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MEADOW MARI PROSODY

Teaduste Akadeemia Kirjastus
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Contents

List of Tables in Chapter 3

List of Figures in Chapter 3

PREFACE

Mari (earlier known also as Cheremis) is a Finno-Ugric language of the Volga branch spoken by about 500,000 people in Central Russia. This book that presents new acoustic data of Meadow Mari prosody is a part of the project "Finno-Ugric Prosody", led and partly funded by Ilse Lehiste, Professor Emeritus of Linguistics at the Ohio State University. The main goal of the project is to provide new phonetic data of the prosodic structure of various Finno-Ugric languages in the same methodological framework and thus to produce a data-based comparative overview of Finno-Ugric prosody. A monograph that treats Erzya prosody was published in 2003 (Lehiste, Aasmäe, Meister, Pajusalu, Teras, Viitso 2003), initial results about Mari prosody were presented in 2001 (Lehiste, Meister, Pajusalu, Parve, Teras, Viitso 2001).

The leading expert of the project in Finno-Ugric languages is Tiit-Rein Viitso, Professor Emeritus of Finnic languages at the University of Tartu. The administrative leader of the project is Professor Karl Pajusalu, Head of the Department of Estonian and Finno-Ugric Linguistics at the University of Tartu. Several research fellows, students, and graduate students of the University of Tartu have been involved in the project. Vasilij Nikolajev participated in the project as a native speaker of Mari.

The book consists of four chapters. The first, introductory chapter gives an overview of research problems and the structure of the study. The second chapter presents outlines of previous phonological and phonetic treatments of Meadow Mari prosody. The chapter was drafted by Toomas Help, Karl Pajusalu, and Tiit-Rein Viitso, and elaborated by Ilse Lehiste. The third, central chapter contains the experimental-acoustic analysis of Meadow Mari prosodic structure. The principal author of the chapter is Pire Teras. The study is based on the measurements of speech samples of eight speakers of Mari. Each of them pronounced frame sentences with 100 test words in two sentence positions. The words were selected by Tiit-

Rein Viitso. The recordings were made by Einar Meister, Head of the Laboratory of Phonetics and Speech Technology at the Institute of Cybernetics of the Tallinn Technical University, and Pärtel Lippus, doctoral student at the University of Tartu. The acoustic measurements of the recordings were made by Pire Teras, Pärtel Lippus, Liina Leemet, Sander Pajusalu, Merike Parve, and Eva Liina Asu. Statistical analyses were made by Pire Teras and partly by Pärtel Lippus and Einar Meister. Einar Meister was also consulted throughout this work. The last chapter of the book summarizes the main results of the research. The primary acoustic data are presented in the Appendices. A map of Mari language areas and a division of the Uralic languages, both composed by Tiit-Rein Viitso, are also included in the Appendices. The introductory and final chapters of the book were written by Ilse Lehiste and Karl Pajusalu in consultation with the other authors. Ilse Lehiste has contributed to all parts of the book.

The authors of the book are most grateful to all the speakers of Mari who participated to the study. The book is dedicated to the Mari people, who this year hosted the Tenth International Congress of Finno-Ugric Studies in Joškar-Ola, the capital of their state.

CHAPTER 1

INTRODUCTION

According to the traditional view, a typical Finno-Ugric language is a language with word-initial stress, distinctive quantity alternations, a rich vowel system, and vowel harmony, as found in Finnish or Hungarian. However, the languages spoken in the center of the Finno-Ugric language area — among them the Mordvin and Mari languages — do not share many of these "typically Finno-Ugric" features. For example, the prosody of Meadow (or Eastern) Mari that is the research object of this study is described in literature as lacking regular quantity distinctions, and instead of fixed stress on the first syllable, it is said to be characterized by unbounded word stress following specific rules. There is a considerable amount of disagreement about the nature of these rules, and the phonetic observations on which they are based are not always sufficiently extensive to justify the generalizations that have been drawn on the basis of these observations.

The primary goal of our project, "Finno-Ugric Prosody", is to provide researchers with reliable acoustic-phonetic data about such less studied, typologically diverse Finno-Ugric languages, using modern experimental methods that were not available to former researchers.

The first monograph that has resulted from our project deals with the phonetic characteristics of Erzya prosody (cf. Lehiste, Aasmäe, Meister, Pajusalu, Teras, Viitso 2003). The results of that study demonstrate that there is neither contrastive quantity nor tone in Erzya, and that neither duration nor pitch serve as unambiguous stress cues. Vowel reduction constitutes the most significant feature that distinguishes unstressed syllables from syllables bearing stress, but there is no categorical substitution of a full vowel by a reduced vowel. Rather, vowel reduction is a process in Erzya that involves gradual movement of a vowel in the acoustic space from a

relatively peripheral toward a central position. According to our results, the basic function of word stress in Erzya is to establish and reflect the rhythmic structure of utterances, which involves the establishment of higher-level prosodic units. The present study of Meadow Mari will make it possible to compare the characteristics of Erzya prosody with the prosody of this cognate language.

The vague status of quantity and tone in Mari, its complicated rules of stress assignment and vowel reduction have become a touchstone for modern phonological theory. In the traditional description of Meadow Mari the distinction of full and reduced vowels is presented as a principal phonological contrast (cf. Kangasmaa-Minn 1998: 223); in some analyses, an attempt has been made to define the alternation of full and reduced vowels as an opposition in vowel length (Hayes 1985).

Similarly to Erzya, word stress is claimed to be non-phonemic in Mari; but unlike in Erzya, it appears to be determined by the segmental structure of the word. A common claim is that stress falls on the last full vowel of the word; if there are no full vowels (i.e. if all vowels in the word are reduced vowels), the initial syllable receives stress (cf. Kangasmaa-Minn 1998: 224). In a modern theory of phonology (OT, Optimality Theory), the system is described as a DTO (default to opposite side) system where stress falls on the rightmost heavy syllable; in the absence of heavy syllables, stress falls on the leftmost syllable (Baković 2004). Even though mid vowels count as full vowels, they can have reduced allophones in word-final position, in which case stress is likewise shifted to the leftmost syllable. Thus, while there are several similarities between Erzya and Meadow Mari prosody, we can anticipate sharp differences between them as well.

The presentation of the prosodic structure of Meadow Mari in the succeeding parts of the book follows the same research plan and methodology as in the above-mentioned study of Erzya.

The chapter following this introduction (Chapter 2) offers a condensed survey of previous studies. A general overview of the topic and of basic features of the Meadow Mari sound system is followed by an outline of early descriptions of the language, beginning with the 18th century. Treatments of Mari prosody in traditional Finno-Ugric scholarship are mentioned next, followed by a brief presentation of Western structuralist and generative points of view. An essential part of Chapter 2 is the characterization of previous phonetic research. It becomes evident that in all former experimental studies the number of speakers has been small (1—3), and often it is unclear to what extent the results have been reliable enough for theoretical generalizations. Thus it appears to be obvious that there is a need for more thorough experimental research that is the task of the present study.

The core part of the book is Chapter 3, which presents the results of our acoustic analysis of Meadow Mari prosody. The speech material, basic data about the eight speakers, and applicable methodology are described first. The analysis focuses on potentially contrastive prosodic features — duration, fundamental frequency, and stress and its phonetic manifestation. The analyzed corpus consisted of 100 test words, placed in sentence frames where they occurred in both phrase-final and sentence-final position. Thus the total number of analyzed test words was 1600 (eight speakers, 100 words occurring twice). The measurements included the duration of segmental sounds, fundamental frequency, and the formant structure of vowels in each of 1600 test words. The main research questions addressed in Chapter 3 are the following:

a) is there contrastive quantity in Mari? What would be the linguistic status of possible phonetic differences in sound duration?
b) what is the role of fundamental frequency in Meadow Mari prosody?
c) what is the relationship between vowel quality and the prosodic system?
d) what are the phonetic manifestations of stress?
e) what is the role of stress in the phonological structure of Meadow Mari?

The main results of our experimental study are summarized in the concluding chapter (Chapter 4) from a typological point of view. Here we offer our responses to the research questions that had been faced earlier by phoneticians and phonologists of various academic backgrounds, such as the relationship between vowel reduction and prosodic phenomena, the connection between stress and higher-level prosodic units, and how do the special features of Meadow Mari prosody express phonological universals.

The book contains additionally a bibliography of studies on Meadow Mari phonetics and phonology, a map showing the Mari settlement and dialect areas (Appendix 1), a schematic presentation of the Uralic languages (Appendix 2), a list of the test words used in the study (Appendix 3), and additional measurement results obtained in the course of the acoustic analysis (Appendix 4).

CHAPTER 2

SURVEY OF PREVIOUS RESEARCH ON MEADOW MARI PROSODY

2.1. Introduction

In this chapter, we offer a review of previous studies dealing with Meadow Mari prosody. The topic has been approached from several points of view; in subsections of this chapter we attempt to look at these studies grouping them under certain unifying principles.

First, however, we will define our topic more precisely. The version of Mari that we are working with is one of the two main variants of the language: Meadow Mari. One of the reasons for choosing the Meadow Mari variant over Hill Mari is the fact that the prosodic structure of Hill Mari appears to be relatively simple, while that of Meadow Mari appears to be much more complicated. There seems to be general agreement that the prosodic system of Hill Mari involves placement of stress on the penultimate syllable, while stress placement in Meadow Mari appears to follow rules that are formulated in different ways by different scholars (Kangasmaa-Minn 1998: 220). An experimental phonetic study can make a contribution by offering objective data, on which a reinterpretation can be based.

The peculiarities of the Meadow Mari stress system have been attributed to language contact. Kovedjajeva (1970: 72—75) has even claimed that the whole modern stress pattern of Meadow Mari has been borrowed from a Turkic language, namely from Ancient Bolgar, the predecessor of modern Chuvash, with which the predecessor of Meadow Mari was in intimate contact. The Mari stress systems thus may be viewed as a combination of the Finno-Ugric principle of word-initial stress and the borrowed Turkic principle of word-final stress.

Modern Mari is currently subjected to massive phonetic and phonological influence of Russian through Mari-Russian bilingualism and the official role of the Russian language (cf. Zorina 1998). However, it is worth observing that during the first centuries of Russian influence on Mari, borrowed Russian words entered the Mari language without affecting its sound structure to a significant degree.

The research reported in the present study aims to establish the role of duration, fundamental frequency, and stress in the prosodic structure of Standard Meadow Mari. The segmental structure is of interest to the extent that it interacts with the prosodic structure. Thus we will include the special characteristics of full and reduced vowels in our presentation, but will omit discussion of such phenomena as vowel harmony and consonant alliteration. We use the term "Standard Meadow Mari" with reservations, knowing full well that the influence of literary standards is still relatively weak in spoken Mari, and that the language represents a dialect continuum. In describing the speakers whose productions we have analyzed, we provide the necessary background information that might help explain some of the exceptional productions that may be due to dialect differences.

The form of Standard Meadow Mari that we are describing has the following phoneme inventory (Kangasmaa-Minn 1998: 220—222):

There are eight vowels: /i/, /ü/, /e/, /ö/, /u/, /o/, /a/, /ə/. The symbol /ə/ stands for the reduced vowel whose acoustic characteristics will be described later in detail. According to Kangasmaa-Minn, there is a certain amount of balance in the vowel system: the four front vowels /i, ü, e, ö/ are opposed by the four back vowels /u, o, a, ə/, and the four rounded vowels /u, ü, o, ö/ contrast with the four unrounded vowels /i, e, a, ə/. The system is not equally balanced with regard to vowel height: there are three high vowels /i, u, ü/, four mid vowels — /e, o, ö, ə/, and one low vowel, /a/. (Note that Kangasmaa-Minn classifies the reduced vowel as a back vowel, which will turn out not to be exact in terms of acoustic structure.) The vowel inventory does not contain diphthongs.

The nineteen consonant phonemes of Meadow Mari include the voiced and voiceless stops /b, d, g, p, t, k/, voiced and voiceless sibilants /z, ž, s, š/, an affricate /č/, four nasals — /m, n, ŋ, ń/ (the palatalized counterpart of /n/), the lateral /l/ and its palatalized counterpart /ĺ/, the trill /r/ and the glide /j/. The voiced plosive /b/ has an allophone [w], and /č/ has a voiced allophone. There are no geminate consonants in Meadow Mari, except for so-called false geminates that arise at morpheme boundaries (cf. Lehiste, Meister, Pajusalu, Parve, Teras, Viitso 2001: 262—263).

In surveying previous publications, we will concentrate on the possible contrastive role of duration, fundamental frequency, and the various phonetic correlates of stress.

2.2. Mari prosody: Traditional Finno-Ugric scholarship and structuralist analyses

Comparative studies of the Finno-Ugric languages developed in parallel with similar research in Indo-European. Some of the earliest treatments of Mari appeared as part of that stream from the middle of the 19th century to the beginning of the 20th, e.g. those by M. A. Castrén (Castrén 1845), F. J. Wiedemann (Wiedemann 1837; 1847), A. Genetz (Genetz 1889), M. Veske (1889), E. Lewy (Lewy 1922), and Y. Wichmann (1923). Comparative Uralic linguistics continued until the emergence of structural linguistics in the middle of the 20th century. Classical treatments can be found in E. Itkonen's numerous works (Itkonen 1954; 1955a; 1955b; 1966) and in B. Collinder's publications (Collinder 1960; 1965). As a representative view one might consider the statement by Collinder (1965: 42—43): "In some of the dialects of chE (= Eastern Cheremis), the main stress is on the etymologically long vowels (see under etymological phonology); if there is no etymologically long vowel in the word, the main stress is usually on the first syllable. In the easternmost Cheremis dialects there is a tendency to put the main stress on the last syllable; this may be owing to Turkic influence."

Structuralist linguists introduced a new type of approach, using direct elicitation of linguistic material from actual informants. One of the first publications within this school of linguistics was the "Eastern Cheremis Manual" by T. Sebeok and F. Ingemann (Sebeok, Ingemann 1961). The authors base their observations on original research, eliciting forms and texts from one speaker of Eastern Mari. Their informant was born and raised in Apštjal, a Mari-speaking village located between Birsk and Burajevo, in what was then the Bashkir Autonomous Soviet Socialist Republic, and is now Baškortostan. The "Eastern Cheremis Manual" contains subchapters on phonology, morphophonemic alternations, grammar and texts. The phoneme inventory contains eight vowels, /i, ü, u, e, o, ö, a, ə/ (the symbol /ə/ is used here to denote schwa). There is a listing of allophones, the occurrence of which is described as being positionally determined; there is no reference to conditioning by stress. For example, on pp. 7—8 /e/ is listed as having six allophones, four of which are described as "mid to high, front to central, unrounded reduced vowel or mid front unrounded vowel" that occur "finally in polysyllabic words, except when preceding vowel is a back vowel", and two that are described as "lower (usually) to higher mid front unrounded vowel", occurring "elsewhere".

Sebeok and Ingemann state (p. 8) that they assume that stress is not phonemic: they caution that this generalization is based on their limited corpus. They list five conditions under which words may have two stress

patterns; these conditions involve vowel harmony. It is to be noted that the reduced vowel, /ə/, can follow all seven full vowels and can carry stress. Depending on segmental structure (= vowel harmony), some words are always stressed on the last vowel (but morphological factors may enter in — some final morphemes never carry stress). Which of the two possible stress patterns occurs appears to depend on sentence-level prosody — intonation and rhythm.

Sebeok and Ingemann do not mention the possible contrastive role of quantity; from the description of allophones, however, it can be deduced that duration is at least occasionally a boundary marker, since /i /, /ü/, /u/ and /o/ are listed as having lengthened allophones in final position.

