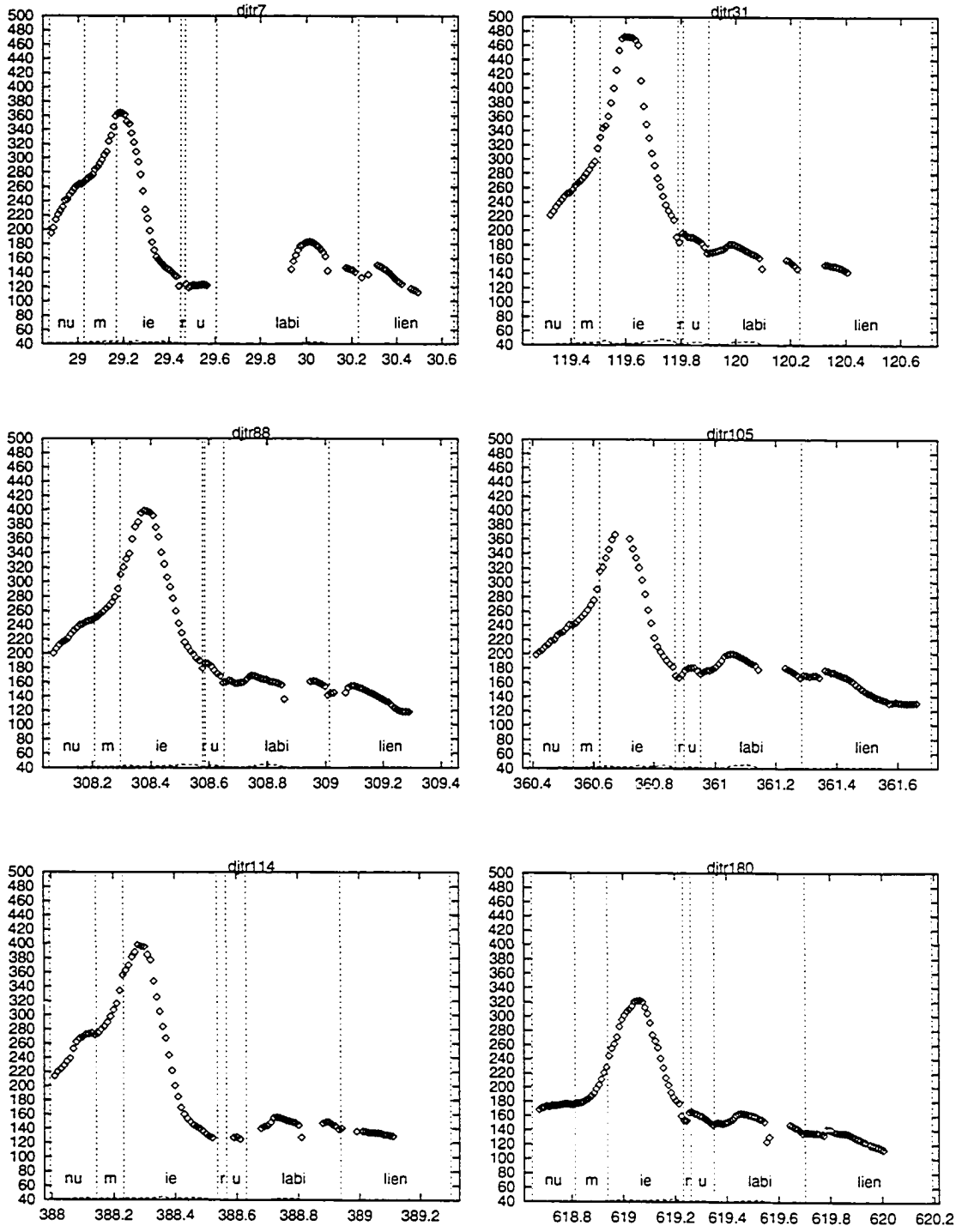
(13) The diphthong /ie/, broken intonation, in the word *mieru* 'peace ACC', speaker JP



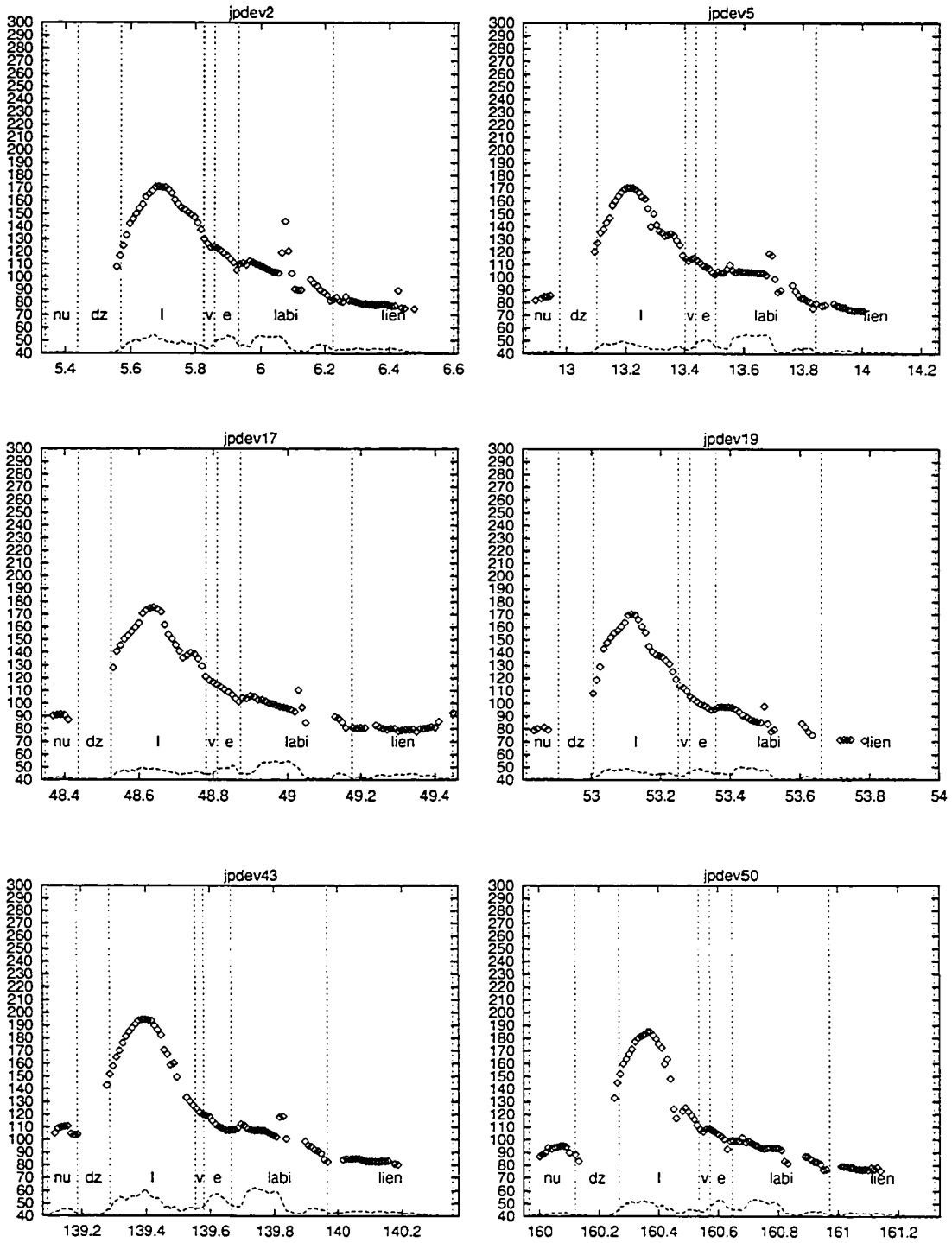
(14) The diphthong /ie/, broken intonation, in the word *mieru* 'peace ACC', speaker SO



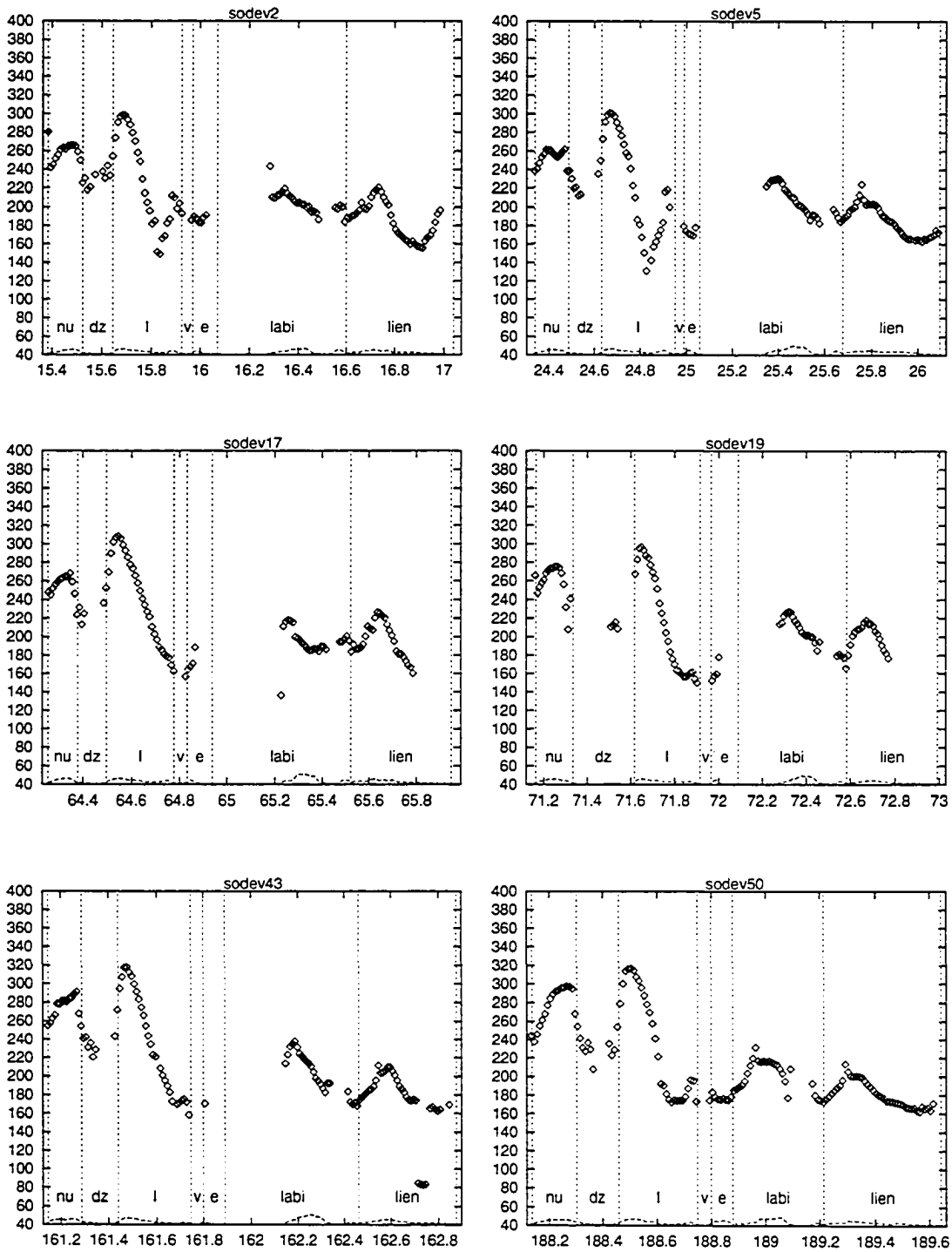
(15) The diphthong /ie/, broken intonation, in the word *mieru* 'peace ACC', speaker DJ