Similar uncertainty in the description of Mari stress is found in the article by Ristinen (1960). Ristinen's informant was the same person whose speech was analyzed by Sebeok and Ingemann. On p. 259 Ristinen states: "It has not been possible for us to make any satisfactory statement about the occurrence of stress, although certain syllables seem to be more prominent than others, and this prominence affects the occurrence of certain allophones, particularly of /r/. Throughout the texts obtained from Mr. Jewskij, we find the same word stressed (to our ear) on one syllable in one instance and on another syllable in another instance. [---] There are statements and discussions in the literature on the occurrence of stress in Eastern Cheremis, but they are of little help in arriving at any solution. Some investigators admit that they know of no satisfactory solution, while others offer inapplicable generalizations. The most reliable rule we have been able to formulate is rather unsatisfactory. It is that the final syllable of a word is most generally stressed, but certain non-initial morphemes, words such as /kən/ 'if' are never stressed."

In footnote 28, pp. 284—285, Ristinen discusses the Itkonen 1955b reference that Hayes (1985) later used as one of the three sources for his theory about stress in Eastern Mari. Ristinen writes: "Itkonen (op. cit. p. 27, fn. 20) states that in Eastern Cheremis the last vowel of a word is stressed, unless it is historically a reduced vowel. Even if this were true of our informant's Cheremis, which it appears not to be, it would of course not be possible to state the conditions governing the position of stress without knowing the history of each morpheme."

A rather traditional overview of Mari phonology by Eeva Kangasmaa-Minn is included in the 1998 survey of Uralic languages edited by Daniel Abondolo (The Uralic Languages 219—248). On p. 224 Kangasmaa-Minn states: "Word stress is non-phonemic. In Eastern Mari it falls on the last phonologically full vowel, e.g.; *olma·* 'apple', but *mu·no* 'egg' (phonologically /munə/), *munən* 'of an egg'. If a word contains only reduced vowels, the stress falls on the first syllable, e.g. *tə·ləzəm* 'moon' (accusative)."

2.3. Mari prosody: Western phonological treatments

In the western research tradition, the article that most contemporary phonologists quote is Kiparsky 1973. Kiparsky's source is Itkonen 1966. According to Itkonen quoted by Kiparsky (p. 101; Itkonen 1966: 156), certain dialects of Eastern Mari have the following rule: (a) The accent falls on the syllable containing the last full vowel of the word; (b) If the word has only reduced vowels, the accent is usually on the first syllable.

An influential publication by Bruce Hayes (1985) quotes Kiparsky 1973, Sebeok, Ingemann 1961 (quoted by Hayes as Ingemann-Sebeok), and Itkonen 1955b. Hayes assumes that the distinction between full and reduced vowels depends on vowel length, which he equates with gemination (p. 57). He motivates this by observing that full vowels are phonetically longer than reduced vowels, and by assuming that "there are apparently no languages having an underlying three-way distinction of the type reduced vowel: full short vowel: full long vowel. This would follow automatically from the assumption that both the full-reduced and the long-short distinctions must be represented underlyingly by gemination."

It is generally assumed that stress in Eastern Mari falls on the last full vowel or a word, and on the initial vowel if the word contains only reduced vowels. It may be deduced from Hayes' statement that he assumes an opposition between short and long vowels in Mari; in the transcription of the five words he brings as examples, the vowels /i/, /a/, and /u/ are written as geminates (with two letters), the reduced vowel [ə] is written with a single letter. Hayes (1995) and Kenstowicz (1994) are mentioned by Urbanczyk (1999: 402) as sources for her inclusion of Mari among languages avoiding stressed schwa.

A recent OT-analysis (Optimality Theory) of unbounded stress systems by Eric Baković (2004) describes Meadow Mari — similarly to Classical Arabic, Chuvash, Selkup etc. — as being a language of the DTO (default to opposite side) system with stress on the rightmost heavy, or else on the leftmost syllable.

Unbounded stress is traditionally seen as lacking any rhythmic or alternating regularities. According to this view, unbounded stress falls on heavy syllables irrespective of the distance from word edge or other stresses. If there is no heavy syllable, an edgemost light syllable is stressed. In the case of a DTO system stress is attracted to a heavy syllable farthest from that edge.

Considering the fact that in unbounded stress systems stress is attracted to heavy syllables, there is a need for a weight-to-stress constraint. Baković applies the Weight-to-Stress Principle (WSP, introduced by Prince 1980

explaining Estonian quantity degrees). The principle postulates that all heavy syllables are prominent in feet and on the grid, being stressed foot heads. Thus, WSP is only relevant in forms with heavy syllables (Baković 2004: 204—207).

The issue that remains to be solved is the relationship between main and secondary stresses in the case of DOT systems. Baković includes a subset of constraints for defining the head of a prosodic word. The head is the foot that bears main stress (Baković 2004: 208—211). Baković states that in the context of his analysis it is necessary to claim that stress is partially independent of foot structure (Baković 2004: 211—212). It is obvious that a more precise treatment of optimal foot structures must be added. The presence of an obligatory secondary-stressed initial foot is also a question that calls for further phonetic investigation.

In considering the treatment of the Meadow Mari stress system by the above-mentioned authors, it should be kept in mind that all these theories are ultimately based on the limited empirical material presented in Sebeok, Ingemann 1961. Although a certain amount of experimental information has been available since 1960 (cf. Gruzov 1960), it appears that a detailed experimental-phonetic study of the prosody of Meadow Mari could make an essential contribution not only to the analysis of the language itself, but also to linguistic theory.

2.4. Mari prosody: Local pre-experimental descriptions

Since the first descriptions of the Mari language, attention has been paid to the question of word stress. In the first Mari grammar of 1775 (Sočinenija 1775) of the Sankt-Petersburg Academy of Sciences (cf. Sebeok, Raun 1956), word stress has been considered a special property of any word. For example, a Mari noun was said to be characterized by declension, number, case, and stress. Problems of stress were also considered in the succeeding early treatments of the Mari language: "Čeremisskaja grammatika" of 1837 by an unknown author, Castrén 1845, Wiedemann 1837, 1847, Veske 1889, Genetz 1889, and Ramstedt 1902.

Among the early writings, an interesting concept of Mari stress was presented in F. Vasiľjev 1887. Vasiľjev does not recognize the specific status of the reduced vowel /ə/ and derives it from a full vowel appearing in unstressed position, e.g. in the contrastive pair *ške·ndən* 'of yourself' (sing.) vs. *škenda·n* 'of yourself' (plur.). According to Vasiľjev, the two sound strings consisted of the same sounds; the phonological distinction was due to contrastive stress. Although this approach is clearly influenced by the structure of Russian, here the inherent significance of different stress patterns in Meadow Mari is given due attention.

Karmazin (1936) provides the following main rules for word stress in Meadow Mari:
1) stress can fall on the first, last, or intermediate syllable: *i·mńe* 'horse', *mu·no* 'egg', *o·do* 'white', *mura·ltəš* 'managed', *ača·* 'father', *izi·* 'small';
2) if there are other vowels than /ə/ in the word, /ə/ will be unstressed: *šo·rək* 'sheep', *a·šnəktəšəm* 'forced to feed', *əštəne·že* 'has decided to do';
3) if there are no other vowels than reduced /ə/ in the word, the first syllable will be stressed: *nə·lət* 'four', *ə·rəktəšəm* 'I warmed up';
4) stress will usually not fall on final /o, ö, e/: *tü·rtö* 'thread', *mu·no* 'egg'.

Formulations such as those by Karmazin emphasize the importance of the difference between full vowels and reduced vowels. The various Mari dialects differ with respect to the number of reduced vowels. In fact the area where Mari dialects are spoken constitutes a dialect continuum (Ivanov 1981). The dialect that forms the basis of the Meadow Mari literary language has only one reduced vowel. Rules based on the relationship between full vowels and reduced vowels differ depending on the number of reduced vowels in the vowel systems of the different dialects. The extent of mutual influences of the literary language and the local dialects is not unequivocally established.

Rules for the placement of stress continue to be formulated by Mari linguists; one of the most recent examples can be found in Kuklin 2003 (pp. 104—108). Kuklin's orthoepic rules specify the location of stress with reference not only to phonetics, but to morphology, syllabic structure, parts of speech, and native versus borrowed history of the lexicon. A basic principle is the interdependence of stress location and the constituent vowel patterns: if the vowel of the final syllable qualifies for word stress, it will be stressed; if not, the vowel of the preceding syllable is subjected to the same kind of evaluation, and the process is repeated towards the beginning of the word until the location of the stress is fixed.

2.5. Previous phonetic research

Early experimental phonetic research concerning the prosodic structure of Mari was summarized by E. I. Kovedjajeva in her book "Проблемы акцентуации марийского языка" (1970). It appears that the first linguist to use experimental techniques was L. P. Gruzov, whose dissertation (Gruzov 1960) contained a section dealing with stress. Gruzov based his conclusions on kymography, a research technique used for measuring volume-velocity of airflow out of the vocal tract.

On the basis of his measurements Gruzov concluded that Mari stress is based exclusively on duration, and that neither fundamental frequency nor intensity play any role. Change in the position of stress can change

the meaning of a word; Gruzov offers a few examples, like *še·rge* 'dear' — *šerge·* 'comb'. Vowels in pretonic syllables are 30% shorter than vowels in stressed syllables. There is no vowel reduction associated with lack of stress; the so-called reduced vowel is a phoneme in its own right, even though it is shorter than so-called full vowels. The reduced vowel can carry stress (in words where there is no other vowel present that might attract stress to itself due to its greater length).

In a later publication, Gruzov (1964a) claimed a role for intensity in the manifestation of stress. He found that in several productions of the pair *še·rge* 'dear' and *šerge·* 'comb', and the sequence *še·rge šerge·* 'dear comb', "the first /e/ in both words was almost exactly identical with respect of the absolute value of intensity, even though in the first word it is stressed and in the second word unstressed. Relative to the vowel of the second syllable, its intensity was in each case higher — from 106% to 120%." (Translation by I. L.)

Gruzov also used x-rays to compare various Mari vowels from the articulatory point of view (Gruzov 1964b). On the basis of these studies, he established the articulatory differences between Mari reduced vowels (in several dialects) and the Russian vowel symbolized as *ы*.

E. I. Kovedjajeva (1970) gives a critical overview of Gruzov's conclusions. In her opinion, a stressed vowel is perceived as having higher intensity due to its greater duration and comparatively higher intensity than other vowels, or vowels in the same word (p. 98). In evaluating the role of intensity in the production and perception of a vowel as being stressed, one has to take into account the characteristic duration and intensity of vowels (the terms usually employed are 'intrinsic intensity' and 'intrinsic duration' — high vowels like [*i*] and [*u*] have lower intensity and are shorter than low vowels like [*a*], all other factors being kept constant — I. L.). Kovedjajeva bases her comments on work done with respect to stress in Russian by L. V. Zlatoustova (1962).

Kovedjajeva agrees with Gruzov that the reduced vowel is not a reduced allophone of a full vowel (like in Russian), but is a phoneme in its own right, and offers three (near-) minimal pairs to substantiate the claim (p. 67: *šə·že* 'autumn' — *ši·že* 'received, 3.pers.imperf.; *tə·šte* 'here' — *tu·što* 'there'; *šə·de* 'anger' — *šu·do* 'grass'). She disagrees with Gruzov about the possible meaning-differentiating role of stress placement (p. 71), saying that even though there are some instances where stress position plays such a role, their number is so small — and basically they are due to borrowed lexicon — that one should not assume that stress plays a contrastive role in the Mari language.

Kovedjajeva's own major contribution is the first spectrographic analysis of Mari vowels (pp. 111—127). She had one female speaker (with a basic

fundamental frequency between 230 and 250 Hz), who produced a set of words with counting intonation. A list of the words is given in the Appendix; there were 13 examples for [*a*], 12 for [*o*], 12 for [*u*], 13 for [*ə*] (the reduced vowel), 9 for [*e*], 8 for [*ö*], 13 for [*ü*], and 9 for [*i*]. Twenty-two figures present spectral cross-sections for stressed and unstressed vowels in different positions within the words. Of special interest is the representation of the reduced vowel [*ə*] in stressed and unstressed position (figures 10 and 11, p. 119). According to Kovedjajeva's analysis, the vowel has three formants with intensity peaks between 500—1000 Hz, at 1600 Hz, and between 3200—8000 Hz, and is clearly differentiated from other vowels by its formant structure.

Among Kovedjajeva's findings is the observation that while there is no qualitative difference between stressed and unstressed vowels in what she calls their quasi-stationary part, some unstressed vowels (especially [*e*] and [*o*]) have a tendency to move toward the schwa-position in their final phase. Also, the formants of unstressed vowels are usually characterized by a shift toward higher values.

A more recent experimental study of Mari vowels is an article by L. V. Bobkova (1975). (The same publication where Bobkova's article appeared contains an article by N. M. Novoselova about the formant structure of sonorant consonants in Mari.) Bobkova's research presents the average frequencies of the first three formants of eight vowels, obtained through spectrographic analysis of 172 words pronounced by each of three speakers. A Visible Speech -type spectrograph was used to produce the spectrograms. Measurements were made at what the author calls quasi-stationary stage of the vowels. A comparison of stressed and unstressed vowels in various positions within the word led to the conclusion that there is no difference in vowel quality that would be caused by lack or presence of stress.

A study of Hill Mari vocalism by Z. G. Zorina (1982) also offers some experimental data concerning Meadow Mari. Her material consisted of 1600 monosyllabic and polysyllabic words produced by three male speakers of the Hill Mari variant of the literary norm (for a total of 4800 recorded words). The recordings were analyzed oscillographically and using the spectrograph; listening tests were also carried out. In separate chapters, Zorina treats duration, intensity, fundamental frequency, and spectral characteristics of vowels. Her results include the following.

In the Meadow Mari variant, stress can be on various syllables. To a certain extent, the position of stress depends on the distribution of phonemes. The phonemes /e/ and /ö/ are not found in post-stress syllables before consonants; /ü/ occurs only under stress and in pre-stress syllables; /ə/ (the reduced vowel) is not used in absolute final

position, and /ə/ can be stressed only in such words where other vowels are missing: /kə·zət/ 'immediately', but /kəša·/ 'footprint' (Zorina 1982: 46).

Zorina also found that stressed vowels were always longer than unstressed vowels, and considers duration to be one of the components of stress in Hill Mari (Zorina 1982: 74). Intensity, however, is not a correlate of stress (Zorina 1982: 85). As regards the role of fundamental frequency, Zorina found that Hill Mari and Meadow Mari differ essentially with respect to F0 movement on vowels. In the Meadow variant, stressed and unstressed vowels have the same kind of tonal movement; in the Hill variant, stressed vowels have a rising F0 curve and unstressed vowels have a falling F0 curve (Zorina 1982: 96). These conclusions were based on material consisting of isolated words, produced with list-reading intonation. Zorina realizes that analysis of isolated words is not sufficient for drawing final conclusions.

Her study of spectral characteristics of Hill Mari vowels demonstrated that there is no essential difference between the F1 and F2 positions of vowels occurring in stressed and unstressed syllables, but that there was a difference in the position of F3, which was higher in stressed vowels.

Baitchura 1988 offers a detailed critique of the instrumental-phonetic studies of the Mari language published by several authors (Gruzov, Kovedjajeva, Bobkova), and summarizes the results of his own work since 1958. His book is divided into five chapters, dealing with vowel length (pp. 35—58), intonation and stress (pp. 59—106), sentence intonation (pp. 107—144), tone and sound-intensity movement (pp. 145—180), and offering some data on the length of consonants (pp. 181—212). The evaluation of previous research is presented in the introduction (pp. 9—34) and in the conclusive materials (pp. 211—234) containing also an overview of Baitchura's own research.

The material on which the results offered in the book are based was recorded from two informants. The first informant was a 20-year-old student at the Kazan University, coming from the village of Novyj Torjal, who represents the Meadow dialect; he was recorded in 1958 at the Laboratory of the Kazan Pedagogical Institute. The second informant was a faculty member of the Mari State University in Joškar-Ola; according to Baitchura, his pronunciation represents the literary Mari language (p. 67). His materials were recorded in 1969 at the Laboratory of Leningrad University. The recording was performed using kymographs available at the two laboratories. The texts consisted both of isolated words and of sequences of two words constituting phrases of three, four, and five syllables. The exact number of items is not listed, but can be deduced to a certain extent from the tables. Thus there were 5 monosyllabic words in the material

recorded by the second informant, 31 isolated disyllabic words produced by the first informant, and 9 isolated disyllabic words produced by the second informant. That speaker also produced 16 trisyllabic words and word combinations, 15 tetrasyllabic combinations of two disyllabic (or one trisyllabic and one monosyllabic) words, 5 pentasyllabic combinations of two words (disyllabic and trisyllabic), and 22 sentences that were analyzed from the point of view of sentence intonation.

On the basis of measurements from these recordings, Baitchura differentiates two degrees of length in Mari: the reduced vowel /ə/ tends to be two or more times shorter than the "vowels of full formation" in analogous phonetic position. He says that this indicates the possibility of distinguishing two degrees of vowel length in Mari dependent on their quality. He also finds that high vowels are unstable and can be reduced in certain positions. At the absolute end of an utterance, the length of all vowels is nearly the same and reaches its maximum, often surpassing by almost two times that of the preceding ones (p. 43).

The part dealing with stress and tone is based on kymographic analysis of part of the material recorded by the two informants: 22 isolated disyllabic words produced by the first informant, and 10 disyllabic words produced by the second informant. That informant's productions of several polysyllabic words were also analyzed (10 trisyllabic isolated words and 7 trisyllabic word combinations, and 8 quadrisyllabic combinations). As some words were apparently produced twice, there are measurements reported for 40 productions by Informant 1 and 46 productions by Informant 2. The data are presented both as tables and as reproductions of kymograph recordings.

For calculating intensity, Baitchura used the following formula: $f = a^2n^2$ or $f = a^2/l^2$, where f denotes acoustical energy, a = the amplitude of vibration, n = the frequency of vibrations, and l = the length of the vibration (p. 145). Baitchura found that "the sound intensity of a vowel is, as a rule, in concordance with the tone, mostly following the latter even up to details, and both the tonic accent and the intensity stress fall usually on the vowel of the initial syllable, the exclusions being rare" (p. 146).

Baitchura recognizes increase of sound intensity as intensity stress, and an increase in tone height (and/or its special movement) as the tonic accent. As both of them as a rule fall on the first syllable of disyllabic Mari words, he concludes that such words had initial stress, in spite of the fact that the second vowel was usually longer (p. 65). In sentences, stress may change its position in a word due to what Baitchura calls "rhythmo-melodical requirements of the language: it could happen because here the place of stress was not of phonological importance for the word in a given situation. However, one should not draw the conclusion that the stress is not

phonologic in Cheremis in general. There are many languages, e.g. of the Ural-Altaic group in which the stress can have phonologic function in some cases and have none in other cases. To all appearances, Cheremis belongs to this kind" (p. 109).

Baitchura reports also measurements of consonant duration and finds a length difference between what he calls "strong consonants" (/k, t/) and "weak consonants" (/g, d/) — the strong consonants are by more than two times longer than the corresponding weak ones (p. 182).

As far as sentence intonation is concerned, Baitchura concludes that there is a general tendency to a more or less falling tone in the sentence. Incompleteness is signalled by a final rise. Sentence intonation predominates over, or is in concordance with, the tone movement in intonation (or sense) groups of words, whereas the latter predominate, in turn, over the intonation of individual words. This does not exclude the existence of word stress, or accentuation of individual words, but when it has no phonological function in a given situation, it can be subjected to what Baitchura calls rhythmo-melodical structure of the concrete context of speech. Such changes are only possible under certain conditions prescribed by the phonetic and other laws of a given language (pp. 134—137).

The book contains 16 pages of reproductions of kymograms and 55 pages of tables, in addition to considerable amounts of measurement results given in the text. References to research by others are given in footnotes; there is no bibliography.

2.6. Summary of current views

As can be seen from the overview offered above, there is still considerable disagreement about the nature of Meadow Mari prosody. Most researchers dismiss the idea that duration has a contrastive function — but Gruzov (1960) as well as Baitchura (1988) interpret the durational difference between full vowels and the reduced vowel as a phonological opposition based on vowel quality, and Hayes (1985) treats it as a difference between geminates and (non-geminate) single vowels. There appears to be general agreement that there is no contrastive tone in Meadow Mari; heightened fundamental frequency may play a role in identifying a stressed syllable, but word-level pitch patterns are subordinated to sentence intonation. The descriptions of the phonetic manifestation of stress seem to offer the greatest number of opposing points of view.

The basic question of whether the position of stress can be contrastive receives somewhat hesitant support. While there are indeed minimal

pairs in the language where a difference in meaning is associated with different placement of stress, the number of such minimal pairs appears to be small, and there seems to be a suspicion that at least some of them involve borrowed lexicon (Kovedjajeva 1970). Researchers have made relative firmer claims about the phonetic realization of stress. Duration is considered to be a reliable stress correlate by, e.g., Gruzov (1960) and Zorina (1982). However, greater length is not the absolute determinant, since the reduced vowel — systematically shorter than full vowels — can nevertheless carry stress. The role of intensity is ambiguous because of the interaction of intensity with vowel quality — stressed high vowels can have lower intensity than unstressed low vowels, due to differences in intrinsic intensity. Nevertheless, Baitchura (1988) found that initial syllables were usually characterized both by greater intensity and by heightened pitch.

The interaction of vowel quality with stress receives — and deserves — a great deal of attention. It is a general observation that lack of stress may be associated with vowel reduction; this is a phenomenon that has been observed in a large number of languages. Acoustically, the term "vowel reduction" refers to a specific change in the position of the vowel in the acoustic space defined by formant positions. Stressed vowels usually occupy more extreme positions within the vowel space, while unstressed vowels move toward the center of the vowel space in greater or lesser degree. The system of Meadow Mari offers special problems, since in Meadow Mari the central vowel — the position toward which the unstressed vowels are expected to move — is a phoneme in its own right. The authors quoted in the overview have differing opinions about vowel reduction in Meadow Mari. Gruzov (1960) claims that there is no vowel reduction associated with lack of stress. Kovedjajeva (1970) observes that some unstressed vowels have a tendency to move toward the schwa-position in their final phase, even though there is no qualitative difference between stressed and unstressed vowels in their steady-state part. Bobkova (1975) likewise found no difference in the quality of stressed and unstressed vowels. Zorina (1982) found differences between stressed and unstressed vowels with regard to the F3 position.

Most of the quoted studies were based on the analysis of a relatively small number of speakers (Gruzov 1960 — 1, Sebeok and Ingemann 1961 — 1, Ristinen 1960 — 1, Kovedjajeva 1970 — 1, Bobkova 1975 — 3, Zorina 1982 — 3, Baitchura 1988 — 2). A serious problem with the use of one or a very small number of informants is the question to what an extent the results characterize the idiolect of the speaker, and to what an extent they can be generalized to the language. It appeared of interest to us to investigate the phonetic reality behind the various analyses of Meadow Mari

prosody, using a more representative number of speakers, and applying contemporary experimental phonetic techniques. We also believe that more accurate phonetic data will constitute a more reliable foundation for phonological theory.

CHAPTER 3

ACOUSTIC ANALYSIS OF MEADOW MARI PROSODY

3.1. Introduction

As described in the preceding chapter, there has been a considerable amount of research on Mari prosody in earlier times. However, extensive acoustic-phonetic data have not yet been presented. This is what we are offering in the current chapter.

The presentation proceeds in the following order. The analyzed material and the methodology of analysis are described first. Quantity issues are dealt with next, followed by a treatment of questions concerning the role of stress and its possible phonetic manifestations. The analysis is based on the averaged results of all eight speakers; details concerning individual speakers are presented in Appendix 4.

3.2. Materials and method

A text corpus was recorded from eight speakers with 100 test words of one to four syllables placed in the frame "*Кызыт* …, *вара* …" ('I said … not …'). Every word occurred both in the phrase-final and sentence-final position. Thus every speaker produced 200 test words, for a total of 1600 for the group. The speakers are listed in the order in which they were recorded, depending on availability. The list of words is given in Appendix 3.

The speakers were as follows:

EI — female. Born 17.01.1976 in Šoršola, Mari El. Received her secondary education in Mari El. During the recording resided and studied in Tallinn.

AA — male. Born 16.10.1974 in Joškar-Ola, Mari El. Received his secondary education in Mari El. During the recording resided and studied in Tallinn.

ST — female. Born in 1977 in Golovino, Mari El. Received her secondary education in Mari El. During the recording resided and studied in Tallinn.

JT — male. Born in 1963 in Maska-Rodo, Mari El. Received his secondary education in Mari El. During the recording resided and studied in Tallinn.

LV — female. Born 26.09.1981 in Čerlak, Baškortostan. Since 2000 in Estonia, studies at Tartu University.

NK — female. Born 06.11.1976 in Toktaj-Beljak, Kužener, Mari El. Since 2001 studying at Tartu University.

VN — male. Born 23.05.1967 in Engermučaši (Vaškino), Suksun, Perm Region. Since 1991 in Estonia, studies at Tartu University.

VA — male. Born 15.08.1971 in Tiškino, Morki, Mari El. Since 1992 in Estonia, working.

The recordings were made (the first 4 speakers) by Einar Meister at the Laboratory of Phonetics of the Institute of Cybernetics of the Tallinn Technical University in 2000 and (the last 4 speakers) by Pärtel Lippus at the University of Tartu in 2004. The text of the first 4 speakers was recorded with a microphone Sony ECM-44B and DAT-recorder Casio. The recordings were stored in the computer as Nsp-files sampled at 20 kHz. The text of the last 4 speakers was recorded with a microphone Philips SBC MD 680 and DAT-recorder Sony TCD-D 100. The recordings were stored as mono Wave files sampled at 48 kHz with a resolution of 16 bits.

The acoustic analysis was carried out using the Kay Elemetrics CSL 4300B speech analyzer and the analysis program Praat, version 4.2. Measurements were made of the duration of each segmental sound (except word-initial consonant), of the fundamental frequency of words at the beginning and end of each vowel, and the values of the three first formants of vowels.

The acoustic analysis was carried out by Eva Liina Asu, Pärtel Lippus, Liina Leemet, Sander Pajusalu, Merike Parve, and Pire Teras. The location of stress was ascertained by Vasilij Nikolajev, a native speaker of Mari, through repeated listening.

3.3. Quantity

The duration of all sounds (except word-initial consonants) was measured. There were instances of vowel omission in the productions of some of the speakers. The female speaker EI did not pronounce the second vowel

of the word *mokšən* 'liver (gen. sg.)' > *mokšn* in sentence-final position. The male speaker AA did not pronounce the vowel of the second syllable of the words *nələtənat* 'foursome' > *nəltənat* and *kutšəneda* 'you (pl.) want to catch' > *kutšneda* in sentence-final position. The female speaker ST pronounced the word *ijəm* 'ice (acc. sg.), I swam' without the second vowel (*ijm*) in sentence-final position. In the speech of the male speaker VN there were more vowel omissions: he omitted the first vowel in *indeše* 'nine' > *ndeše*, the second vowel in *kiddəme* 'handless' > *kitme*, *luddəmo* 'unreadable, unread; boneless' > *lutmo, ludənam* 'I read (praet. II)' > *ludnam*, and the third vowel in *nələtənat* 'foursome' > *nələtnat* in phrase-final position, and the first vowel in *čəke* 'little haystack' > *čke* and *kəša* 'footprint' > *kša* and the second vowel in *ijəm* > *ijm* in sentence-final position. As a slip of the tongue, he pronounced the 4th word of the 3rd bloc as *da* instead of *ida* 'don't (2pl. imper.)'; thus that word could not be included in the analysis. The word *lu* 'ten, bone', first word of the first bloc, produced in phrase-final position, could not be included because of a technical error.

3.3.1. Vowel duration

3.3.1.1. Duration of vowels of open syllables

The vowel system of Meadow Mari consists of 8 (short) monophthongs: the high vowels /i, ü, u/, mid vowels /e, ö, o, ə/, and the low vowel /a/. There are no diphthongs, but the combination of /i/ and the glide /j/ occurs in words like *vijdəme* 'powerless'. The status of /ij/ will be discussed below.

The total number of stressed and unstressed open syllables occurring in the one- to four-syllable test words is 127. For all eight speakers and for both sentence positions, this amounts to 2032 instances; but because of the above-mentioned vowel omissions, the actual number of analyzed open syllables is 2023. The first syllable of disyllabic words, the first and second syllable of trisyllabic and the first and third syllable of four-syllable words (there was no stress on the second syllable) are considered as non-final stressed syllables. Here, open syllables with secondary stress are not included, as their duration is much shorter that that of other stressed syllables.

The duration of vowels in open stressed syllables in phrase-final and sentence-final positions is given in Table 1 (as for data by speakers, cf. Appendix 4, Table 1A). Separate consideration is given to the duration of the reduced vowel /ə/ in a stressed syllable, the duration of the vowel in stressed syllable in word-internal and word-final position, and the duration of a vowel in monosyllabic words (the corpus included only two mono-

syllabic words consisting of an open syllable). There were no words with a stressed /ə/ in word-final position.

Table 1

Vowel duration in milliseconds (ms) in open stressed syllables occurring in non-final and final positions in the test words. Phrase-final (PF) and sentence-final (SF) occurrences are presented separately. N — number of tokens, $\bar{x}$ — average duration, s.d. — standard deviation

Position		/ə/ (nonfinal)		V (nonfinal)		V (final)		Monosyllabic	
		N	$\bar{x}$	N	$\bar{x}$	N	$\bar{x}$	N	$\bar{x}$
PF		66	90	180	107	111	180	15	179
	s.d.		18		19		33		58
SF		72	93	177	104	109	174	16	183
	s.d.		22		21		31		44
Overall		**138**	**92**	**357**	**106**	**220**	**177**	**31**	**181**
average	s.d.		**20**		**20**		**32**		**51**

The duration of vowels in open stressed syllables appears to be determined both by vowel quality and by position of the syllable in the word. The reduced vowel schwa is significantly shorter than the other ("full") vowels in comparable positions (non-final open stressed syllables); the difference between the averages (92 ms for /ə/, 106 ms for full vowels) is shown by analysis of variance (ANOVA) to be significant at the $p < 0.0001$ level.

The difference associated with position in the word is considerably greater: vowels in open stressed syllables in non-final position had an average duration of 106 ms, and in word-final syllables — 177 ms. The difference between the averages is shown by analysis of variance (ANOVA) to be significant at the $p < 0.0001$ level.

The duration of vowels in monosyllabic words was comparable to that of vowels in word-final open stressed syllables. No significant difference was found between the durations of vowels in stressed syllables of words occurring in phrase-final and sentence-final position (significance of the difference between the duration of stressed non-final vowels occurring in phrase-final and sentence-final position — $p = 0.5$, stressed word-final vowels — $p = 0.3$, non-final stressed /ə/ — $p = 0.4$).