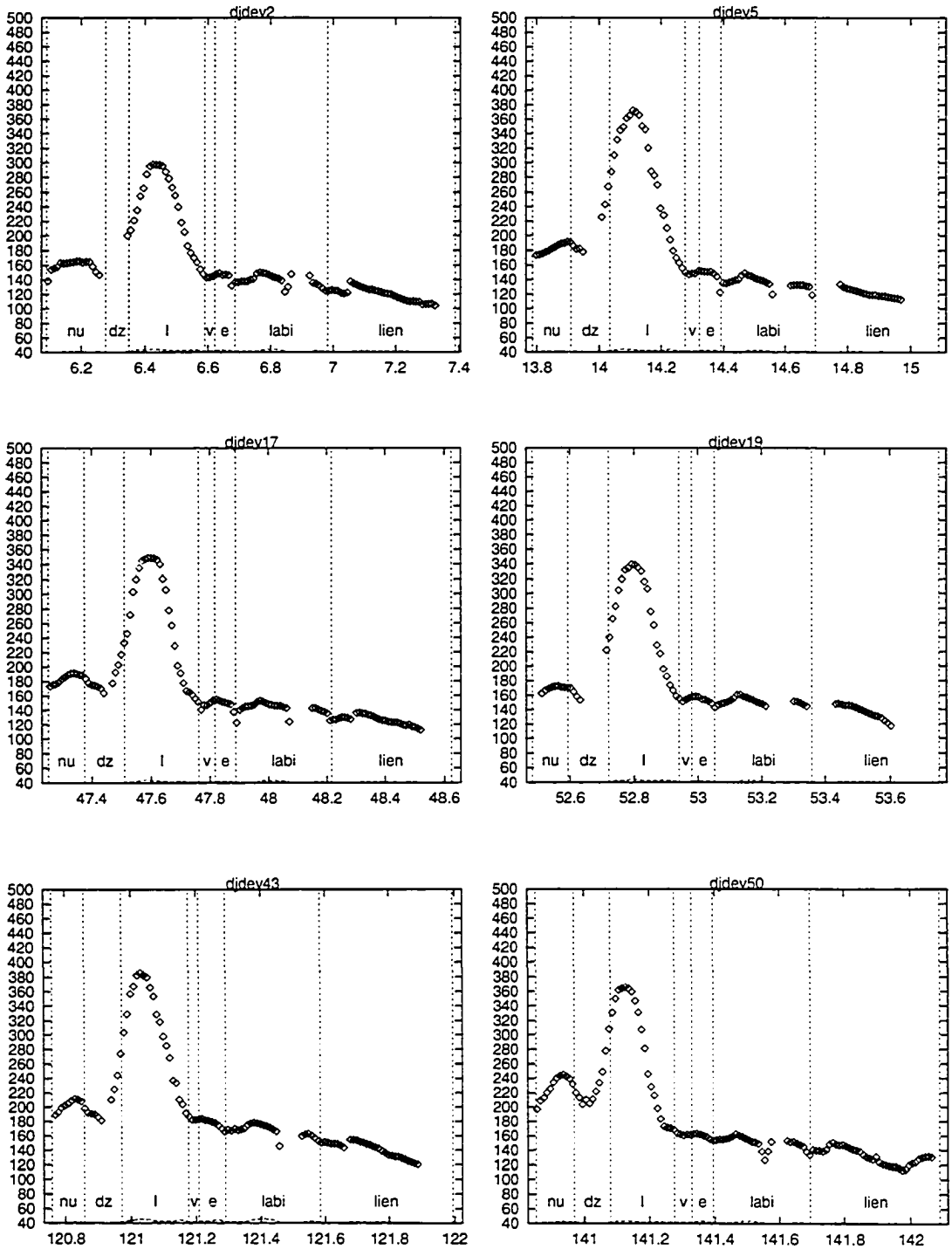
(16) The monophthong /i:/, broken intonation, in the word *dzi:ve* 'life', speaker JP



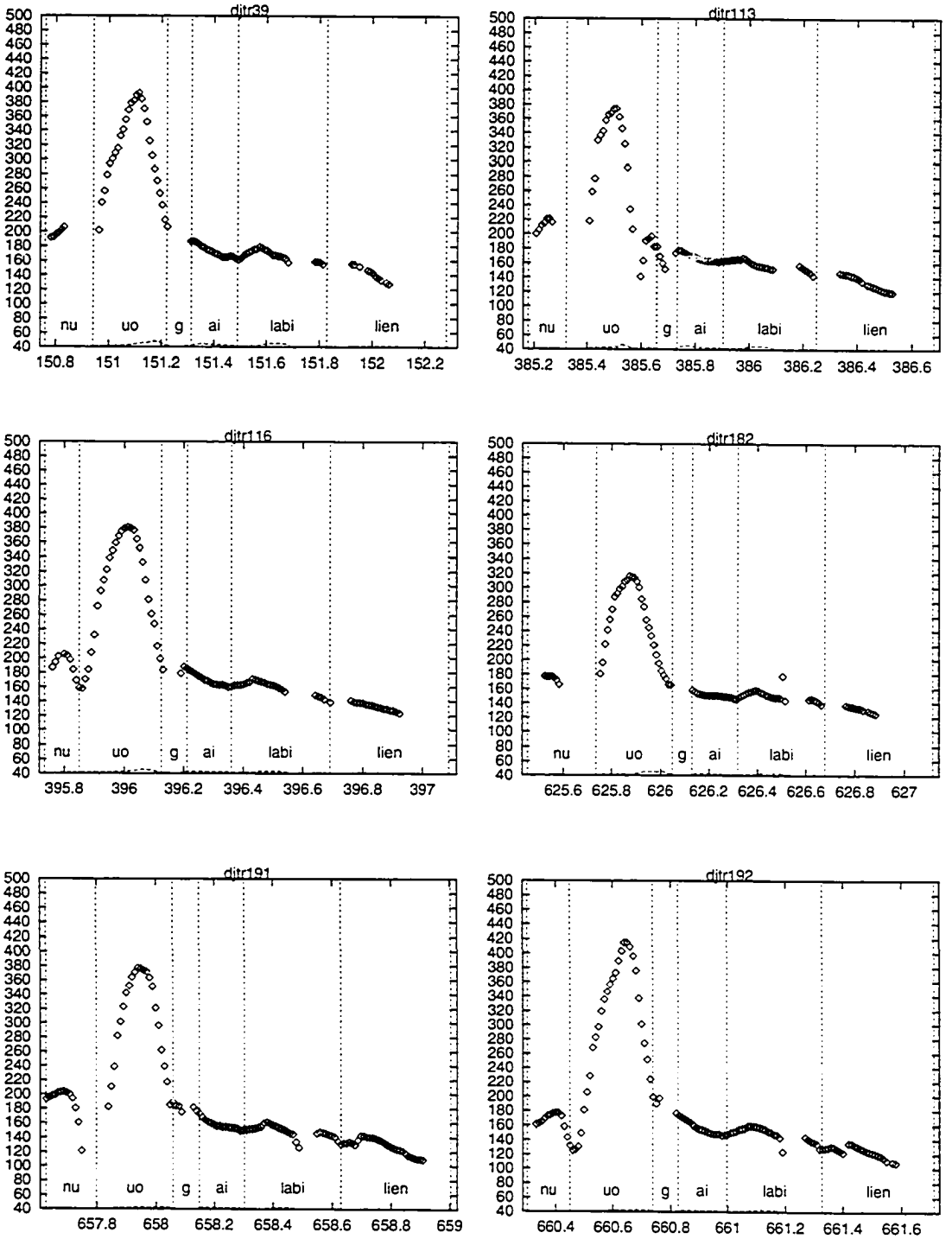
(17) The monophthong /i:/, broken intonation, in the word *dzi:ve* 'life', speaker SO



(18) The monophthong /i:/, broken intonation, in the word *dzi:ve* 'life', speaker DJ

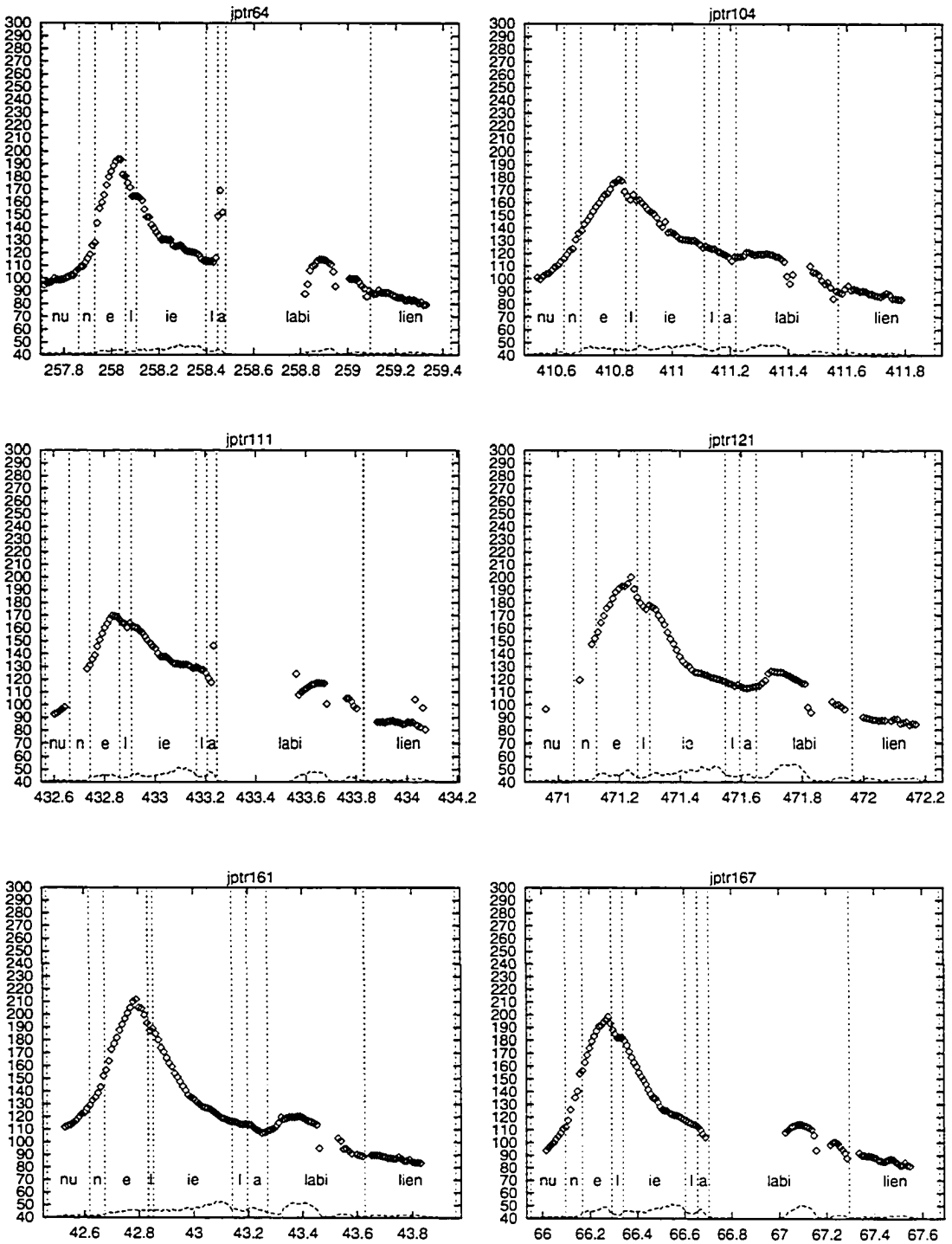


(19) The diphthong /uo/, broken intonation, in the word *uogai* 'for the berry', speaker DJ