As can be seen from Table 1A in the Appendix 4, all speakers had the longest vowels in word-final open stressed syllables and in monosyllabic words. Speaker VA had exceptionally long vowels in monosyllabic words, both in phrase-final and in sentence-final position; it might be appropriate to recall here that only two monosyllabic words consisting of an open syllable occurred in the corpus.

The duration of vowels in open unstressed syllables is given in Table 2 (cf. Appendix 4 Table 2A as well). Separate consideration is given to the reduced vowel /ə/ in unstressed syllables in non-final position and to the duration of vowels in unstressed syllables in word-internal and word-final position. The corpus did not contain words with an unstressed /ə/ in final position.

Table 2

Vowel duration (ms) in open unstressed syllables in phrase-final (PF) and sentence-final (SF) words (N — number of tokens, $\bar{x}$ — average, s.d. — standard deviation)

Position		/ə/ (nonfinal)		V (nonfinal)		V (final)	
		N	$\bar{x}$	N	$\bar{x}$	N	$\bar{x}$
PF		197	58	174	71	268	124
	s.d.		10		9		24
SF		195	54	178	67	265	119
	s.d.		5		8		25
Overall		**392**	**56**	**352**	**69**	**533**	**121**
average	s.d.		**7**		**8**		**25**

The longest unstressed vowels occurred in the final open syllable of a word in phrase-final position. The considerable difference between durations of vowels in analogous word-internal and word-final positions suggests the presence of word-final lengthening, as had been observed for vowels in stressed syllables (cf. Table 1).

The reduced vowel /ə/ had the shortest duration of vowels in unstressed syllables — shorter than that of other vowels in unstressed word-internal position. Speakers ST and NK produced these word-internal unstressed vowels with durations that were not different from each other at a statistically significant level ($p = 0.2$ for both speakers). But within the group, the difference between the reduced vowel and full vowels was statistically significant ($p < 0.0001$).

The situation is comparable with regard to unstressed syllables in sentence-final words. Here, too, the reduced vowel was shorter than a full vowel in the same position, the difference being statistically highly significant ($p < 0.0001$).

In general, the duration of vowels in stressed syllables is greater in every position, compared to the duration of unstressed vowels. The duration of vowels in unstressed syllables amounts to approximately 64—69% of the duration of vowels in comparable stressed syllables in phrase-final position, and 58—69% of the duration of stressed vowels in sentence-final

position. The difference is statistically significant ($p < 0.0001$) for both phrase-final and sentence-final occurrences. This applies also to the duration of /ə/, where the difference between the durations of stressed and unstressed occurrences is significant at the same level ($p < 0.0001$).

The variability of the duration of vowels was greatest in word-final position, as evidenced by the standard deviations (stressed vowel in phrase-final position — 33 ms, unstressed vowel — 24 ms; stressed vowel in sentence-final position — 31 ms, unstressed vowel — 25 ms). The big variation of the duration of vowels in monosyllabic words (average standard deviation of 51 ms) may be due to the relatively small number of tokens (there were only two open-syllable monosyllabic words in the corpus).

The averaged duration of the vowels in stressed and unstressed syllables is compared on Figure 1.

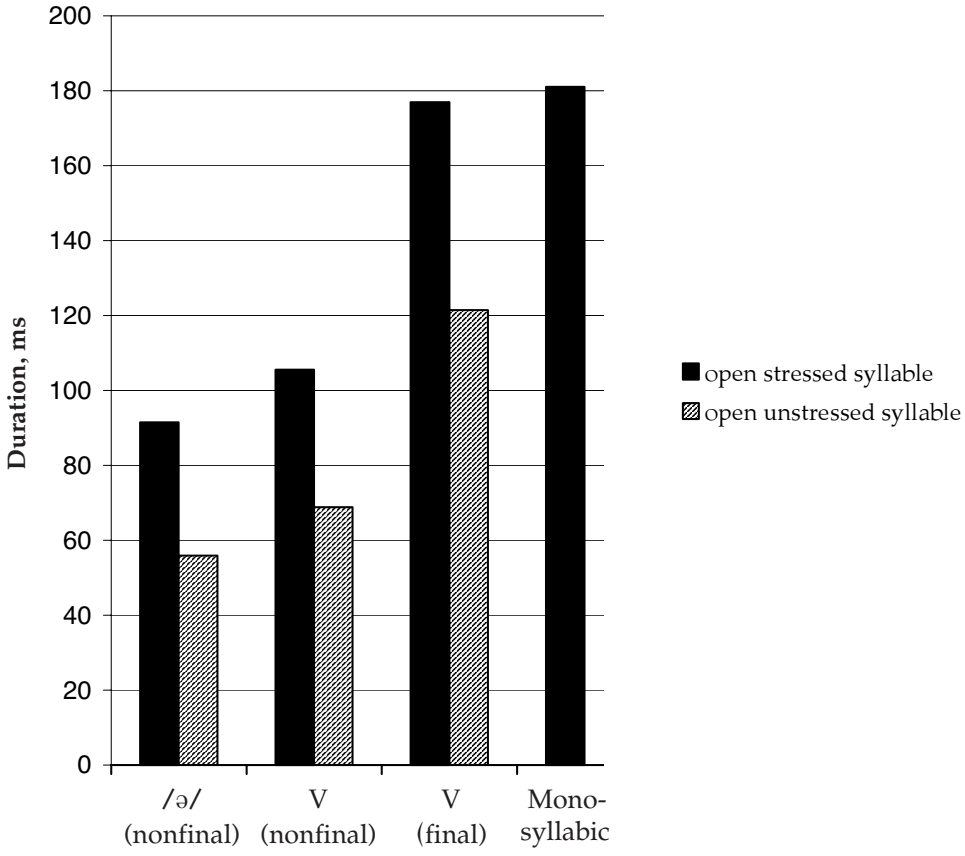

Figure 1. **The duration of vowels (ms) in open stressed and unstressed syllables. Both positions (phrase-final and sentence-final) are combined.**

Among the test words there were some containing a long high front vowel. We analyze this syllable nucleus as consisting of a sequence of the vowel /i/ + the high front glide /j/. The reasons are primarily distributional: the language appears to have no length opposition in the other vowels, and the syllable nucleus inventory (cf. Chapter 2, section 1) contains no diphthongs.

Table 3 contains average durations of /i/ and /ij/ in words constituting the near-minimal pair *piže* and *ijže* ('his/her dog' — 'let him/her swim') and the minimal pair *ida* — *ijda* ('don't (2pl. imper.)' — 'your ice, year'), as well as the duration of the second vowel. In the minimal pair, stress is expected to fall on the second syllable, but Speaker LV produced both of them with stress on the first syllable, and Speakers VN (both phrase- and sentence-final words) and VA (phrase-final words) pronounced the word *ijda* with stress on the first syllable. Individual data are presented in Appendix 4, Table 3A.

Table 3

The duration (ms) of the short /i/ and the combination of /i/ and the glide /j/ as well as the vowel of the following syllable (the duration of the vowel in a stressed syllable in boldface)

Speaker	*piže*		*ijže*		*ida*		*ijda*	
	V1	V2	V1	V2	V1	V2	V1	V2
PF	**135**	145	**191**	132	**112**	149	**173**	176
					85	**215**	134	**208**
SF	**126**	114	**177**	120	**102**	145	**158**	129
					85	**212**	146	**192**
Overall average	**131**	130	**184**	126	**107**	147	**166**	153
					85	**214**	140	**200**

As shown in Table 3, the stressed /i/ in /piže/ was regularly shorter than the stressed /ij/ in /ijže/, with a ratio of 0.71. The unstressed second vowel /e/ had approximately the same duration as the stressed /i/ in /piže/, with a ratio of 1.01, but the long syllable nucleus of /ijže/ was considerably longer than its unstressed second vowel, with a ratio of 1.46. (Individual data are presented in Appendix 4, Table 3A.)

In the minimal pair /ida/ — /ijda/ the first word was stressed on the first syllable by one, and the second word by three of the eight speakers (Speaker VA produced /ijda/ with stress on the first syllable in phrase-final position, and on the second syllable in sentence-final position. Cf. Appendix 4, Table 3A for individual speakers' data). In these cases, the durations of the stressed syllable nuclei were comparable to those in the

first pair, with a ratio between the durations of /i/ and /ij/ of 0.65. The duration of the unstressed second vowel /a/ was considerably greater than that of unstressed /e/, resulting in smaller ratios between the two syllable nuclei of the words: in /ida/, the ratio between stressed /i/ and unstressed /a/ was 0.73, and in /ijda/, the ratio between /ij/ and /a/ was 1.08.

In productions with stress on the second syllable, certain differences are observable. The ratio between the durations of unstressed /i/ and /ij/ is 0.61, which resembles the relationship found in their stressed counterparts, but the actual durations are considerably shorter. This may be attributed to the presence versus absence of stress. The main difference between the two word pairs is in the duration of the second vowel, which, when stressed, is longer than the stressed /ij/ in either word pair.

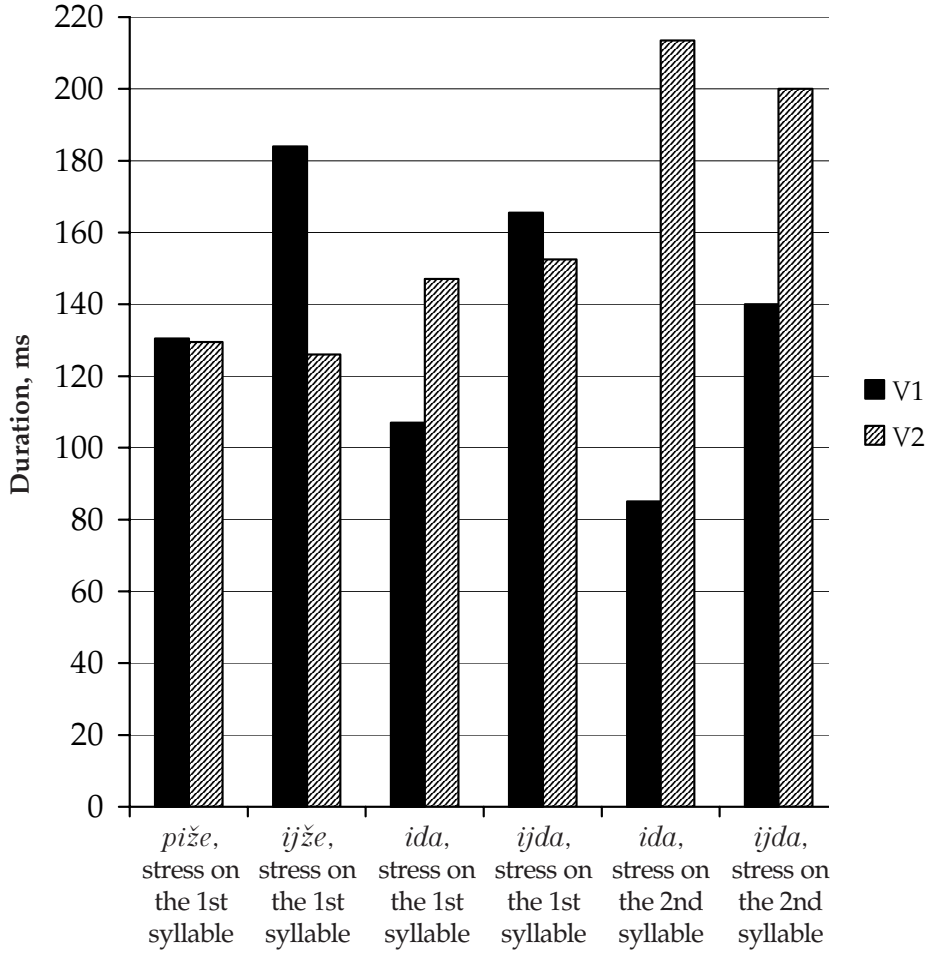

Figure 2. **Average durations (ms) of V1 and V2 in words containing /i/ and /ij/. Both positions (phrase-final and sentence-final) are combined.**

In words with stress on the second syllable, the ratios between the durations of the syllable nuclei were 0.40 for /ida/ and 0.70 for /ijda/. On the basis of these limited data, there appears to be no difference in duration associated with position in the sentence (p = 0.532195).

3.3.1.2. Vowel duration in mono- and disyllabic words

The set of test words contained ten monosyllabic words, of which 2 consisted of an open syllable and 8 a closed syllable. Each vowel occurred in phrase-final and sentence-final position, for a total of 20 tokens.

In the case of disyllabic words, four kinds of combinations of syllable type were represented:
(1) CV.CV both syllables open
(2) CVC.CV closed first syllable (ending in a consonant cluster or the first part of a geminate), open second syllable
(3) CV.CVC open first syllable, closed second syllable
(4) CVC.CVC both syllables closed.

In some of the words, the first syllable was stressed; in others, stress occurred on the second syllable. The average duration of vowels in stressed and unstressed syllables in the two positions within the word is presented separately.

3.3.1.2.1. Monosyllabic words

The average duration (ms) of the vowels in monosyllabic words in open and closed syllables is given in Table 4 (for data by speakers cf. Appendix 4, Table 4A; the word *lu* 'ten, bone', produced in phrase-final position by Speaker VN, could not be included because of a technical error).

Table 4

Average duration (ms) of vowels and coda consonants in monosyllabic words in open and closed syllables (PF — phrase-final, SF — sentence-final, N — number of tokens, $\bar{x}$ — average, s.d. — standard deviation)

Position		Open		Closed		
		N	V	N	V	C
PF	$\bar{x}$	15	179	64	112	103
	s.d.		58		28	40
SF	$\bar{x}$	16	183	64	108	118
	s.d.		44		32	45
Overall average	$\bar{x}$	**31**	**181**	**128**	**110**	**111**
	s.d.		**51**		**30**	**43**

In both phrase-final and sentence-final positions, the average duration of vowels is longer in monosyllabic words constituting an open syllable than in those consisting of a closed syllable, with a ratio of 1.65 (the difference between the vowels in open and closed monosyllables is significant at the $p < 0.0001$ level). The difference in duration due to phrase-final or sentence-final position is not significant (open syllable $p = 0.93225$; closed syllable $p = 0.499912$).

3.3.1.2.2. Disyllabic CV.CV words (both syllables open)

The duration of vowels in disyllabic CV.CV words is given in Table 5 (for individual speakers cf. Appendix 4, Table 5A). Speaker LV pronounced all words in this group with stress on the first syllable. In sentence-final words she pronounced one word (*vita* 'seeps through') with stress on the second syllable. In sentence-final position, Speaker VN pronounced two words without a vowel in the first syllable (*čəke* 'little haystack' > *čke*, *kəša* 'footprint' > *kša*), and made a slip of the tongue while pronouncing the word *ida* 'don't (2pl. imper.)'. Speaker VN pronounced one word (*kəne* 'cannabis') with stress on the second syllable, but there the vowel in the first syllable was almost completely elided (V1 — 16 ms, V2 — 140 ms), and the word was not included in the analysis.

Table 5

Vowel durations (ms) and V1/V2 duration ratios in disyllabic CV.CV words

Position		First syllable stressed								Second syllable stressed							
		N	/ə/	V2	V1/V2	N	V1	V2	V1/V2	N	/ə/	V2	V1/V2	N	V1	V2	V1/V2
PF	$\tilde{x}$	26	99	126	0.78	54	113	138	0.82	22	46	170	0.27	18	78	202	0.39
	s.d.		18	9			21	21			10	17			14	17	
SF	$\tilde{x}$	26	102	117	0.87	52	107	128	0.84	19	45	169	0.27	19	73	192	0.38
	s.d.		16	14			16	21			9	22			18	23	
Overall average	$\tilde{x}$	**52**	**101**	**122**	**0.83**	**106**	**110**	**133**	**0.83**	**41**	**46**	**170**	**0.27**	**37**	**76**	**197**	**0.39**
	s.d.		**17**	**12**			**19**	**21**			**10**	**20**			**16**	**20**	

As becomes evident from the table, both stress and position within the word have an influence on the duration of the vowels. A stressed V1 is longer than an unstressed V1 (110 vs. 76 gives a ratio of 1.45). The same applies to V2 (stressed V2 vs. unstressed V2 — 197/133 = 1.48). The behavior of /ə/ resembles that of the full vowels (except for the fact that /ə/ is always shorter than a comparable full vowel). The ratio of stressed /ə/, to unstressed /ə/ is 2.2.

The influence of position is evident in the fact that both stressed and unstressed V2 is longer than the corresponding V1. In the case of CV.CV words with stress on the first syllable, the unstressed V2 is longer than

the stressed V1; in the case of CV.CV words with stress on the second syllable, the contribution of position increases the difference in duration between V1 and V2. This phenomenon is tentatively explained as pre-boundary lengthening rather than pre-stress shortening, since both stressed and unstressed syllables experience pre-boundary lengthening.

3.3.1.2.3. Disyllabic CVC.CV words (first syllable closed, second syllable open)

The duration of vowels in disyllabic CVC.CV words is given in Table 6 (for individual data, cf. Appendix 4, Table 6A). The test set included words with stress on the first syllable as well as words with stress on the second syllable, and in general, the speakers agreed with each other. The Speaker LV pronounced all the words in this group with stress on the first syllable; Speaker VN pronounced three words (/ludde/ 'without reading', /purde/ 'without biting' in phrase-final position, /akla/ 'he/she evaluates (2sg.)' in sentence-final position) with stress on the second, and all other words with stress on the first syllable.

Table 6

Vowel and coda consonant durations (ms) and V1/V2 duration ratios in disyllabic CVC.CV words

Position		First syllable stressed					Second syllable stressed				
		N	V1	C.	V2	V1/V2	N	V1	C.	V2	V1/V2
PF	$\bar{x}$	83	102	113	121	0.84	37	67	119	191	0.35
	s.d.		25	42	23			14	32	18	
SF	$\bar{x}$	85	102	119	122	0.83	35	71	135	182	0.39
	s.d.		24	43	21			19	48	21	
Overall average	$\bar{x}$	**168**	**102**	**116**	**122**	**0.84**	**72**	**69**	**127**	**187**	**0.37**
	s.d.		**25**	**42**	**22**			**17**	**40**	**20**	

A first observation regarding the duration of vowels in closed first syllables is the similarity of these durations to that of vowels in open first syllables. In Table 5, the average duration for vowels in open first syllables was 110 ms, when that syllable was stressed, and 76 ms in the unstressed case; here the duration of the vowel in a stressed closed syllable was 102 ms, and 69 ms in unstressed position. This invites comparison with monosyllabic words (Table 4), where the vowel duration in a closed syllable was considerably shorter than was the case with open syllables (110 ms vs. 181 ms).

The question raised by these results concerns the relationship between segmental timing and syllabic timing. In monosyllabic words ending in a consonant, the average duration of the final consonant was 111 ms; this compensates for the shortening of the syllable nucleus and yields an overall duration of 221 ms for the nucleus + coda of the closed monosyllable.

(Word-initial and syllable-initial consonants are not contrastive and are not included in this discussion. The duration of consonants is treated in more detail in section 3.3.2. below.) The difference between the overall durations (181 ms vs. 110 + 111 ms) is significant (p = 0.000284). Even though the difference between the overall durations is significant, the timing of monosyllabic words shows a tendency toward syllabic isochrony.

On the basis of the observed structure of monosyllabic words, one would expect the overall duration of stressed CVC-syllables to match that of stressed CV-syllables. A comparison of vowel durations in the first syllables of CVC.CV words, given in Table 6, with the duration of vowels in analogous position in CV.CV words given in Table 5, shows that the difference between vowel durations is not significant (vowel duration in stressed CVC — 102 ms, unstressed 69 ms; vowel duration in stressed first CV — 110 ms, unstressed 76 ms, stressed V1 p = 0.052475, unstressed V1 p = 0.082891). Since the duration of the CVC-syllables includes the duration of the coda consonant, the timing here appears to be taking place on the segmental level rather than syllabic level. The problem will be considered further in connection with other word types.

The open second syllable of CVC.CV words behaved comparably to the open second syllable in CV.CV words: shorter in unstressed position, longer when bearing stress, with a ratio of 122/187 = 0.65. (For CV.CV words, the corresponding ratio was 133/197 = 0.68.) Preboundary lengthening was observed in both stressed and unstressed final open syllables. Position within the sentence had no significant influence on vowel duration (p = 0.766547).

3.3.1.2.4. Disyllabic CV.CVC words (first syllable open, second syllable closed)

The duration of vowels in disyllabic words with an open first syllable and a closed second syllable is presented in Table 7. (For individual data, cf. Appendix 4, Table 7A).

Table 7

Vowel and coda consonant durations (ms) and V1/V2 duration ratios in disyllabic CV.CVC words

Position		First syllable stressed					Second syllable stressed				
		N	V1	V2	C	V1/V2	N	V1	V2	C	V1/V2
PF	$\bar{x}$	64	104	73	122	1.41	69	70	136	139	0.52
	s.d.		20	17	54			20	25	49	
SF	$\bar{x}$	67	104	68	124	1.53	66	67	143	136	0.47
	s.d.		21	17	47			21	22	48	
Overall average	$\bar{x}$	**131**	**104**	**71**	**123**	**1.47**	**135**	**69**	**140**	**137**	**0.50**
	s.d.		**21**	**17**	**50**			**21**	**24**	**49**	

The vowels in open syllables show a consistent pattern: longer in stressed first position, shorter in unstressed first position. The vowel of the closed second syllable is likewise shorter in unstressed position, and longer in stressed final position, where preboundary lengthening appears to contribute extra length. In the interpretation of the durational patterns in CV.CVC words, the fact should be taken into account that the second vowel in words with stress on the first syllable was /ə/ in every case.

A comparison of the measurements in this table with those of Table 5 (CV.CV words) raises again the question of whether timing patterns are based on segment durations or syllabic durations. If the patterns are based on segment durations, a CVC-syllable can be expected to have greater duration than a CV-syllable; ratios based only on the vowel component of a CVC-syllable are larger or smaller than in CV.CV words, depending on whether the CVC syllable is in initial or final position in the disyllabic word. If the durations of syllables are more or less constant, the syllabic ratios should not depend on the segmental composition of the syllables, and vowels in CVC-syllables should be shorter than those in CV-syllables.

The temporal structuring of monosyllabic words (Table 4) favors syllabic isochrony: the duration of the vowel in open monosyllables was longer than that of the vowel in closed monosyllables (vowel duration in CV-words — 181 ms, vowel duration in CVC-words — 110 ms, final consonant duration 111 ms, for a total of 221 ms). The results presented in Tables 6 and 7, where one of the syllables was open and one was closed, suggest that syllable duration is at least to some extent segmentally determined.

3.3.1.2.5. Disyllabic CVC.CVC words (both syllables closed)

The duration of vowels in disyllabic words with two closed syllables is presented in Table 8. (For individual data, cf. Appendix 4, Table 8A).

Table 8

Vowel and coda consonant durations (ms) and V1/V2 duration ratios in disyllabic CVC.CVC words

Position		First syllable stressed						Second syllable stressed					
		N	V1	C.	V2	C	V1/V2	N	V1	C.	V2	C	V1/V2
PF	$\bar{x}$	33	97	78	60	102	1.63	48	67	89	123	133	0.55
	s.d.		25	20	13	45			13	30	18	47	
SF	$\bar{x}$	31	101	76	59	93	1.71	49	66	102	134	143	0.50
	s.d.		20	19	18	30			17	49	19	55	
Overall average	$\bar{x}$	**64**	**99**	**77**	**60**	**97**	**1.67**	**97**	**67**	**96**	**129**	**138**	**0.53**
	s.d.		**23**	**19**	**16**	**37**			**15**	**39**	**19**	**51**	

In the two previous tables, the two syllables differed in their segmental structure, and the temporal structure of the word could be expected to be influenced by the difference in syllable type. In the present table, both syllables are closed; thus the influence of stress is more obvious. Regardless of position, the vowel in the stressed syllable is approximately twice as long as the vowel in the unstressed syllable. Pre-boundary lengthening can be deduced from the fact that the vowel of the stressed second syllable is longer than the vowel of the stressed first syllable. In the words with stress on the first syllable, the vowel of the unstressed second syllable was schwa.

3.3.1.2.6. Overview of the durations of vowels in disyllabic words

A comparison of vowel durations in the four kinds of disyllabic words described above is offered in Figure 3.

The figure is to be read as follows. The first two double columns on the left show the average duration of vowels in CV.CV words (both syllables open), with stress on the first syllable; the second two double columns give durations of vowels in CV.CV words with stress on the second syllable. The difference in vowel durations reflects both stress and position within the word.

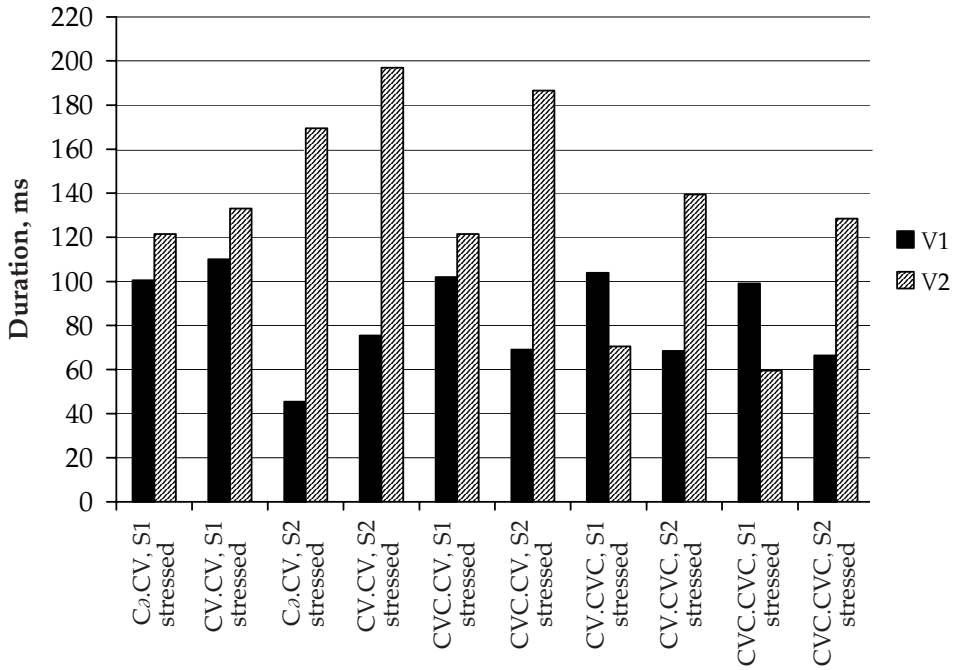

Figure 3. **Vowel durations (ms) in different disyllabic word types.**

As can be seen from the figure, in CV.CV words the vowel in a stressed syllable is longer than a vowel in an unstressed syllable in the same position within the word. First or second position within the word is likewise reflected in duration: a stressed first vowel is longer than an unstressed first vowel, but shorter than either a stressed or unstressed second vowel. We interpret the extra length of the second vowel as preboundary lengthening, and consider this as evidence for the existence of disyllabic feet as units within the phonological hierarchy. The relative importance of stress and position in the temporal structure of the disyllabic words is evidenced by the fact that the increase in the duration of stressed vowels in preboundary position is considerably greater than the increase due to stress in the first position.

The fifth and sixth double columns represent the durations of vowels in CVC.CV words (closed-open), with stress on the first syllable (fifth set) and on the second syllable (sixth set). The seventh and eighth double columns represent vowel durations in CV.CVC words (open-closed), with stress on either syllable; the ninth and tenth double columns show vowel durations in CVC.CVC words (both syllables closed) with stress on either the first or the second syllable.

The comparison of patterns in all ten double columns makes it possible to draw some generalizations. Vowels in second syllables are always longer than vowels in first syllables, except in two cases: CV.CVC words with stress on the first syllable, and CVC.CVC words with stress on the first syllable. Vowels in stressed syllables are longer than vowels in unstressed syllables, except in the first stressed syllable of CV.CV and CVC.CV. Vowels in open syllables are longer than vowels in closed syllables, except in CV.CVC words with stress on the second syllable.

3.3.1.3. Vowel duration in trisyllabic words

Among the test words there were 24 trisyllabic words in both sentence positions (48 in all). In those words the first, second, and the third syllable could be stressed. One word containing the combination of /i/ and the glide /j/ (*vijdəme* 'powerless') was not included in analysis. Speaker VN pronounced some words without some vowels: *kiddəme* 'handless' > *kitme, luddəmo* 'unreadable, unread; boneless' > *lutmo, ludənam* 'I read (praet. II)' > *ludnam*.

The durations of vowels in trisyllabic words are given in Table 9 and Figure 4 (cf. as well Appendix 4, Table 9A). The data are taken on the basis of the syllable under consideration. For example, "stressed open first syllable" gives the average of vowel durations in the stressed first syllable in words with both open and closed second and third syllables.

Table 9

Average duration (ms) of vowels in the stressed and unstressed syllables of trisyllabic words in closed and open syllables

Position	Syllable type	N			Stressed V1			N			Stressed V2			N			Stressed V3		
					V1	V2	V3				V1	V2	V3				V1	V2	V3
PF	open	59	57	61	87	62	113	0	16	16		137	117	69	47	24	62	69	158
	s.d.				18	12	20					11	13				16	22	27
	closed	26	26	27	77	55	70	17	2	2	64	131	80	12	33	57	50	70	126
	s.d.				17	8	14				19						16	19	18
SF	open	60	57	58	87	60	112	2	16	18	53	136	119	66	46	20	58	66	165
	s.d.				20	11	19					5	19				18	19	25
	closed	24	27	26	84	49	73	17	3	1	72	84	91	15	35	61	43	75	129
	s.d.				20	9	17				8	78					5	28	15
Overall average	open	**119**	**114**	**119**	**87**	**61**	**113**	**2**	**32**	**34**	**53**	**136**	**118**	**135**	**93**	**44**	**60**	**67**	**161**
	s.d.				**19**	**12**	**20**				**11**	**8**	**16**				**17**	**21**	**26**
	closed	**50**	**53**	**53**	**81**	**52**	**71**	**34**	**5**	**3**	**68**	**107**	**83**	**27**	**68**	**118**	**46**	**72**	**127**
	s.d.				**18**	**9**	**16**				**13**	**78**	**15**				**10**	**23**	**16**

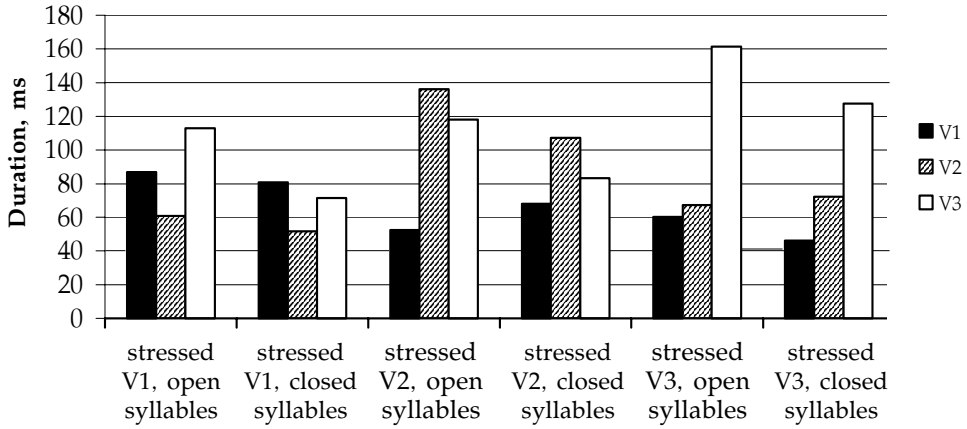

Figure 4. **Average duration of vowels (ms) in open and closed syllables in trisyllabic words with stress on the first, second, and third syllable.**

The figure is to be read as follows. The first set of three columns shows the average duration of vowels in open syllables in trisyllabic words with stress on the first syllable. The second set contains comparable information for words with closed syllables. The next set of three columns presents the average duration of vowels in open syllables in trisyllabic words with stress on the second syllable; the following set gives analogous information for vowels in closed syllables. The last two sets of columns give average durations of vowels in open and closed syllables in words stressed on the third syllable.