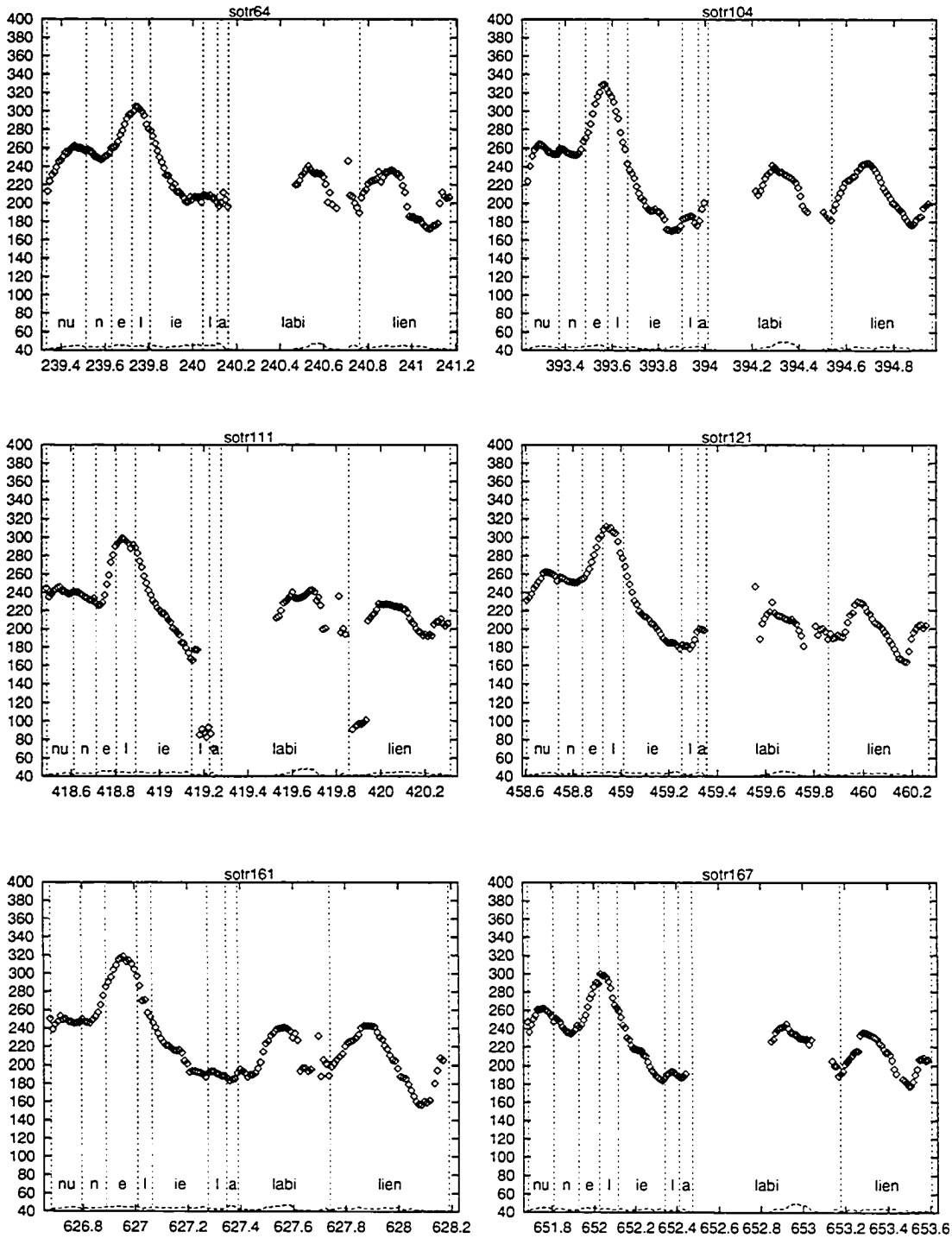


Appendix H Tonal curves for syllable intonations in unstressed position

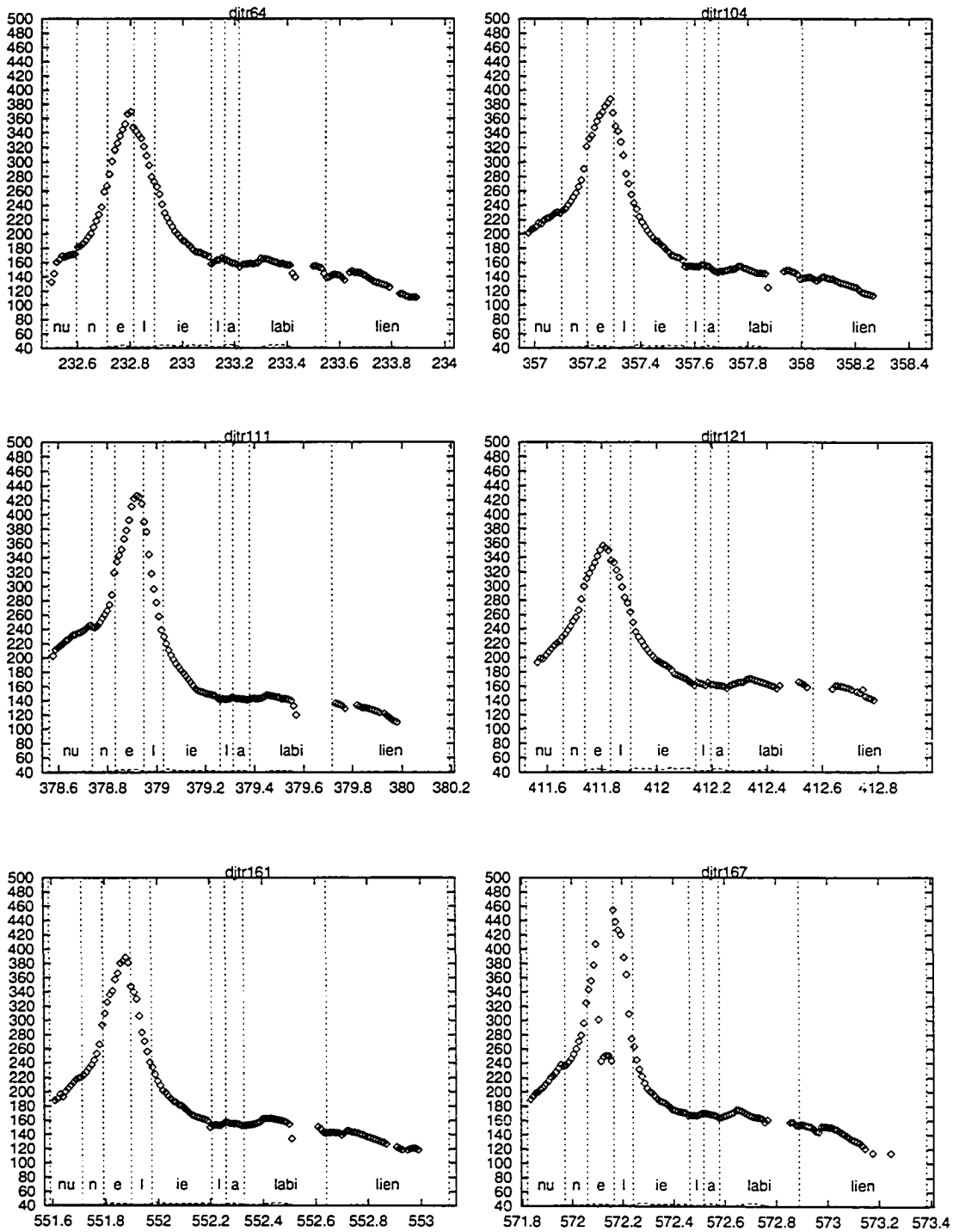
(1) The diphthong /ie/, level intonation, in the word *neliela* 'not large', speaker JP



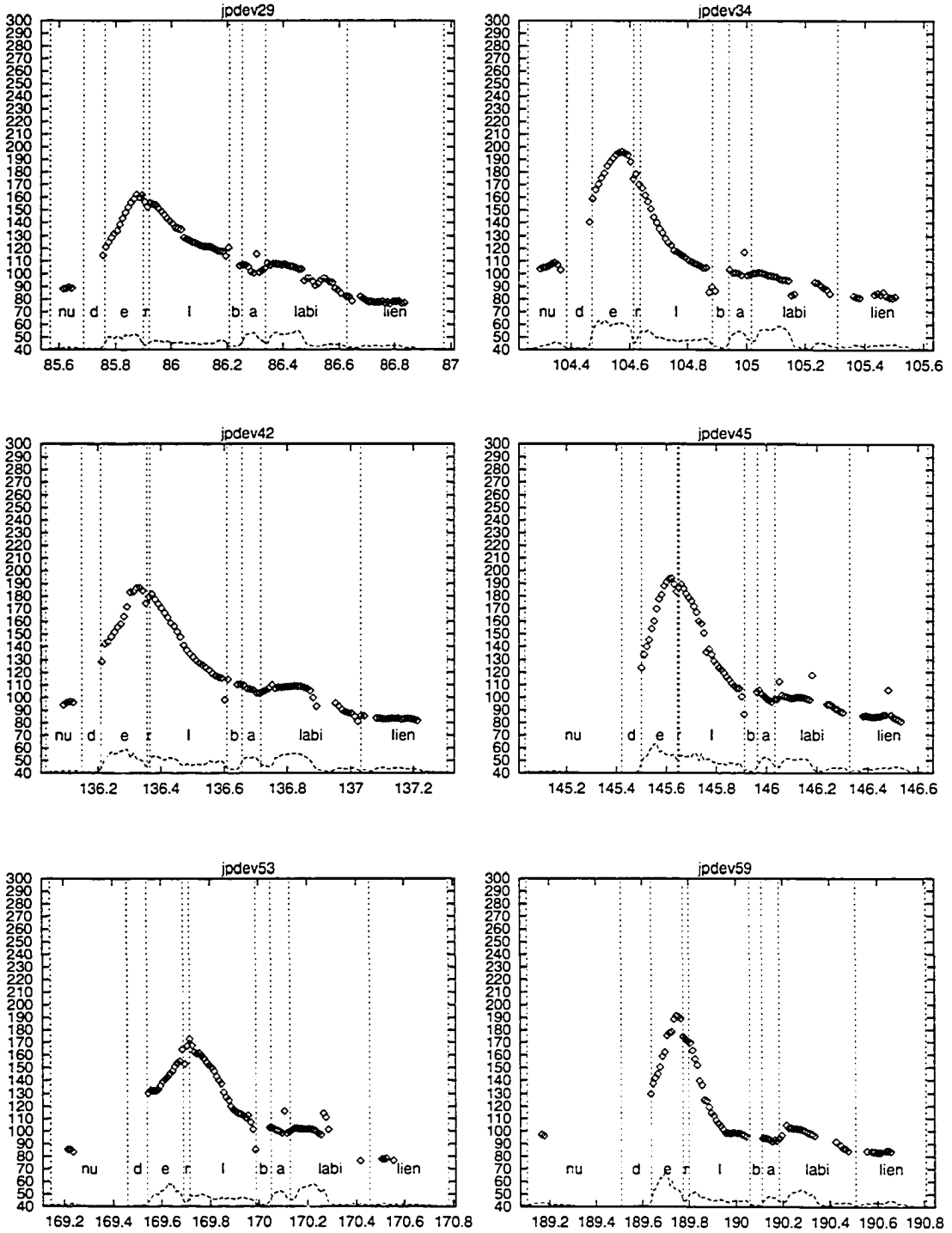
(2) The diphthong /ie/, level intonation, in the word *neliela* 'not large', speaker SO



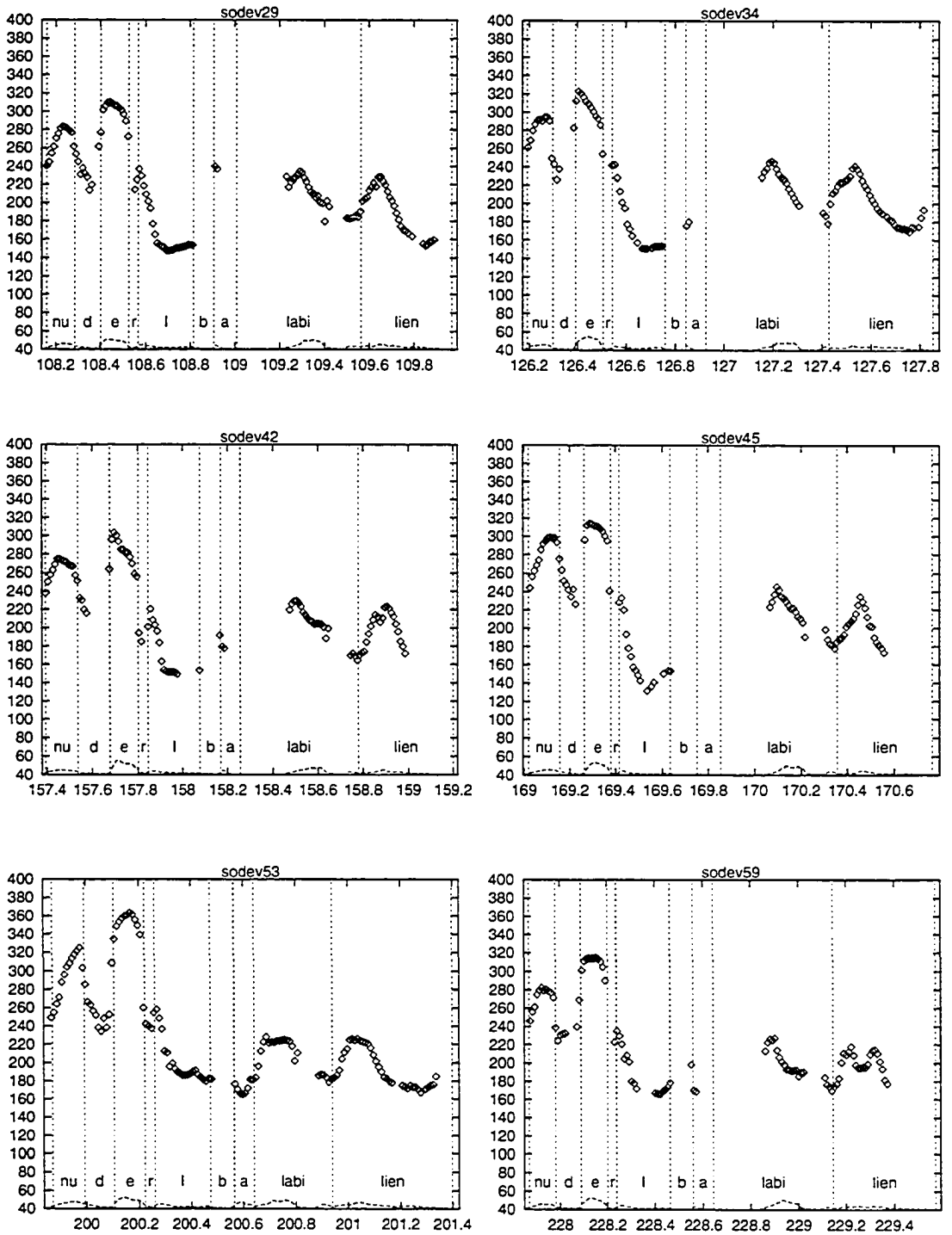
(3) The diphthong /ie/, level intonation, in the word *neliela* 'not large', speaker DJ