The durational patterns in trisyllabic words resemble those observed in disyllabic words. A stressed syllable is longer than a comparable unstressed syllable (open or closed) in an analogous position. The vowel in an open syllable is generally longer than a vowel in a closed syllable (but see an exception pointed out below).

An interaction between lengthening due to stress and preboundary lengthening can be observed to take place; however, it is not as straightforward as with disyllabic words. The vowel of a stressed final syllable (V3) is longest both in CV and CVC syllables, where both stress and position contribute to its duration. The vowel of a stressed closed final syllable is, however, shorter than the vowel of the open second syllable, when that syllable carries word-level stress. Nevertheless, V3 in those words is longer than the equally unstressed V1, which confirms the presence of preboundary lengthening.

There is one case that contradicts expectations. This is the duration of V1 in open syllables in words with stress on the second syllable: one would expect V1 in an open syllable to be longer than V1 in a closed syllable (shown in the next set of columns). The values, however, based on only two tokens.

3.3.1.4. Vowel duration in four-syllable words

Among the test words there were 6 four-syllable words. The averaged duration of their vowels is given in Table 10 (cf. as well Appendix 4, Table 10A). In four-syllable words the first syllable was either with main or secondary stress, the second syllable unstressed, the third syllable either unstressed or with main stress (in one word: *kučəneže* 'he/she wants to catch'), the fourth syllable either with main or secondary stress (in the word with the stressed third syllable the fourth syllable was unstressed).

Table 10

The duration of vowels in four-syllable words (ms)

Position	V1		V2	V3		V4		
	primary	secondary	unstressed	primary	unstressed	primary	secondary	unstressed
PF	78	42	54	133	58	140	75	114
s.d.	20	6	9	21	8	18	28	45
SF	82	42	52	125	58	150	79	97
s.d.	20	7	6	16	7	23	19	31
Overall average	**80**	**42**	**53**	**129**	**58**	**145**	**77**	**105**
s.d.	**20**	**7**	**7**	**18**	**7**	**21**	**23**	**38**

In the case of syllables with main stress the longest vowels are in the word-final syllables of phrase-final words (140 ms) and the shortest vowels in the first syllable with main stress (78 ms). The vowels in syllables with secondary stress are almost twice as short as the vowels in syllables with main stress and their duration is comparable to the duration of vowels in unstressed syllables. In case of unstressed syllables, again, the longest vowels are in word-final unstressed syllables.

In sentence-final words as well, as for vowels in syllables with the main stress, the longest vowels are the word-final ones (150 ms) and the shortest vowels those in the first syllables with main stress (82 ms). The vowels in stressed syllables in sentence-final words are longer than the vowels in stressed syllables in phrase-final words. In sentence-final words as well, the vowels in syllables with secondary stress are almost twice as short as the vowels in syllables with main stress. Similarly, the vowels in the final syllable with secondary stress are longer than the vowels in the first syllable with secondary stress. Among the vowels in unstressed syllables, the longest vowels are word-final. This is probably due to final lengthening.

A comparison of the duration of vowels in syllables with main stress indicates that the difference in duration of V1 and V3 is statistically significant ($p < 0.0001$); the same applies to the duration of V1 and V4 ($p < 0.0001$). Although the difference between V3 and V4 is smaller in absolute values, this is likewise statistically significant as well ($p = 0.03$). The difference in the duration of vowels in the first syllable with both main and secondary stress and the final syllable is also statistically significant ($p < 0.0001$ in both cases).

3.3.2. Consonant duration

The consonant system of Meadow Mari consists of the following consonants: /p, t, k, b, d, g, č, s, š, z, ž, m, n, ń, ŋ, l, ľ, r, j/. The recorded corpus contained occurrences of contrastive single and geminate consonant pairs: /n/ — /nn/, /d/ — /dd/, /l/ — /ll/. The syllable boundary within the geminate usually coincides with a morpheme boundary. The duration of these consonants and preceding vowels is given in Table 11 and shown graphically on Figure 5. (Individual data are included in Appendix 4, Table 11A.)

The last column of Table 11 contains the duration of what we consider to represent the duration of a closed syllable, consisting of the vowel and the first part of the geminate. The duration of that first part was calculated by subtracting the average duration of a single intervocalic consonant from that of the long consonant. The duration of the syllable-initial consonant is not contrastive.

Table 11

The duration of short and long consonants and the duration of vowels preceding them (ms) (N — tokens)

Position		N	V	/n/	N	V	/nn/	V+/n/
PF	x̄	71	56	80	41	62	189	163
	s.d.		20	18		14	36	
SF	x̄	71	52	82	41	62	207	188
	s.d.		22	17		16	39	
Overall	x̄	**142**	**54**	**81**	**82**	**62**	**198**	**176**
average	s.d.		**21**	**18**		**15**	**38**	
Position		N	V	/d/	N	V	/dd/	V+/d/
PF	x̄	151	77	74	40	62	193	181
	s.d.		25	18		19	32	
SF	x̄	149	75	81	39	62	211	191
	s.d.		26	17		22	28	
Overall	x̄	**300**	**76**	**78**	**79**	**62**	**202**	**186**
average	s.d.		**26**	**18**		**21**	**30**	
Position		N	V	/l/	N	V	/ll/	V+/l/
PF	x̄	78	76	66	25	71	181	186
	s.d.		24	17		17	26	
SF	x̄	78	80	68	25	74	183	189
	s.d.		27	12		22	21	
Overall	x̄	**156**	**78**	**67**	**50**	**73**	**182**	**188**
average	s.d.		**26**	**15**		**20**	**24**	

The small differences in the number of tokens are due to the fact that on occasion, speakers pronounced a word differently from how it was written in the list. In phrase-final words, ST pronounced *tolənna* 'we came (praet. II)' instead of *toləna* 'we come (1pl.)', and JT produced *pəllan* 'to the cloud (all. sg.), on the cloud (adess. sg.)' instead of *pəlan* 'cloudy'. In sentence-final words ST pronounced again *tolənna* instead of *toləna*, and JT a geminate in *pəllan* instead of *pəlan*. In sentence-final words, ST also pronounced *idda* instead of *ijda* 'your (pl.) ice, year', and *viddəme* instead of *vijdəme* 'powerless' (these productions were not included in the calculations). Speaker VN pronounced *kidavlak* instead of *kiddavlak* 'your (pl.) hands' (which was not included in the calculations) and made a slip of the tongue while pronouncing *ijda*. JT pronounced *pəllan* instead of *pəlan* and *nəllənnan* instead of *nələnnan* 'of us four (gen. sg.)' (the latter word was not included in the calculations).

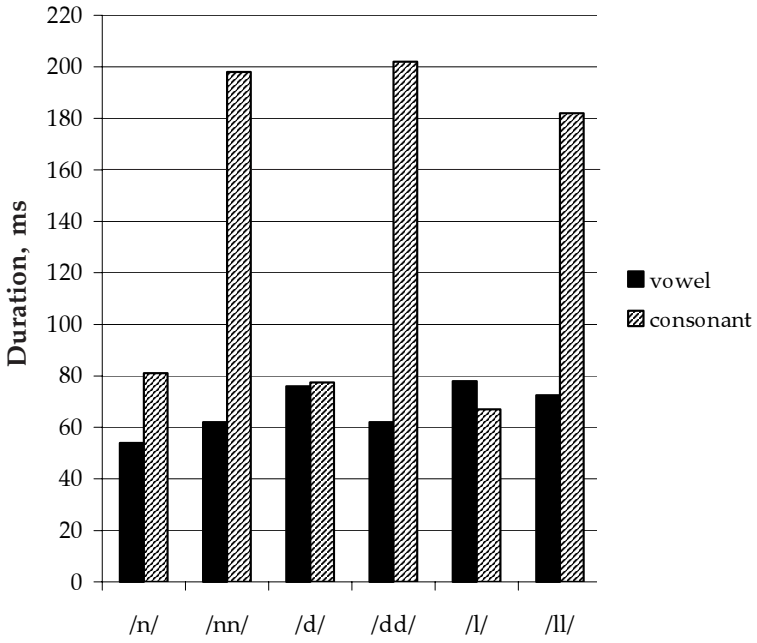

Figure 5. **The duration of short and long consonants and the duration of vowels preceding them (ms). Both positions (phrase-final and sentence-final) are combined.**

As can be seen from Table 11, there is a considerable difference between the durations of long and short consonants in both phrase-final and sentence-final positions. In phrase-final position, the duration ratios of long to short consonants are 2.4 for /nn/ vs. /n/, 2.3 for /dd/ vs. /d/, and 2.3 for /ll/ vs. /l/. In sentence-final position, the respective ratios are 2.3, 2.6, and 2.7. The larger ratios in sentence-final position are due to the greater duration of long consonants (except for /nn/): /dd/ is longer in this position by 23%, and /ll/ by 16%, than in phrase-final position. In general, the average duration of a geminate is 2.4 to 2.7 times greater than that of a single consonant.

Recalling that in monosyllabic words the vowels were shorter in closed syllables than in open syllables (cf. Table 4), it is of considerable interest whether there is a similar difference in the duration of vowels preceding a single intervocalic consonant (i.e. in an open syllable) and those preceding a geminate (i.e. in a closed syllable). The results presented in Table 11 show that this is not the case. The differences in vowel duration before single and geminate consonants are smaller than one standard deviation in every instance. The vowel is longer before /nn/ than before /n/, while in the other two pairs, the vowel is longer before the single consonant. The differences between

the averages range from 5 ms to 14 ms and are comparable to the differences between the average durations of consonants.

The last column in Table 11 gives the duration of the closed syllable consisting of the vowel and the first part of the geminate. These durations range from 163 to 191 ms and are comparable to the durations of /i/ plus the glide /j/: as shown in Table 3, the average duration of /ij/ (in the stressed first syllable) in *ijže* 'let him/her swim (3sg. imper.)' was 191 ms and the average duration of /ij/ in *ijda* 'your (pl.) ice, year' was 173 ms in phrase-final position, and the corresponding averages in sentence-final position were 177 and 158 ms.

3.4. Fundamental frequency

The following section is devoted to the comparison of fundamental frequency contours associated with different stress patterns in words of one, two, three, and four syllables. The F0 contours in words produced by female speakers (EI, ST, LV, NK) and male speakers (AA, JT, VN, VA) are considered separately. The fundamental frequency of productions by the male speaker VN could not always be established because of the creakiness of his voice. F0 measurements were made at the beginning (Vbeg) and end (Vend) of every vowel.

3.4.1. Monosyllabic words

The F0 contours of monosyllabic words in phrase-final and sentence-final positions are presented in Table 12 and Figure 6. For data by individual speakers, cf. Appendix 4, Table 12A.

Table 12

The F0 contours of monosyllabic words (Hz) in phrase-final and sentence-final position (PF — phrase-final, SF — sentence-final, N — number of measurements)

Female	N		V1beg	V1end	Female	N		V1beg	V1end
PF	40	$\bar{x}$	256	314	SF	40	$\bar{x}$	216	205
		s.d.	23	33			s.d.	11	10
Male	N		V1beg	V1end	Male	N		V1beg	V1end
PF	39	$\bar{x}$	164	207	SF	40	$\bar{x}$	161	146
		s.d.	17	27			s.d.	15	12

On the average, both male and female speakers had a rising F0 in phrase-final words and a falling F0 in sentence-final words. Two speakers differed somewhat from the general pattern. Speaker LV had

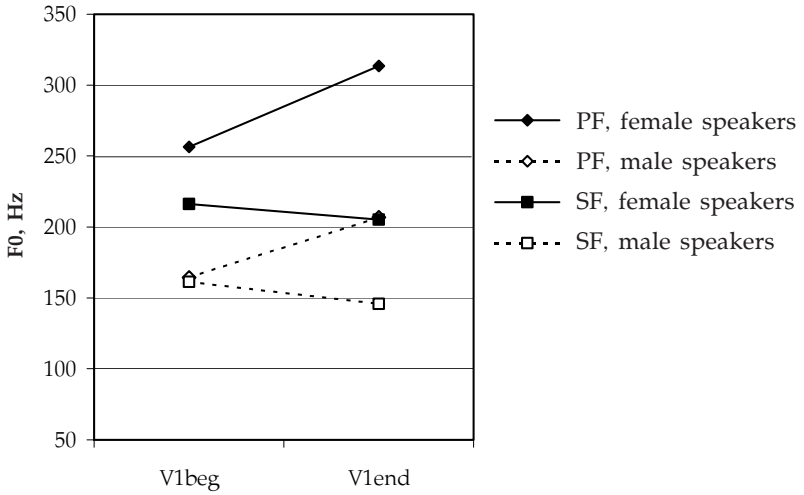

Figure 6. **The F0 contours of monosyllabic words in phrase-final and sentence-final position (4 female and 4 male speakers).**

a rising F0 in both positions, but the rise was smaller in sentence-final position than in phrase-final position (4% and 9% respectively). Speaker VN produced the words practically on a monotone in both positions (average F0 values 161—165 Hz in phrase-final position and 164—165 Hz in sentence-final position).

The F0 contours appear to reflect sentence structure, rising F0 signalling continuation, and falling F0 signalling termination of the sentence.

3.4.2. Disyllabic words

The set of disyllabic words included words stressed on the first syllable as well as words stressed on the second syllable. The two subsets are described separately.

3.4.2.1. Disyllabic words with stress on the first syllable

The fundamental frequency of disyllabic words with a stressed first syllable is presented in Tables 13 and 14 and on Figure 7. Table 13 offers data for words in which the stressed first syllable was followed by an unstressed second syllable with rising F0 in both phrase-final and sentence-final position; Table l4 gives comparable information for words in which the unstressed second syllable was produced with a falling intonation.

Table 13

The F0 of disyllabic words with a stressed first syllable, followed by an unstressed second syllable with rising F0 (Hz) in phrase-final and sentence-final position (PF — phrase-final, SF — sentence-final, N — number of measurements)

Female	PF, N		V1beg	V1end	V2beg	V2end	SF, N	V1beg	V1end	V2beg	V2end
	2	$\bar{x}$	268	310	299	315	29	227	208	209	216
		s.d.	6	15	1	3		15	9	8	9
Male	PF, N		V1beg	V1end	V2beg	V2end	SF, N	V1beg	V1end	V2beg	V2end
	49	$\bar{x}$	167	151	203	252	3	212	158	142	156
		s.d.	22	28	27	33		54	27	27	32

Table 14

The F0 of disyllabic words with a stressed first syllable, followed by an unstressed second syllable with falling F0 (Hz) in phrase-final and sentence-final position (PF — phrase-final, SF — sentence-final, N — number of measurements)

Female	PF, N		V1beg	V1end	V2beg	V2end	SF, N	V1beg	V1end	V2beg	V2end
	139	$\bar{x}$	271	306	255	215	110	232	213	219	203
		s.d.	20	20	27	18		17	15	17	12
Male	PF, N		V1beg	V1end	V2beg	V2end	SF, N	V1beg	V1end	V2beg	V2end
	90	$\bar{x}$	191	208	179	154	137	173	151	147	135
		s.d.	19	22	31	36		18	14	12	11

The fundamental frequency of the stressed first syllable may be rising or falling; there is no systematic relationship between the F0 direction on the stressed first syllable and the direction of the F0 movement on the unstressed second syllable. In phrase-final position, female speakers had a rising F0 on the first syllable, which could be followed by either a rising or a falling second syllable. In sentence-final position, the stressed first syllable had a falling F0, which could be followed by either a rising or a falling unstressed second syllable.

Male speakers had both rising and falling F0 movements on the stressed first syllable in words in phrase-final position. The stressed first syllable with a falling F0 was followed by a rising second syllable, while the first syllable with a rising F0 curve was followed by a falling second syllable. In sentence-final position, the F0 movements were less extensive, and the F0 curves on the stressed first syllable were falling. The falling first syllable could be followed by either a rising or a falling unstressed syllable.

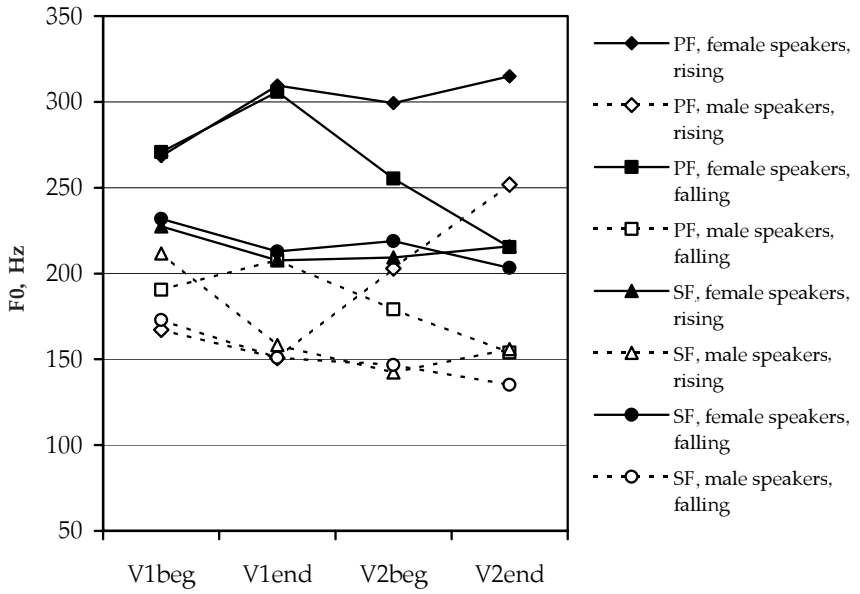

Figure 7. **The F0 of disyllabic words with a stressed first syllable (with rising and falling F0 on the unstressed second syllable), produced by four female and four male speakers.**

Individual data are presented in Appendix 4, Tables 13A and 14A. Some cases might be mentioned here. In phrase-final words the F0 direction was usually falling at the end of the word, i.e. on the unstressed second syllable (in 82% of the words). Some speakers, however, produced the second syllable with rising F0 (two words in productions by the female speaker ST, several by the male speakers AA and JT). In sentence-final position, 89% of the words were produced with falling F0 on the second syllable. However, the female speakers EI and ST had a rising F0 at the end of the words, the rise being less extensive than in phrase-final position. The male speaker AA produced three sentence-final words with a rising F0 on the final syllable. Several speakers produced some stressed first syllables with level F0 in both positions (AA and VN in phrase-final position, ST, LV, and VN in sentence-final position).

3.4.2.2. Disyllabic words with stress on the second syllable

The fundamental frequency on disyllabic words with a stressed second syllable is presented in Tables 15 and 16, and on Figure 8. Table 15 offers data for words in which the stressed second syllable was produced with a rising F0 in both phrase-final and sentence-final position; Table 16 gives comparable information for words in which the stressed

second syllable had a falling F0. Individual data are included in Appendix 4, Tables 15A and 16A.

Table 15

The F0 of disyllabic words with a stressed second syllable with rising F0 (Hz) in phrase-final and sentence-final position (PF — phrase-final, SF — sentence-final, N — number of measurements)

Female	PF, N		V1beg	V1end	V2beg	V2end	SF, N	V1beg	V1end	V2beg	V2end
	95	x̄	235	223	245	300	45	224	207	203	219
		s.d.	16	14	19	21		19	14	11	12
Male	PF, N		V1beg	V1end	V2beg	V2end	SF, N	V1beg	V1end	V2beg	V2end
	88	x̄	154	144	165	222	29	144	130	139	149
		s.d.	11	13	21	26		12	8	7	9

Table 16

The F0 of disyllabic words with stressed second syllable with falling F0 (Hz) in phrase-final and sentence-final position (PF — phrase-final, SF — sentence-final, N — number of measurements)

Female	PF, N		V1beg	V1end	V2beg	V2end	SF, N	V1beg	V1end	V2beg	V2end
	4	x̄	252	260	301	283	56	230	216	212	192
		s.d.	25	45	15	20		14	15	10	12
Male	PF, N		V1beg	V1end	V2beg	V2end	SF, N	V1beg	V1end	V2beg	V2end
	13	x̄	142	133	146	128	55	209	203	158	128
		s.d.	13	6	10	7		21	19	18	8

Unlike the words with a stressed first syllable, phrase-final words with a stressed second syllable were usually produced with a rising F0 on that syllable (92% of instances). The F0 on the unstressed first syllable was falling in these cases. There were some productions with a falling F0 on the stressed phrase-final syllable: the female speaker ST had rising F0 on the first syllable and a falling F0 on the second syllable in four words, the male speaker VN had level F0 on the first syllable and rising F0 on the second syllable in seven words, and the male speaker VA had falling F0 on both syllables. However, phrase-final falling second syllables always started at a higher frequency than either rising or falling first syllables (cf. Table 16).

In sentence-final position, both rising and falling F0 curves were observed on the stressed second syllable (40% rising, 60% falling). Female speakers had falling F0 in more than half of the instances, and a rising F0 in less than half of the cases. Male speakers usually had falling F0 on the sentence-final stressed second syllable. There were some productions with a rising F0, but speakers AA and JT never had

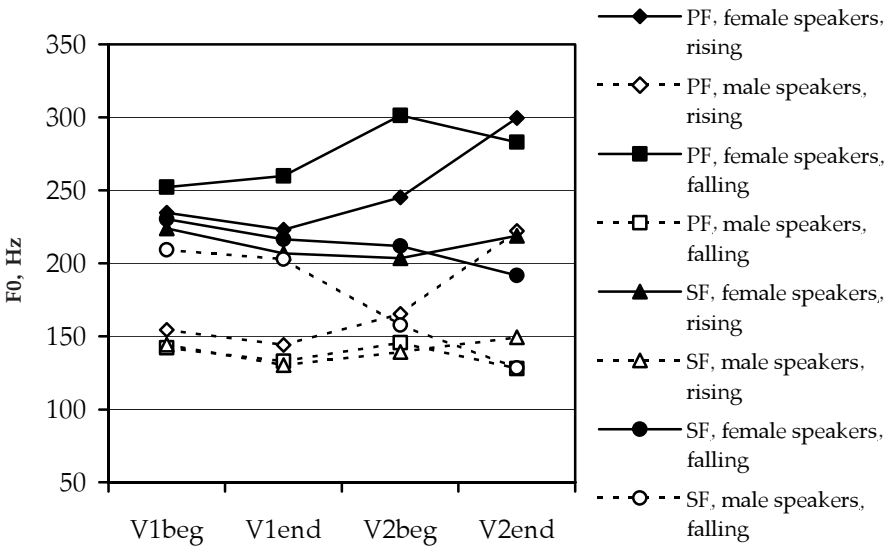

Figure 8. **The F0 of disyllabic words with a stressed second syllable (with rising and falling F0 on that syllable) produced by four female and four male speakers.**

a rising F0 on the sentence-final stressed second syllable, and speakers VN and VA had no falling F0 on the sentence-final syllable.

One difference between phrase-final and sentence-final productions by male speakers should be pointed out: in sentence-final position, the stressed syllable with falling F0 was preceded by an unstressed syllable with considerably higher pitch.

3.4.3. Trisyllabic words

The corpus included trisyllabic words with stress on the first, second, and third syllable. In what follows, words with different stress patterns are treated separately.

3.4.3.1. Trisyllabic words, first syllable stressed

The F0 of trisyllabic words with stress on the first syllable is given in Table 17 and Figure 9 (for data of individual speakers, cf. Appendix 4, Table 17A).

In phrase-final trisyllabic words with a stressed first syllable, seven out of eight speakers had a rising F0 on the stressed syllable, followed by falling F0 on the rest of the word. The exception was the male speaker JT, who had the first syllable with rising F0, the second syllable with falling F0, and the final syllable with rising F0. His results (11 words) were not taken into account for calculating averages (cf. Appendix 4, Table 17A).

Table 17

The F0 of trisyllabic words with a stressed first syllable (Hz) in phrase-final and sentence-final position (PF — phrase-final, 4 female and 3 male speakers; SF — sentence-final, 4 female and 4 male speakers; N — number of measurements)

Female		N	V1beg	V1end	V2beg	V2end	V3beg	V3end
PF	x̄	47	265	302	290	249	226	208
	s.d.		25	22	38	26	15	12
SF	x̄	46	221	209	215	202	207	200
	s.d.		22	8	11	10	12	11
Male		N	V1beg	V1end	V2beg	V2end	V3beg	V3end
PF	x̄	34	198	217	184	154	146	132
	s.d.		35	39	31	26	28	30
SF	x̄	46	174	156	149	138	142	133
	s.d.		17	14	10	11	12	13

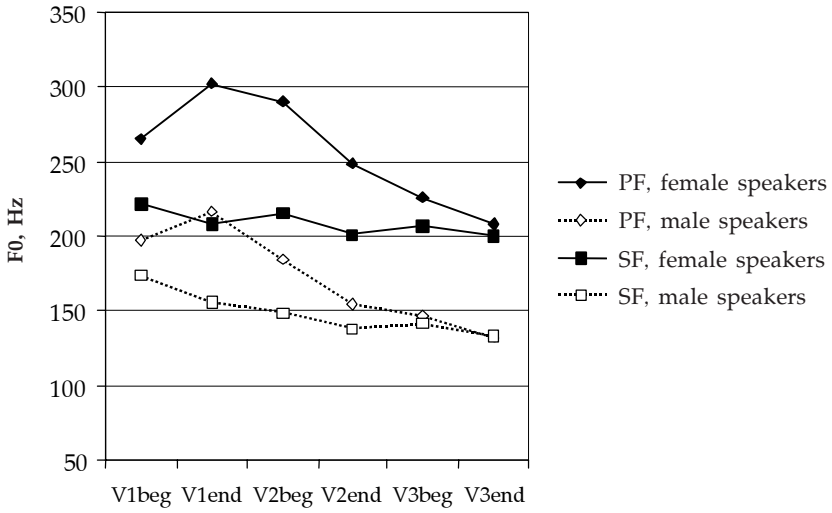

Figure 9. **F0 contours of trisyllabic words with a stressed first syllable (4 female and 3 male speakers — phrase-final occurrences; 4 female and 4 male speakers — sentence-final occurrences).**

In sentence-final position, F0 is falling on the stressed syllable as well. There were minor fluctuations — the female speaker LV had a slight rise (9 Hz) in the vowel of the first syllable, the female speaker ST had level F0 on the last syllable, and the male speaker VN had a

level first syllable, followed by falling F0 on the unstressed syllables. All speakers had lower F0 values in sentence-final position.

3.4.3.2. Trisyllabic words, second syllable stressed

The F0 of trisyllabic words with stress on the second syllable is given in Table 18 and Figure 10 (for data of individual speakers, cf. Appendix 4, Table 18A).

Table 18

The F0 of trisyllabic words with a stressed second syllable (Hz) in phrase-final and sentence-final position (PF — phrase-final, 4 female and 3 male speakers; SF — sentence-final, 2 female and 2 male speakers; N — number of measurements)

Female		N	V1beg	V1end	V2beg	V2end	V3beg	V3end
PF	$\bar{x}$	9	230	220	245	314	250	217
	s.d.		9	10	20	18	15	10
SF	$\bar{x}$	5	273	266	207	190	210	192
	s.d.		19	12	10	8	14	2
Male		N	V1beg	V1end	V2beg	V2end	V3beg	V3end
PF	$\bar{x}$	7	159	149	156	205	172	148
	s.d.		9	7	10	14	39	44
SF	$\bar{x}$	6	189	172	142	132	140	131
	s.d.		43	29	7	12	13	10

In phrase-final position, words with stress on the second syllable had a falling F0 on the unstressed initial syllable, rising F0 on the stressed second syllable, and falling F0 on the unstressed third syllable. Speakers ST, JT, and VN had a level F0 on the unstressed first syllable. Speaker JT differed from the others in having a level F0 on the first syllable, falling F0 on the second syllable, and rising F0 on the third syllable; his results were not taken into account in calculating the averages (cf. Appendix 4, Table 18A).

In sentence-final position, the F0 was falling throughout the whole word in the speech of two female speakers (EI and NK) and two male speakers (AA, VA); the averaged values in Table 18 are based on productions by these speakers. The female speaker ST had a falling F0 on the first two syllables, but a rising F0 at the end of the word. The female speaker LV and the male speaker VN produced the sentence-final words in the same way as phrase-final words — with a rising F0 on the stressed second syllable. The male speaker JT had rising F0 on the first syllable and falling F0 on the second and third syllables.

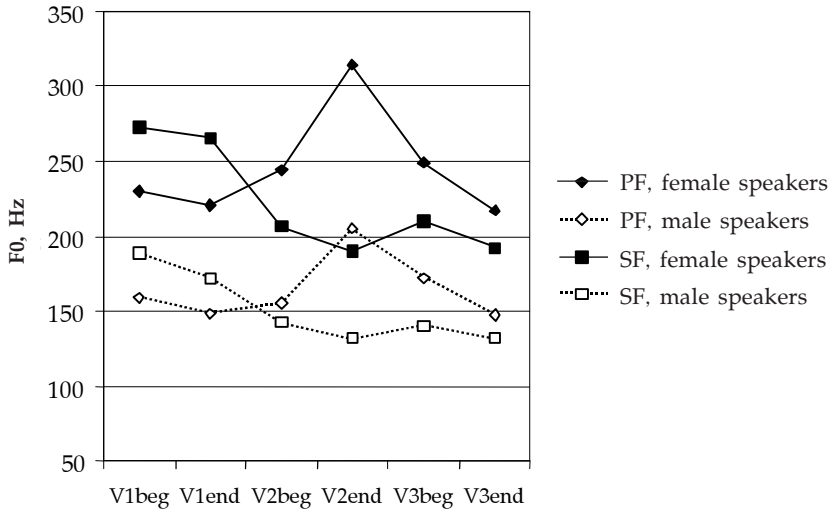

Figure 10. **The F0 contours of trisyllabic words with a stressed second syllable (4 female and 3 male speakers — phrase-final occurrences; 2 female and 2 male speakers — sentence-final occurrences).**

3.4.3.3. Trisyllabic words, third syllable stressed

The F0 of trisyllabic words with a stressed third syllable is given in Table 19 and Figure 11 (for data by individual speakers, cf. Appendix 4, Table 19A).