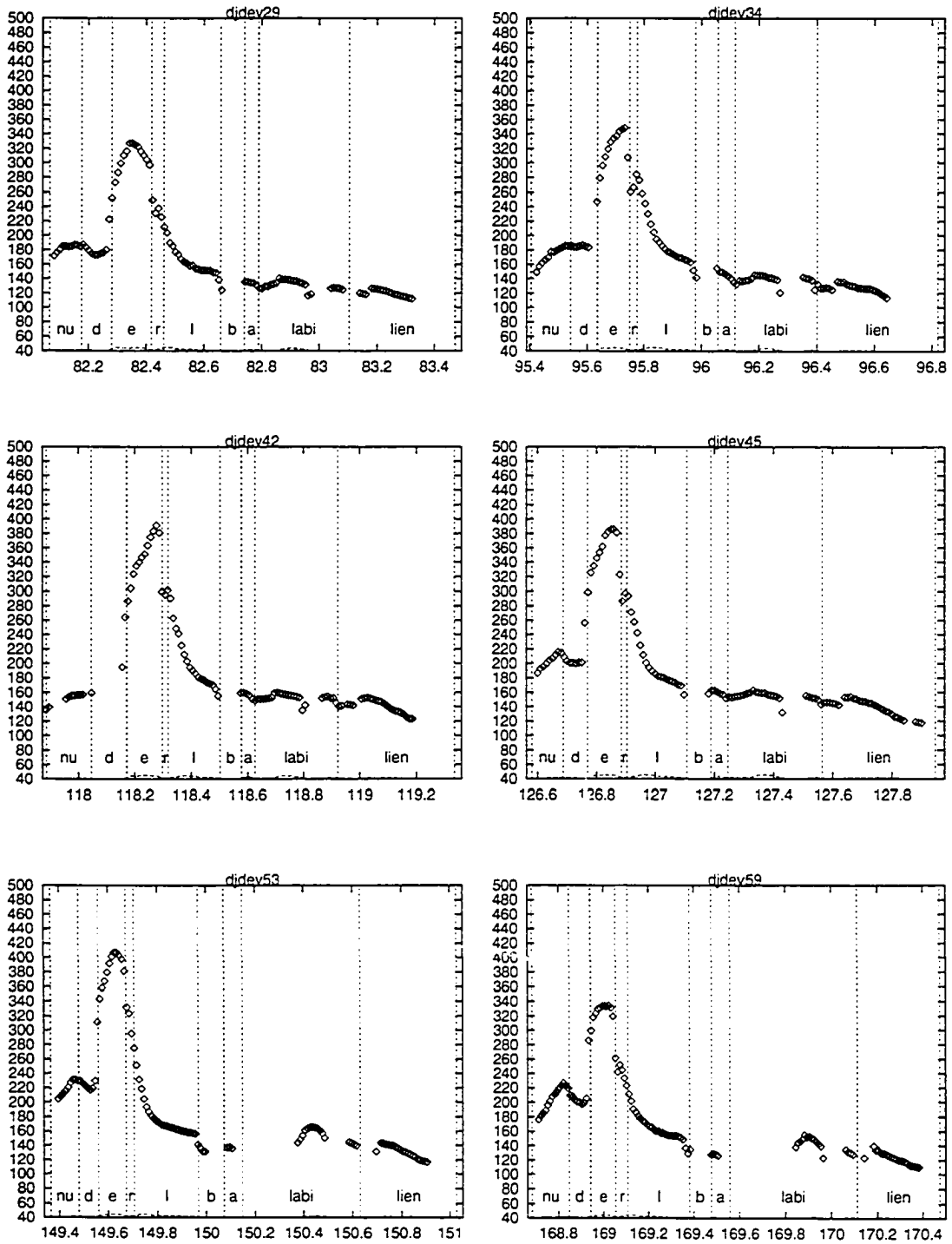
(4) The monophthong /i:/, level intonation, in the word *deri:ba* 'testament', speaker JP



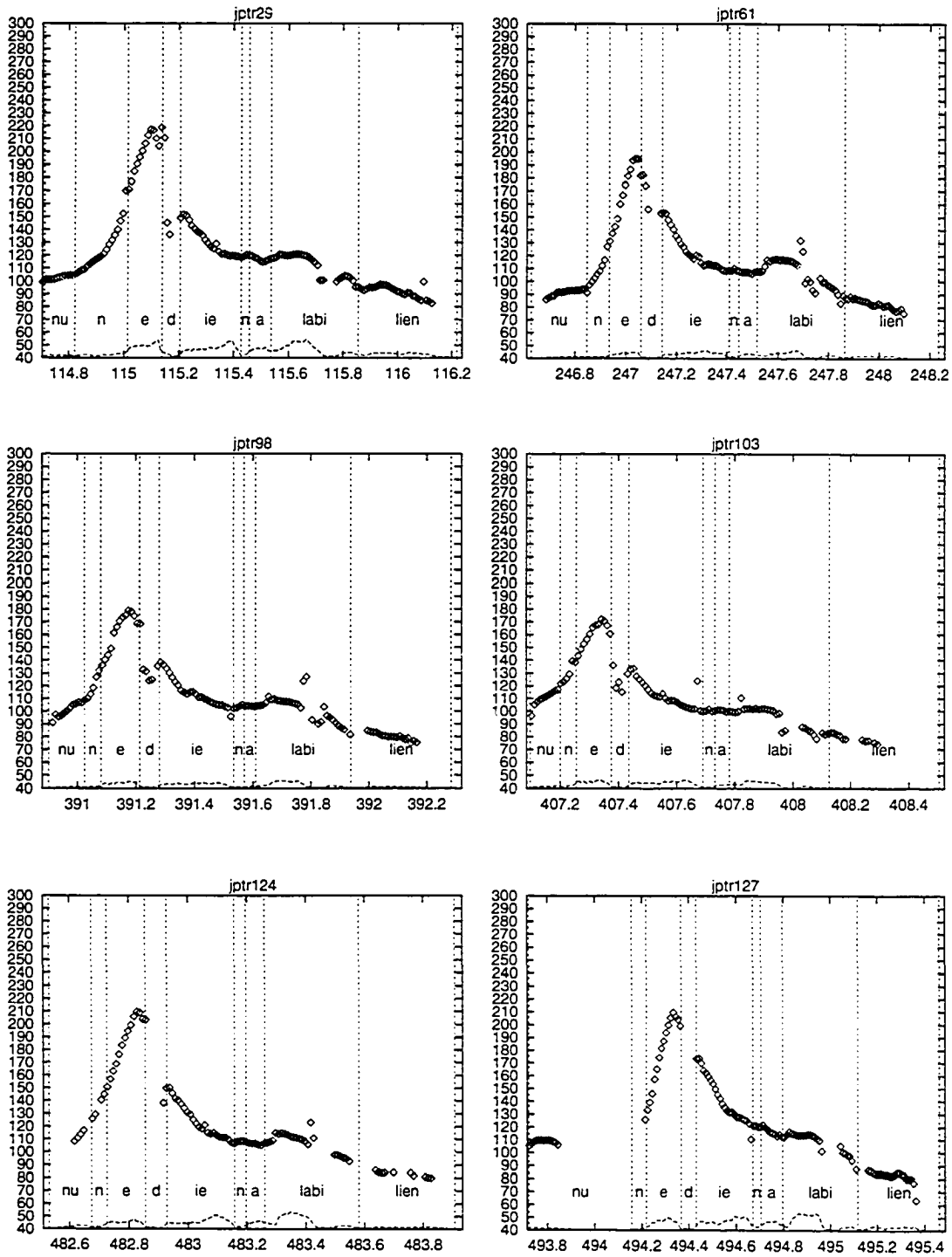
(5) The monophthong /i:/, level intonation, in the word *deri:ba* 'testament', speaker SO



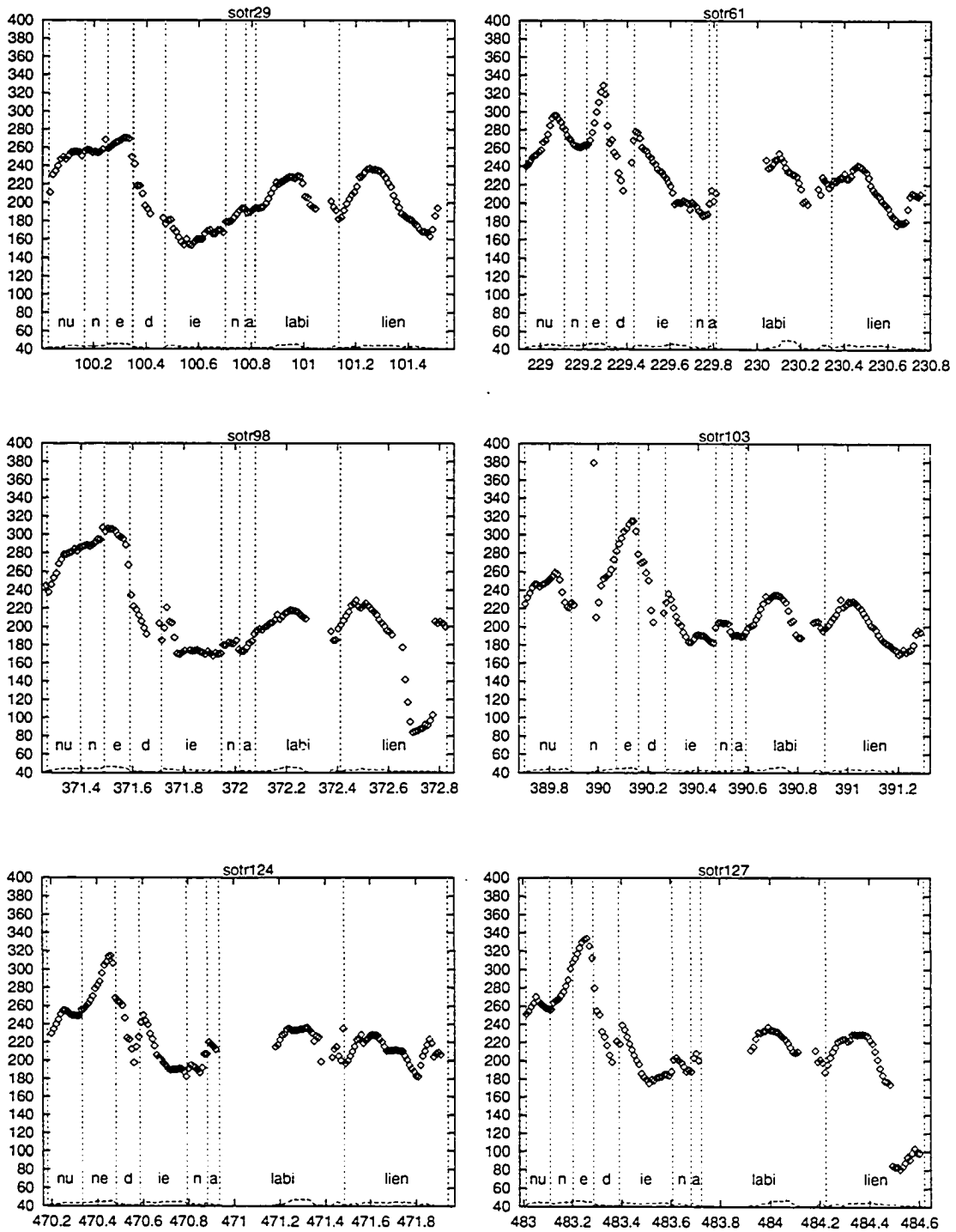
(6) The monophthong /i:/, level intonation, in the word *deri:ba* 'testament', speaker DJ



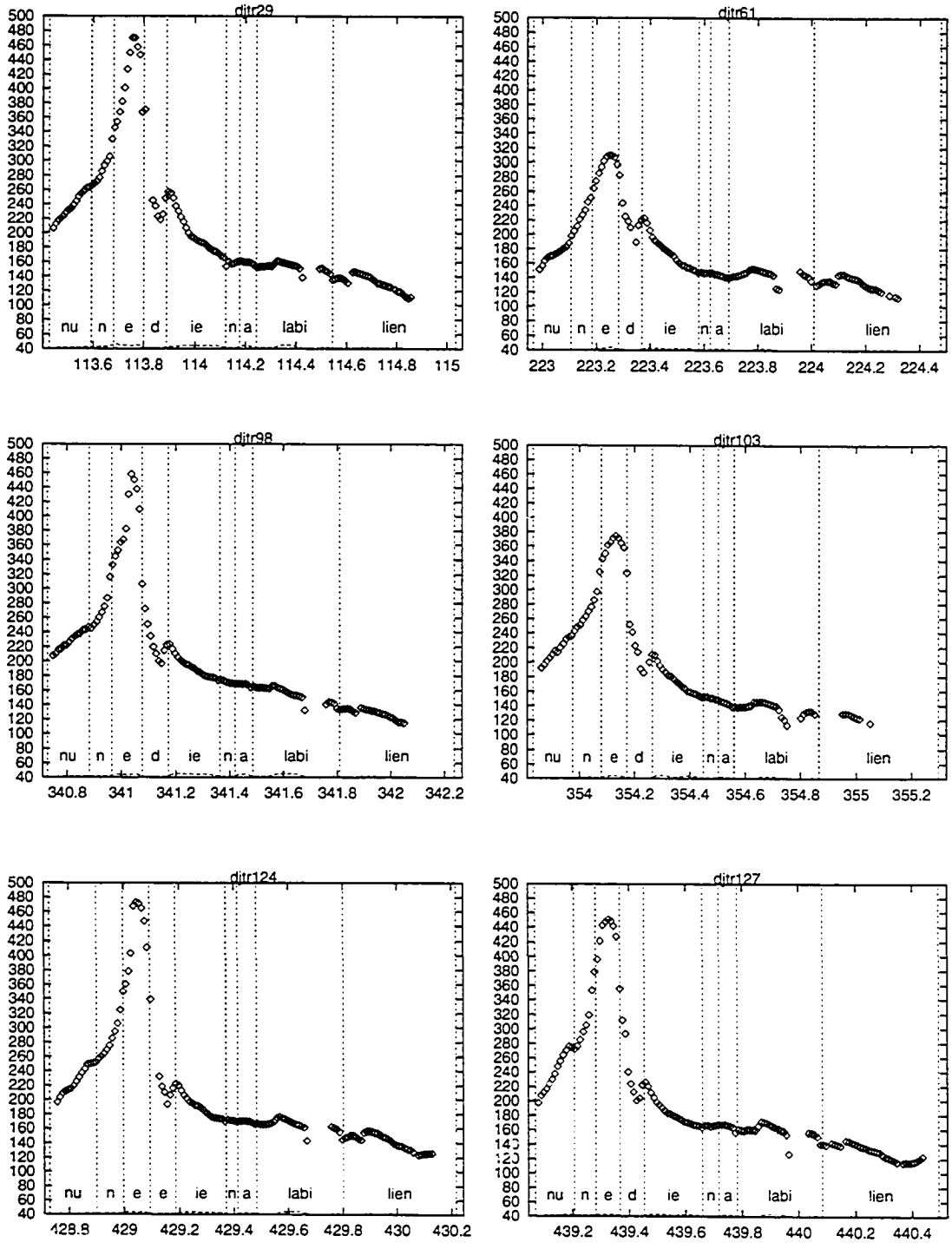
(7) The dipnthong /ie/, falling intonation, in the word *nediena* 'bad day', speaker JP



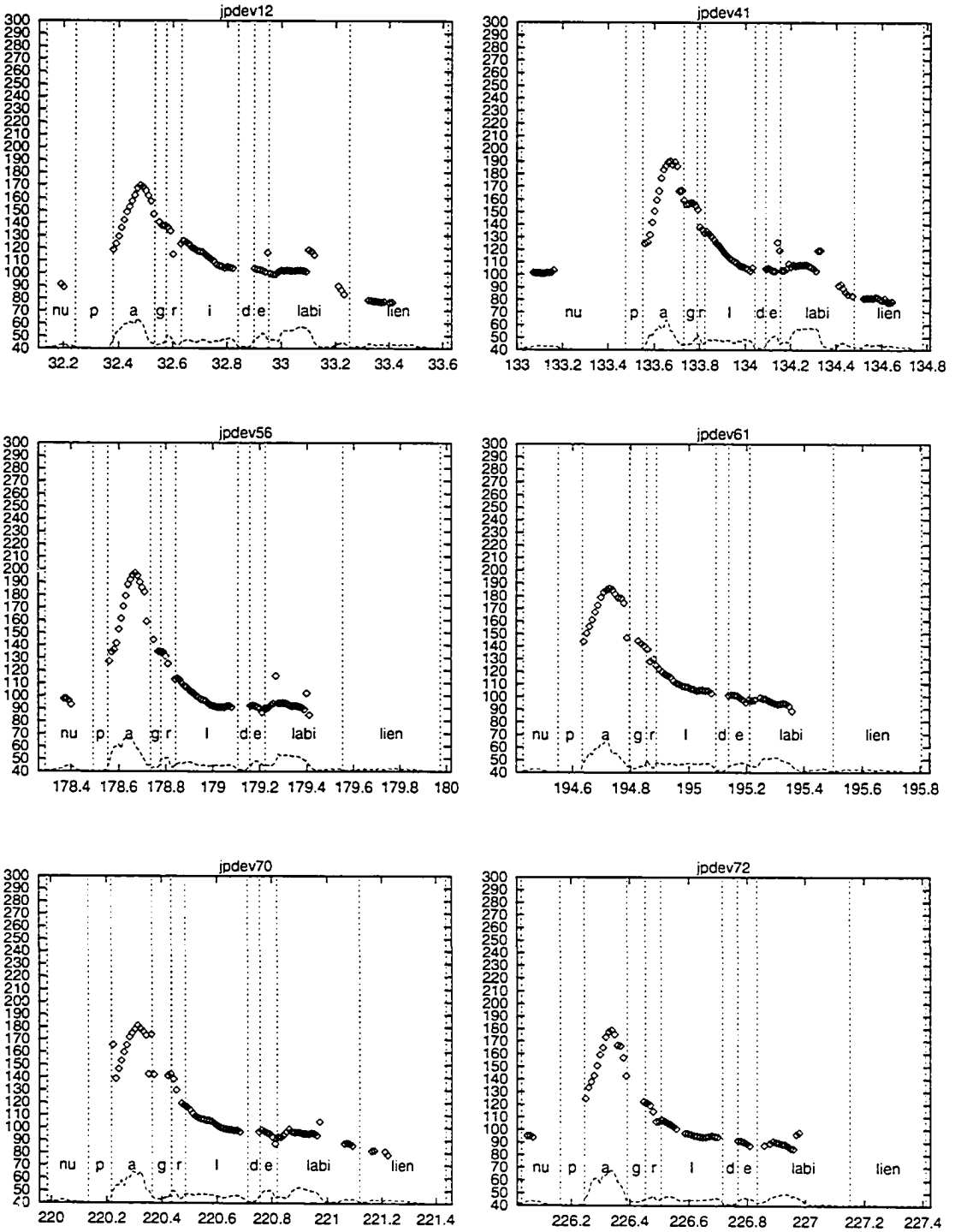
(8) The diphthong /ie/, falling intonation, in the word *nediena* 'bad day', speaker SO



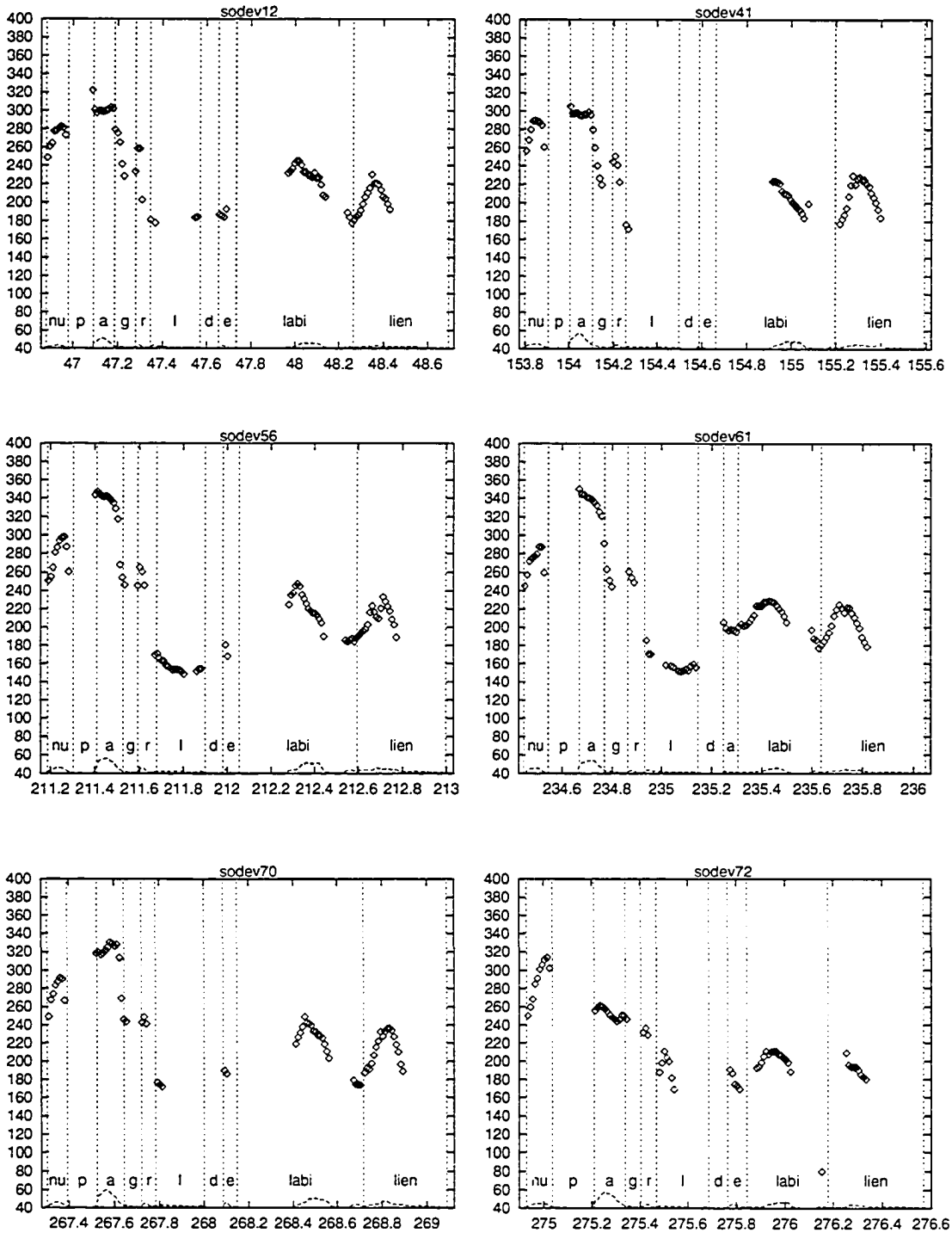
(9) The diphthong /ie/, falling intonation, in the word *nediena* 'bad day', speaker DJ



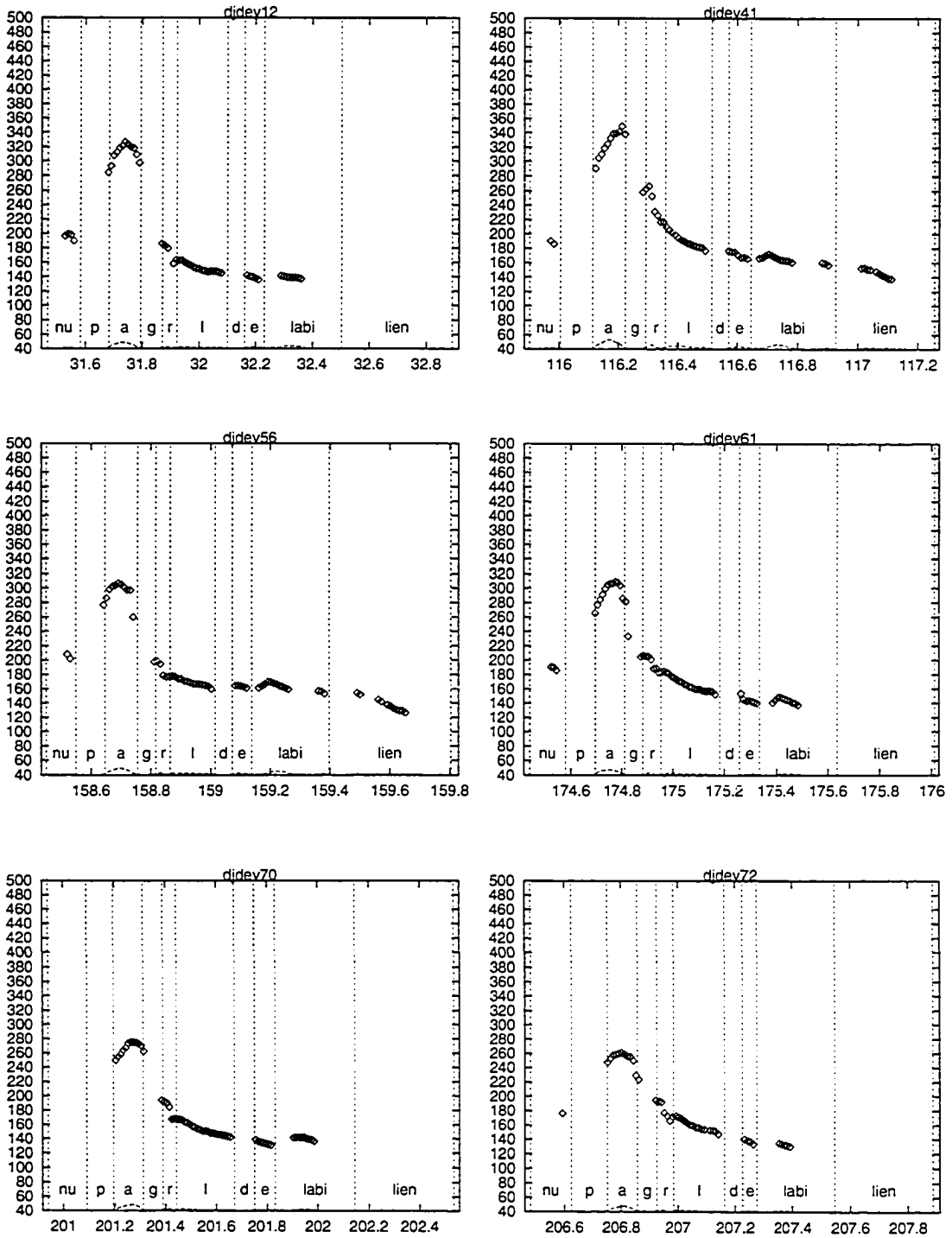
(10) The monophthong /i:/, falling intonation, in the word *pagri:de* 'underground', speaker JP



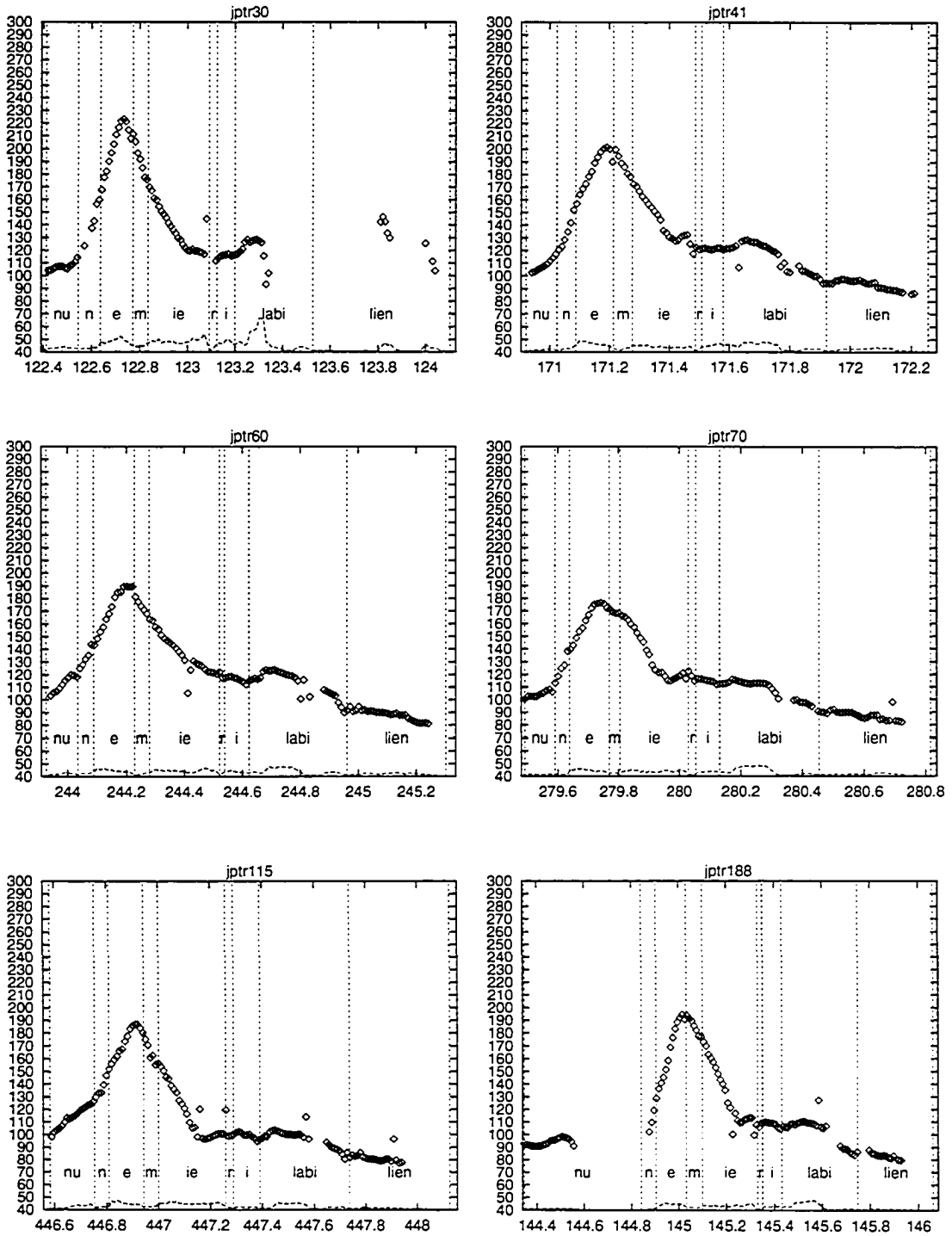
(11) The monophthong /i:/, falling intonation, in the word *pagri:de* 'underground', speaker SO



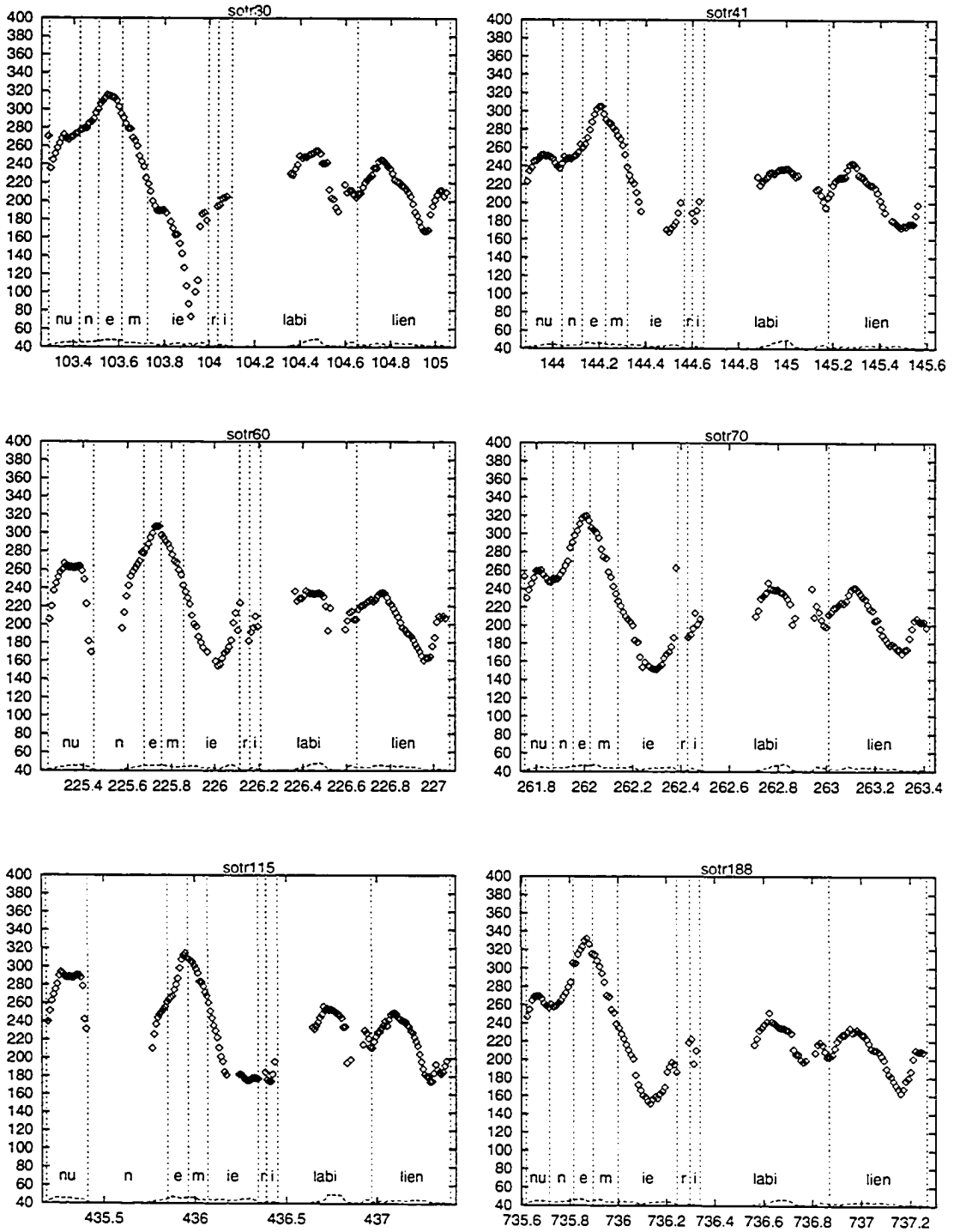
(12) The monophthong /i:/, falling intonation, in the word *pagri:de* 'underground', speaker DJ



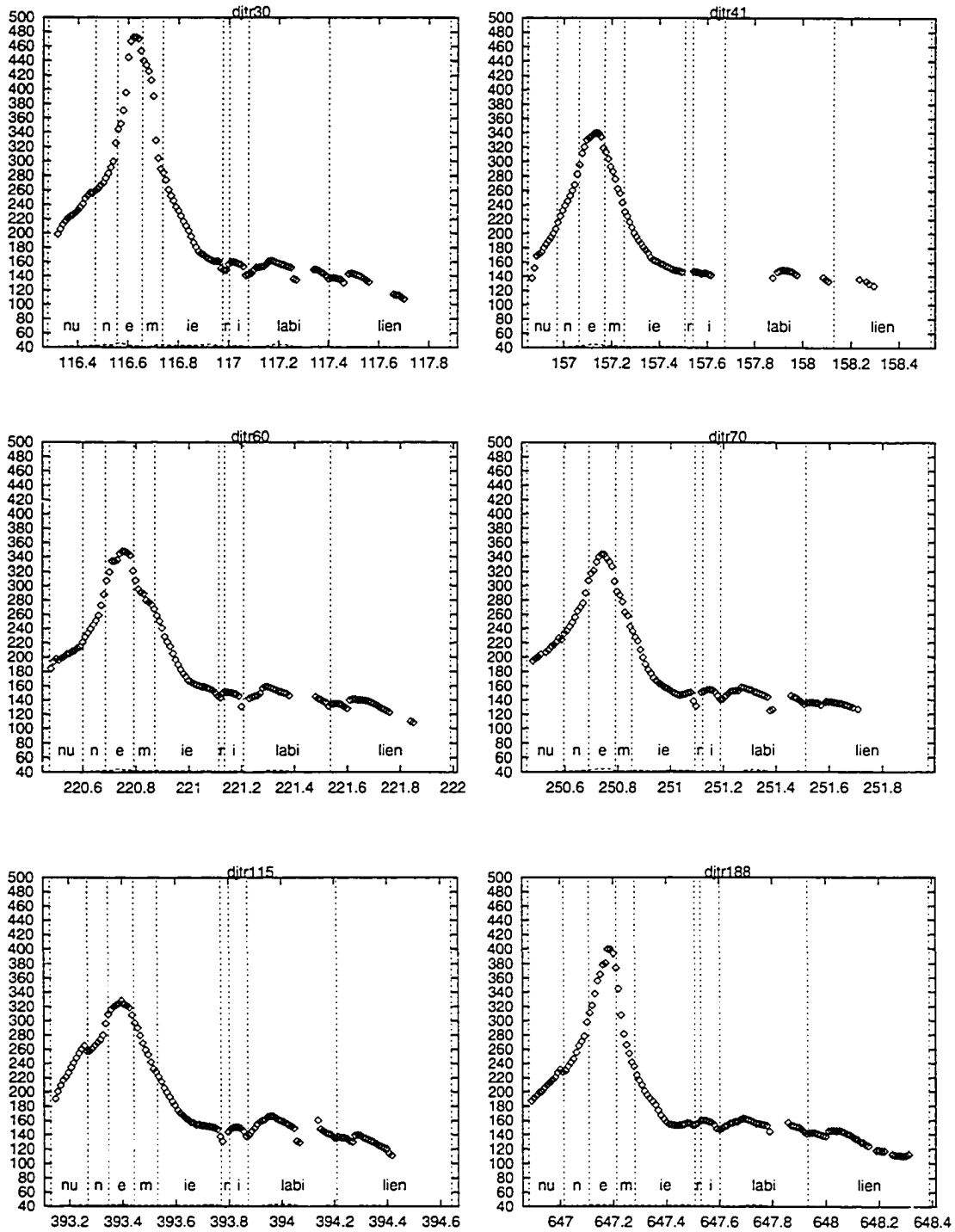
(13) The diphthong /ie/, broken intonation, in the word *nemieri* 'unrest', speaker JP



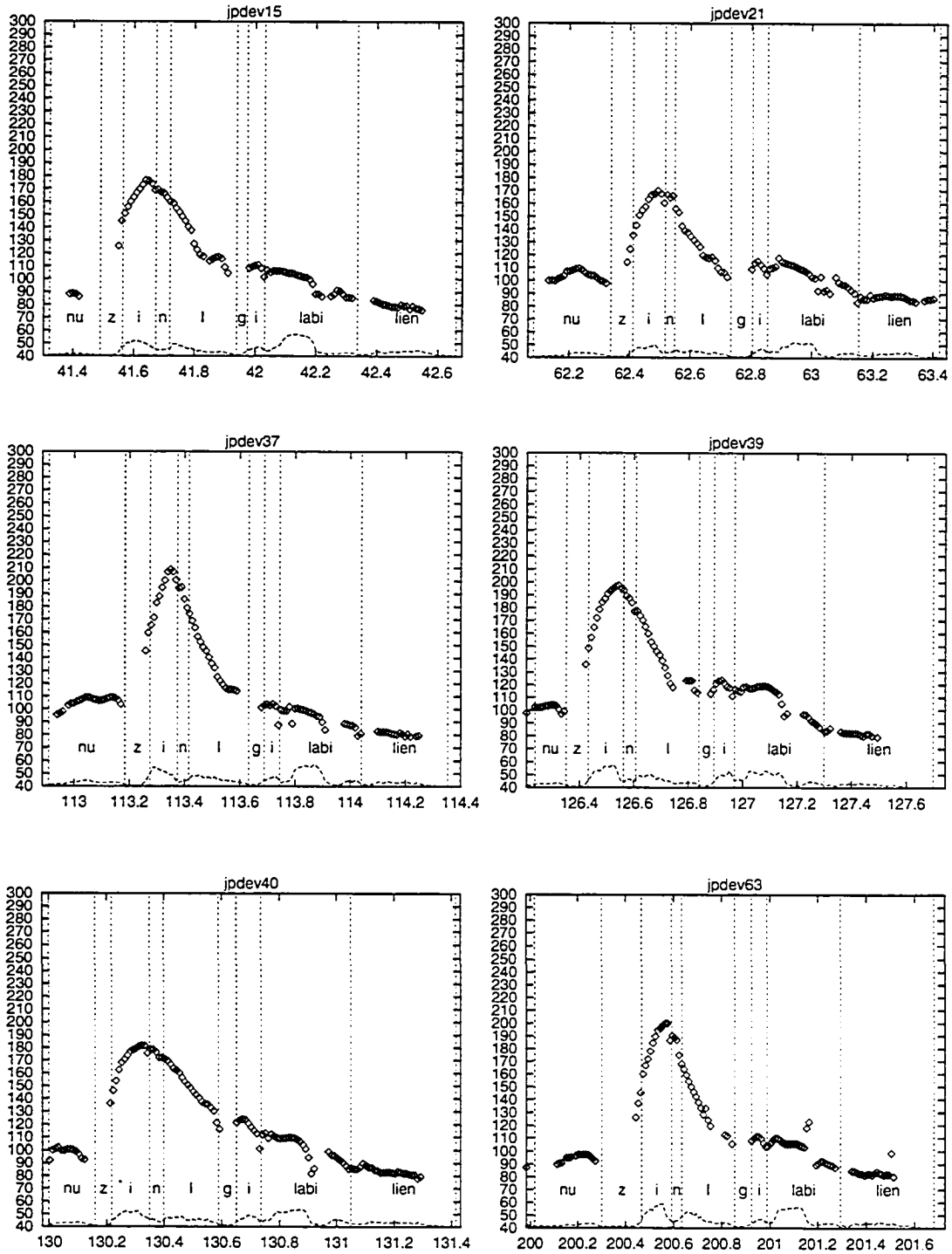
(14) The diphthong /ie/, broken intonation, in the word *nemieri* 'unrest', speaker SO



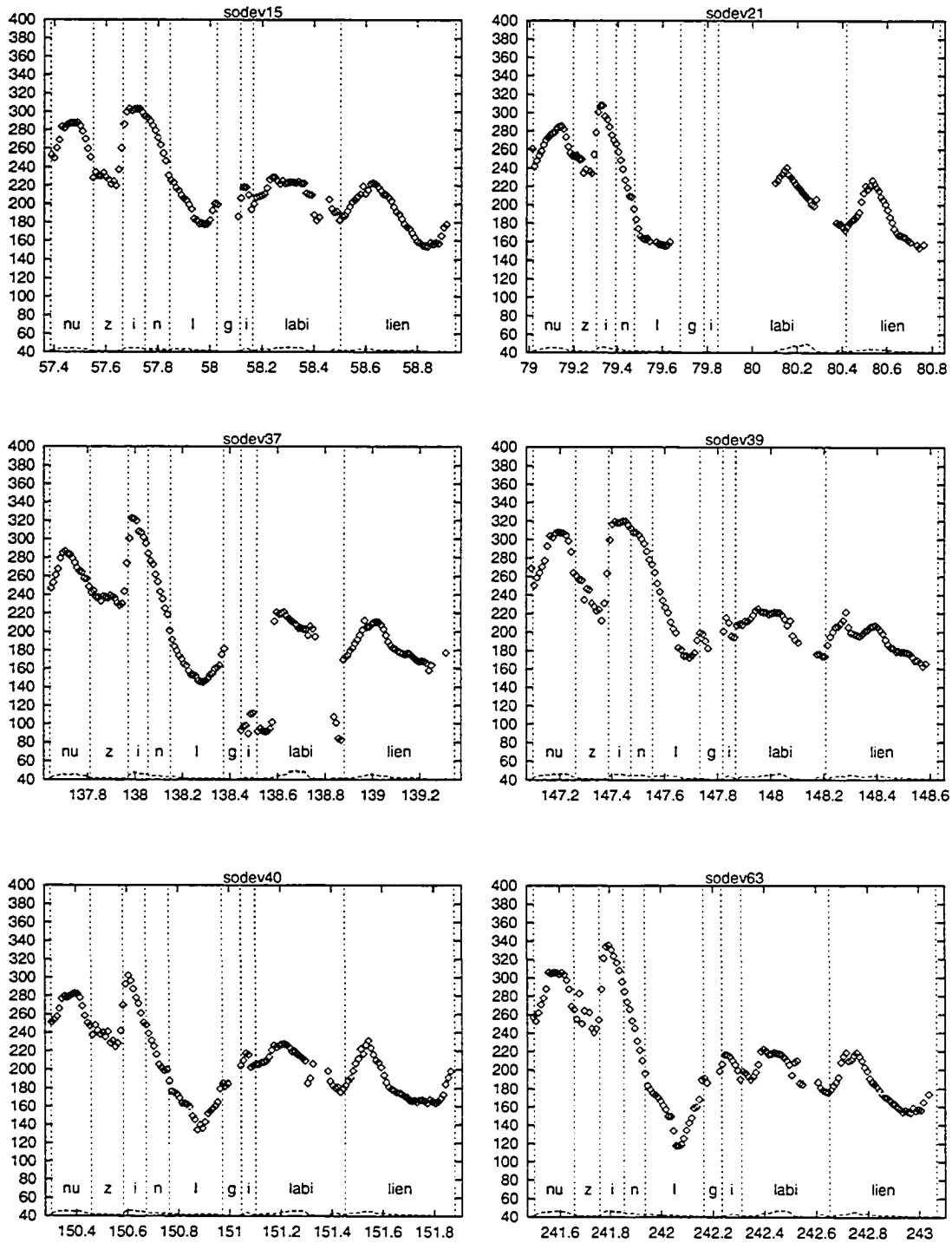
(15) The diphthong /ie/, broken intonation, in the word *nemieri* 'unrest', speaker DJ



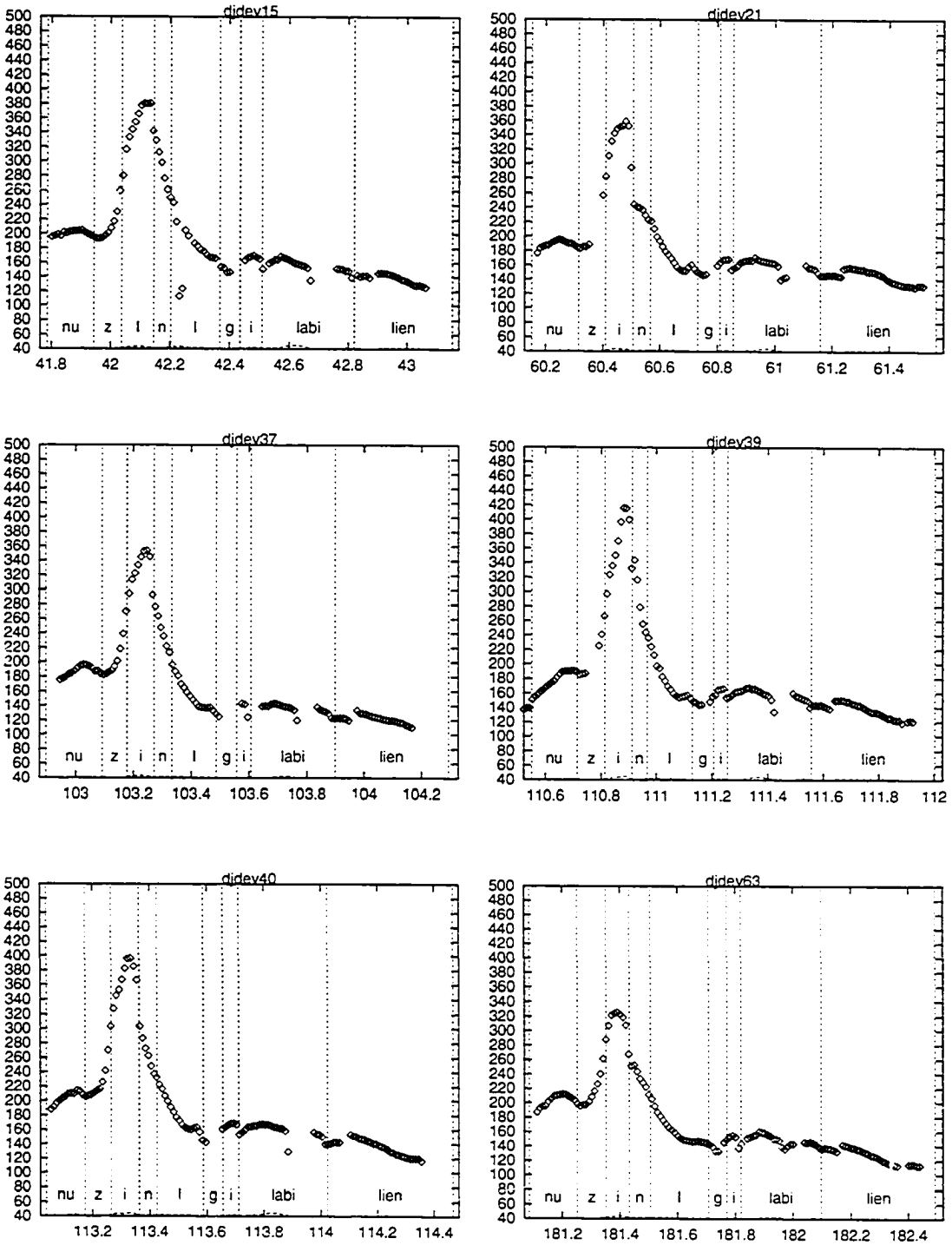
(16) The monophthong /i:/, broken intonation, in the word *zini:gi* 'knowingly', speaker JP



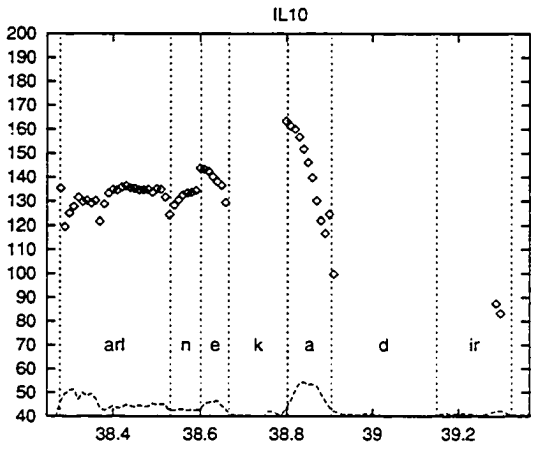
(17) The monophthong /i:/, broken intonation, in the word *zini:gi* 'knowingly', speaker SO



(18) The monophthong /i:/, broken intonation, in the word *zini:gi* 'knowingly', speaker DJ

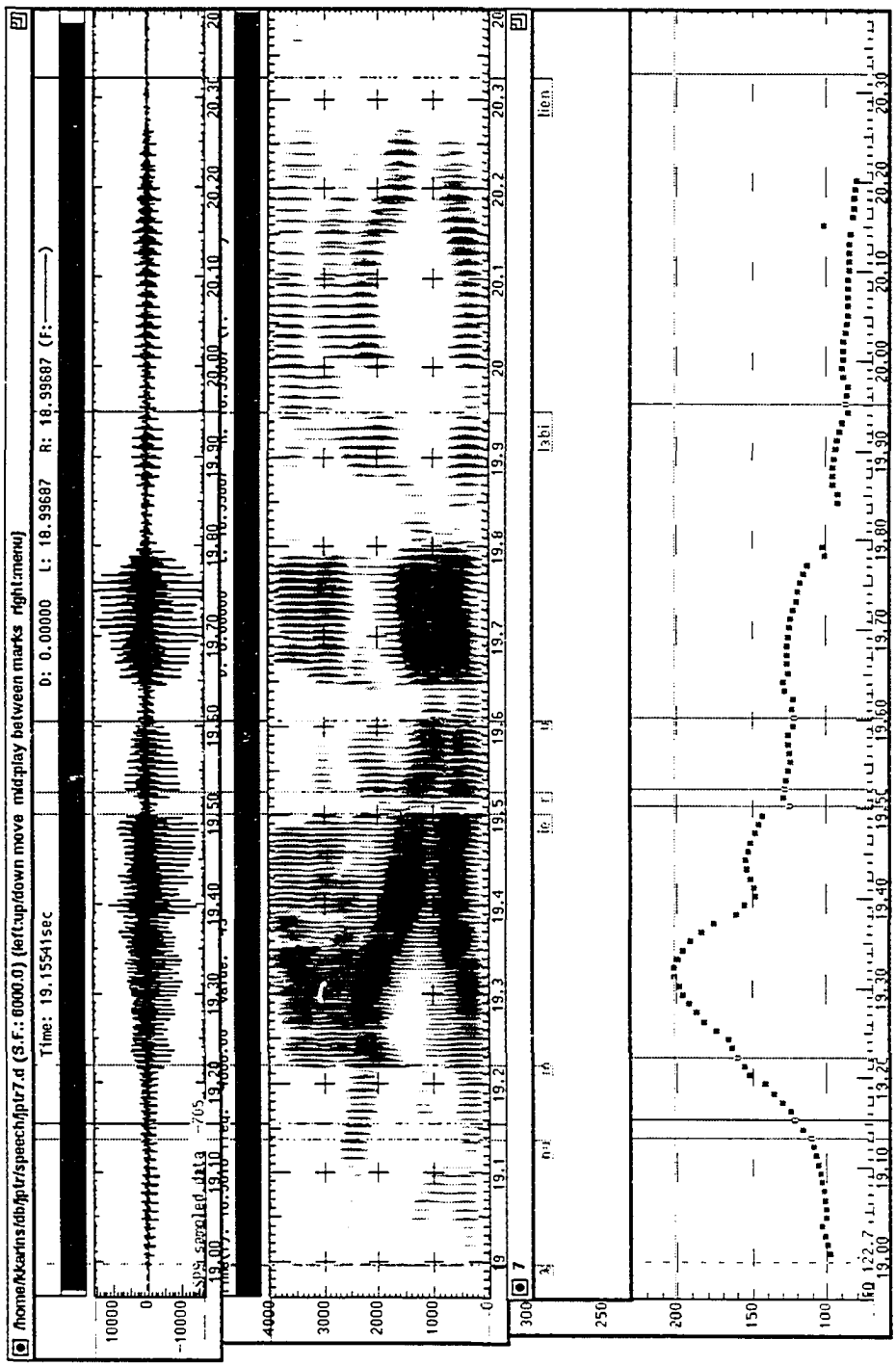


(19) The short monophthong /a/ with primary stress in the second syllable in the word *nekad* 'never', speaker IL

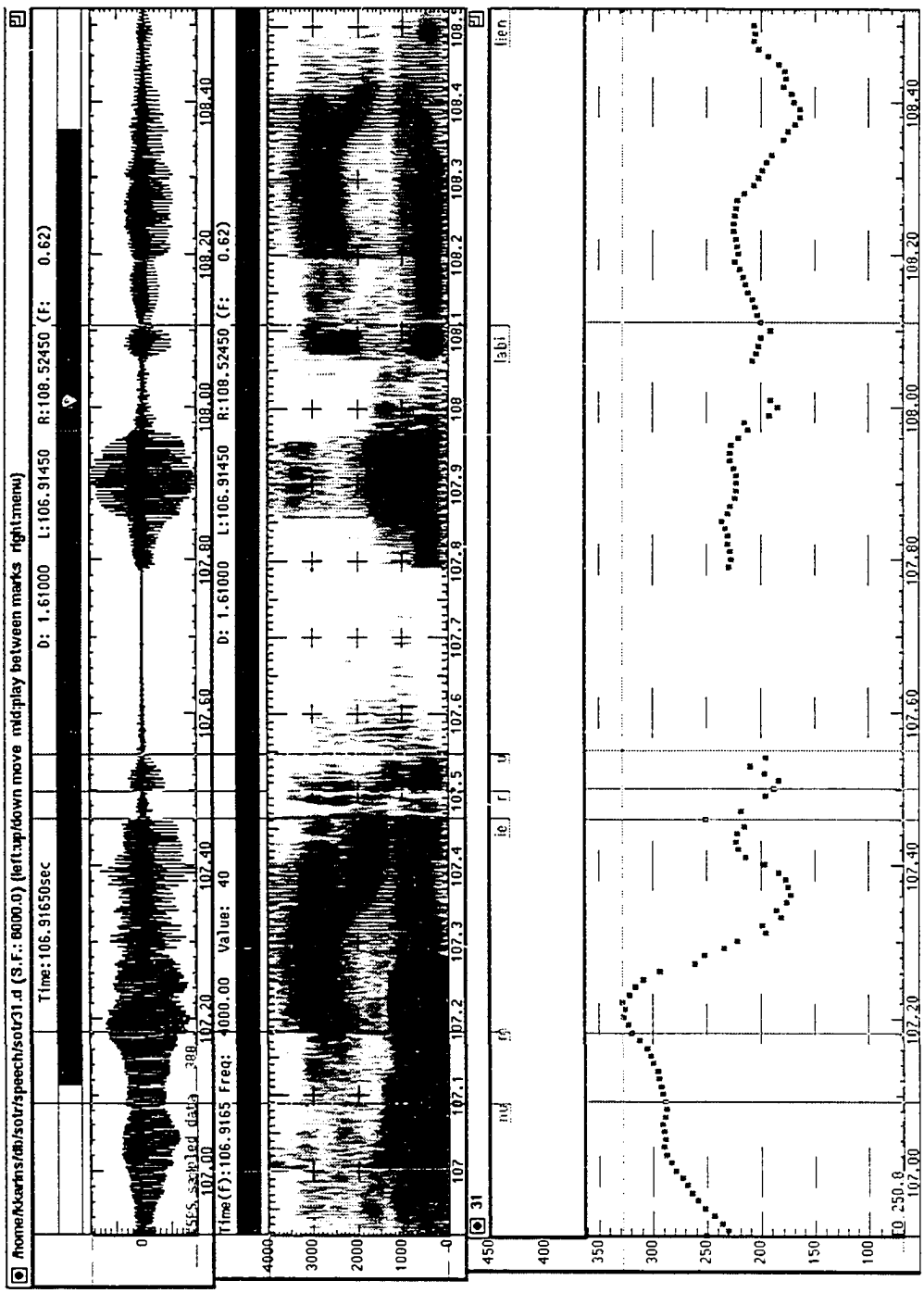


Appendix I Spectrograms of the broken and falling intonations for two speakers

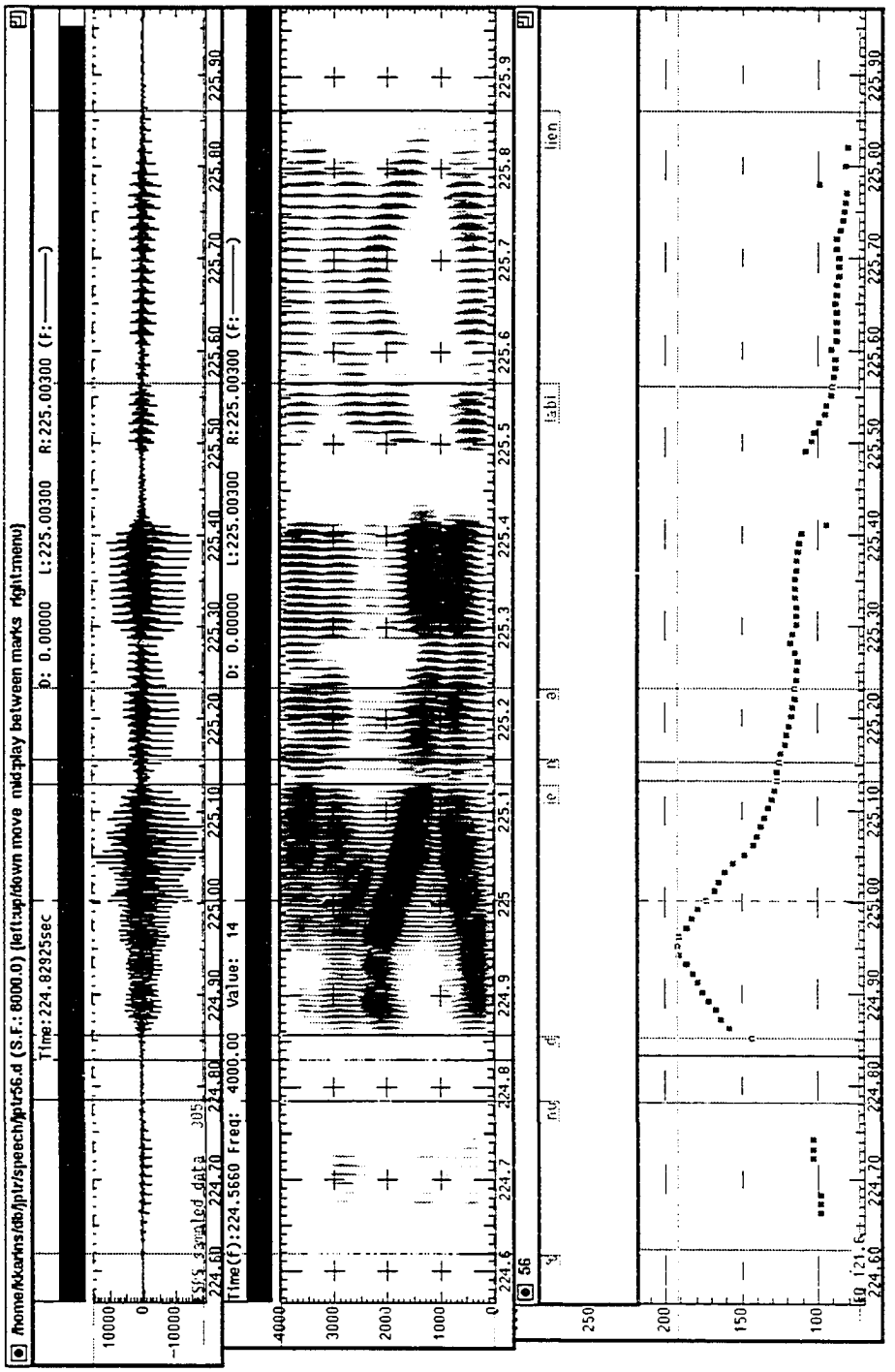
(1) Spectrogram, pitchtrack and waveform with the broken intonation in the word *mieru* 'peace ACC', speaker JP



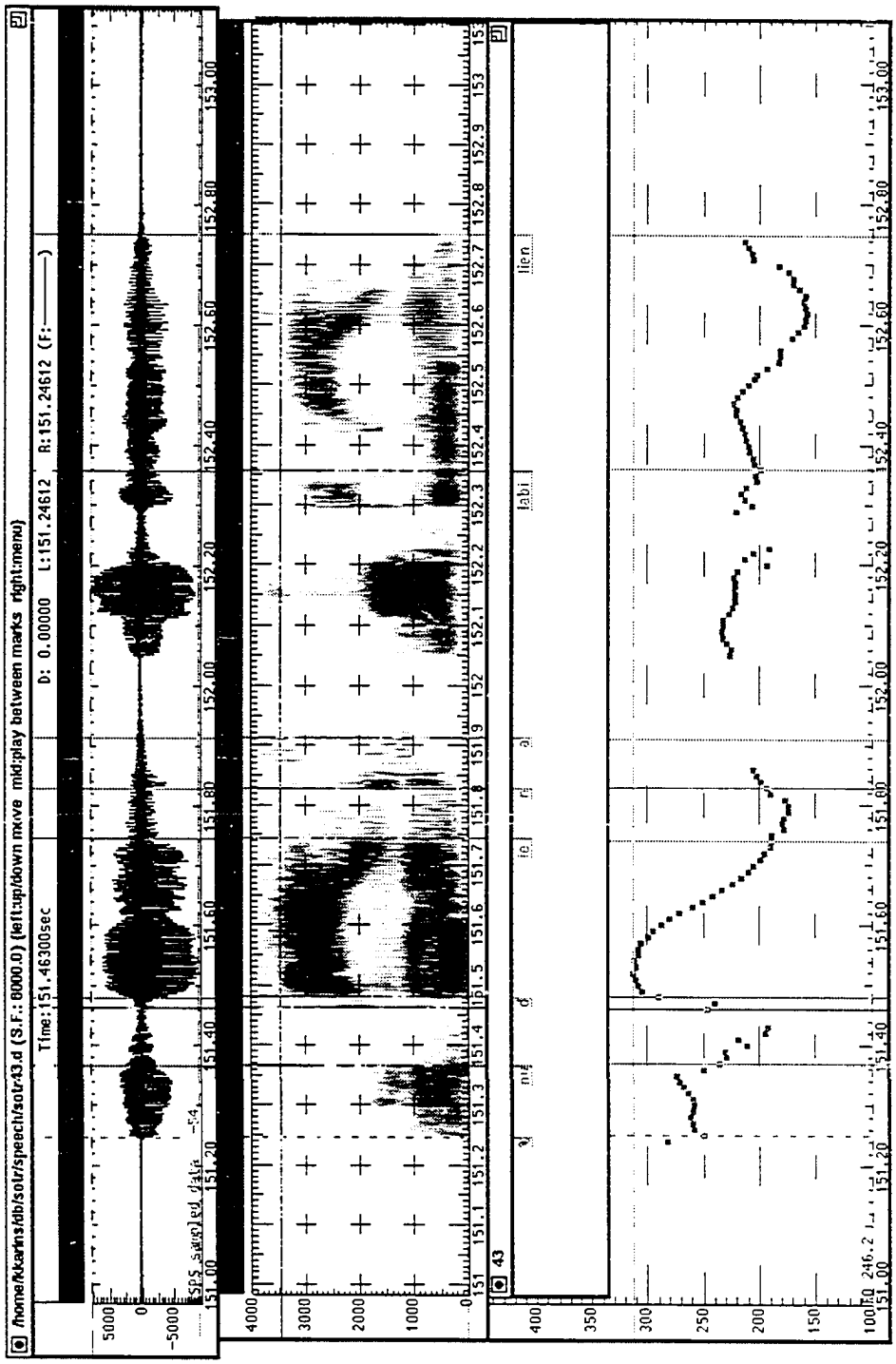
(2) Spectrogram, pitchtrack and waveform with the broken intonation in the word *mieru* 'peace ACC', speaker SO



(3) Spectrogram, pitchtrack and waveform with the falling intonation in the word *diena* 'day', speaker JP



(4) Spectrogram, pitchtrack and waveform with the falling intonation in the word *diena* 'day', speaker SO



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