Table 19

The F0 of trisyllabic words with a stressed third syllable (Hz) in phrase-final and sentence-final position (PF — phrase-final, 4 female and 4 male speakers; SF — sentence-final, 3 female and 3 male speakers; N — number of measurements)

Female		N	V1beg	V1end	V2beg	V2end	V3beg	V3end
PF	$\bar{x}$	40	234	221	228	220	241	306
	s.d.		16	13	15	17	17	17
SF	$\bar{x}$	29	245	225	238	224	206	202
	s.d.		20	15	24	18	10	11
Male		N	V1beg	V1end	V2beg	V2end	V3beg	V3end
PF	$\bar{x}$	41	158	144	150	142	158	213
	s.d.		11	12	10	11	18	28
SF	$\bar{x}$	30	183	172	188	183	155	130
	s.d.		15	11	16	15	11	11

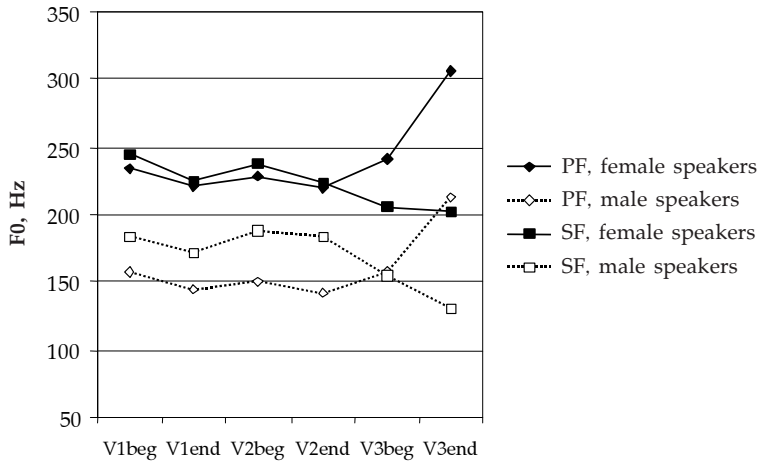

Figure 11. **The F0 contours of trisyllabic words with a stressed third syllable (4 female and 4 male speakers — phrase-final occurrences; 3 female and 3 male speakers — sentence-final occurrences).**

The phrase-final words with a stressed third syllable were always pronounced with a rising F0 on the word-final stressed syllable. The first two syllables had falling F0.

In sentence-final position, however, the F0 was usually falling also on the stressed third syllable. There were two exceptions: the female speaker LV and the male speaker VN produced the words in sentence-final position with the same F0 contour as in phrase-final position (cf. Appendix 4, Table 19A). Therefore their results were excluded when the F0 averages were calculated.

3.4.4. Four-syllable words

There were six four-syllable words in the corpus, with stress on the first (2 words), third (1 word), and fourth (3 words) syllable.

3.4.4.1. Four-syllable words; first syllable stressed

The data on the F0 of two four-syllable words (*nələnəštəm* 'these/those four (acc. sg.)', *vitədəme* 'waterproof') with a stressed first syllable are given in Table 20 and Figure 12 (data by individual speakers cf. Appendix 4, Table 20A). The male speakers JT and VN also pronounced the word *nələtənat* 'foursome' with primary stress on first syllable in sentence-final position.

Table 20

The F0 of four-syllable words with primary stress on the first syllable and a secondary stress on the fourth syllable (Hz) (PF — phrase-final, 4 female and 3 male speakers; SF — sentence-final, 2 female and 2 male speakers; N — number of measurements)

Female	N		V1beg	V1end	V2beg	V2end	V3beg	V3end	V4beg	V4end
PF	8	x̄	251	312	331	275	249	230	218	208
		s.d.	18	20	27	30	8	7	11	7
SF	4	x̄	222	240	257	231	234	227	231	221
		s.d.	8	20	25	23	23	17	12	19
Male	N		V1beg	V1end	V2beg	V2end	V3beg	V3end	V4beg	V4end
PF	6	x̄	162	201	205	170	149	131	131	121
		s.d.	16	22	40	53	12	5	9	3
SF	6	x̄	153	156	158	146	147	139	143	133
		s.d.	8	16	10	6	9	1	7	12

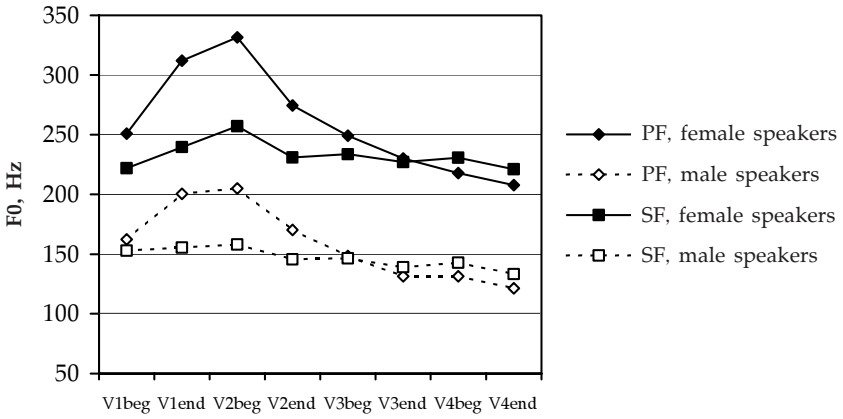

Figure 12. **The F0 of four-syllable words with primary stress on the first and the secondary stress on the fourth syllable (Hz) in phrase-final and sentence-final position (4 female and 3 male speakers — phrase-final; 2 female and 2 male speakers — sentence-final).**

In phrase-final position, the F0 is rising during the stressed first syllable. The F0 rise continues to the beginning of the second syllable, and falls continuously from that point; the pitch may also be level at the end of the word. As was the case of trisyllabic words with a stressed first syllable, here too the male speaker JT constitutes an exception: in his speech, the words had falling F0 in the first syllable and rising F0 in the final syllable (cf. Appendix 4, Table 20A). His values are not included in the averages.

In sentence-final position, the speakers differed more among themselves. Table 20 contains values averaged from productions by two female speakers (ST and LV) and two male speakers (JT and VN). The two female speakers produced sentence-final words with the same F0 contours as phrase-final words. The female speaker EI had a falling F0 in the first two syllables, a rising F0 in the third syllable, and a falling or rising F0 in the fourth syllable (which averaged to a level contour). The female speaker NK had a falling F0 throughout the whole word. The male speakers JT and VN had a level F0 in the first syllable, followed by a falling F0. The F0 of Speaker AA was falling during the first and third syllables, but rising at the end of the word. Speaker VA had a rising F0 in the first syllable, as in phrase-final words, and falling F0 in the following syllables.

3.4.4.2. Four-syllable words with stress on the third or fourth syllable

The F0 data for four-syllable words with a stressed third syllable are given in Table 21 and Figure 13 (for data by individual speakers, cf. Appendix 4, Table 21A). There was only one such word in the corpus: *kučəneže* 'she/he wants to catch'.

Table 21

The F0 of the four-syllable word *kučəneže* 'she/he wants to catch' with a stressed third syllable (Hz) (PF — phrase-final, 4 female and 4 male speakers; SF — sentence-final, 3 female and 4 male speakers; N — number of measurements)

Female	N		V1beg	V1end	V2beg	V2end	V3beg	V3end	V4beg	V4end
PF	4	x̄	229	206	244	227	248	311	240	219
		s.d.	18	24	26	28	34	33	40	51
SF	3	x̄	236	221	245	232	186	173	191	179
		s.d.	27	15	18	23	18	4	6	9
Male	N		V1beg	V1end	V2beg	V2end	V3beg	V3end	V4beg	V4end
PF	4	x̄	165	145	167	154	176	217	145	120
		s.d.	28	16	14	15	17	44	10	10
SF	4	x̄	174	152	173	152	135	120	129	121
		s.d.	33	32	47	36	14	10	14	10

In phrase-final position, the word was produced with rising F0 on the stressed third syllable and falling F0 on the other syllables. The F0 of the beginning of the second syllable was higher than the F0 at the end of the first syllable.

In sentence-final position, the female speakers had falling F0 on the whole word, some of the syllables being level. The male speakers usu-

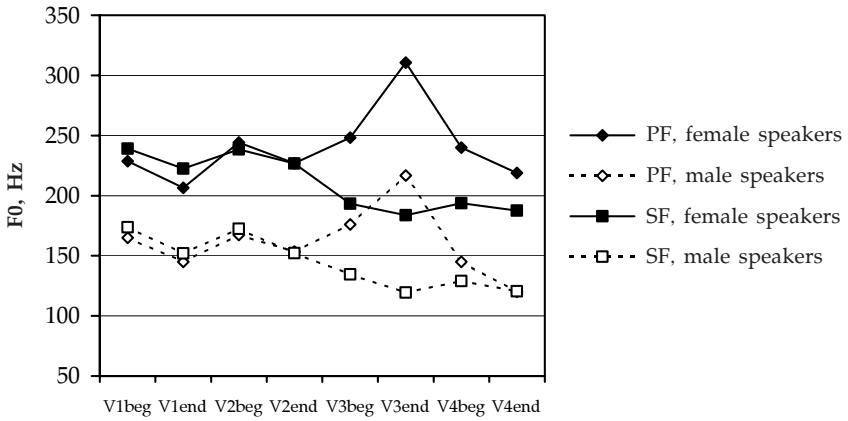

Figure 13. **The F0 of the four-syllable word** *kučəneže* **with stress on the third syllable (Hz) in phrase-final and sentence-final position (4 female and 4 male speakers — phrase-final; 3 female and 4 male speakers — sentence-final).**

ally produced the sentence-final word with a falling F0 also. There were two exceptions: the female speaker LV produced the sentence-final words with a final rise, like in the phrase-final position, and the male speaker VN pronounced these words with a slightly rising F0 at the end of the words (these results were excluded from the averages). All speakers could occasionally have a level F0 on some of the syllables.

The F0 of three four-syllable words (*nələtənat* 'foursome', *pətarəmaš* 'completion', *kučəneda* 'you (pl.) want to catch') with a stressed final syllable and a first syllable with secondary stress is given in Table 22 and Figure 14 (for data by individual speakers, cf. Appendix 4, Table 22A).

Table 22

The F0 of four-syllable words with primary stress on the fourth syllable and secondary stress on the first syllable (Hz) (PF — phrase-final, 4 female and 4 male speakers; SF — sentence-final, 3 female and 3 male speakers; N — number of measurements)

Female	N		V1beg	V1end	V2beg	V2end	V3beg	V3end	V4beg	V4end
PF	12	x̄	229	212	225	214	225	216	238	314
		s.d.	13	13	17	17	16	21	22	17
SF	9	x̄	258	236	254	241	257	233	208	203
		s.d.	14	11	24	17	21	20	10	9
Male	N		V1beg	V1end	V2beg	V2end	V3beg	V3end	V4beg	V4end
PF	12	x̄	157	142	158	144	151	144	162	231
		s.d.	6	10	12	8	9	9	13	17
SF	8	x̄	183	168	181	166	181	173	143	120
		s.d.	10	13	6	5	17	12	4	4

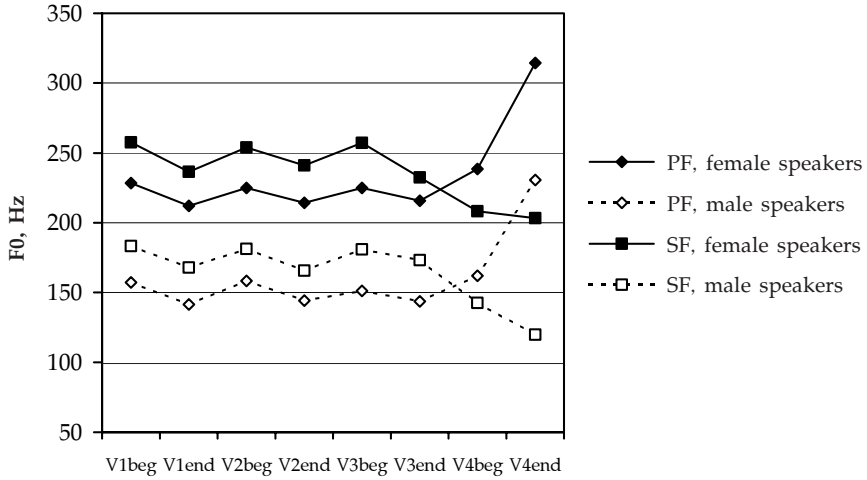

Figure 14. **The F0 of four-syllable words with primary stress on the fourth syllable and secondary stress on the first syllable (Hz) in phrase-final and sentence-final position (4 female and 4 male speakers — phrase-final; 3 female and 3 male speakers — sentence-final).**

In phrase-final position, four-syllable words with primary stress on the final syllable and secondary stress on the first syllable were produced by all speakers with a considerable F0 rise on the stressed final syllable; the pitch on the preceding syllables was falling.

In sentence-final position, both groups of speakers generally had falling F0 throughout the word; the final syllable could also be produced with level F0. There were two exceptions: the female speaker LV produced sentence-final words in the same way as words in phrase-final position, namely with a rising F0 on the final syllable (these productions were excluded in averaging), and the male speaker VN produced these words with a slight rise on the final syllable (again excluded from the averages). Both female and male speakers could have level F0 on some of the syllables.

3.5. The role of stress

3.5.1. Potential role of stress position

Stress position appears not to be fixed with reference to a given syllable within a word. For example, in the set of disyllabic words, there were 29 words where the speakers stressed the first syllable, 13 words with stress on the second syllable, and in the case of 16 words, different speakers positioned stress differently. An overview of those words

where the speakers disagreed with each other is offered in Table 23. The speakers who were in the minority with regard to stress placement are identified by initials.

Table 23

Differences by speakers in locating stress in disyllabic words (PF — phrase-final, SF — sentence-final, N — number of speakers)

Word	PF, speakers	Stress S1, N	Speakers	Stress S2, N	SF, speakers	Stress S1, N	Speakers	Stress S2, N
šəŋa	LV	1		7	LV, VN	2		6
kəne	ST, LV, VN, VA	4	EI, AA, JT, NK	4	ST, LV, VA	3		5
čəke	ST, JT, LV, VA	4	EI, AA, NK, VN	4	ST, JT, LV, VA	4	EI, AA, NK, VN	4
kəša	LV	1		7	LV	1		7
kugu	LV, VN	2		6	LV, VN	2		6
ida	LV	1		7	LV	1		6
viŧa	LV, VN, VA	3		5	VN	1		7
šunna		5	EI, NK, VA	3		6	EI, NK	2
ijda	LV, VN, VA	3		5	LV, VN, VA	3		5
purde	LV, VA	2		6	LV, VN, VA	3		5
kidda	LV, VN	2		6	LV, VN	2		6
pörŧda	LV, VN	2		6	LV, VN	2		6
akla	LV, VN	2		6	LV	1		7
ludde	LV	1		7	LV, VN	2		6
luaš	VN	1		7	VN	1		7
jereš	ST	1		7	ST	1		7

Table 23 contains phrase-final and sentence-final occurrences of 16 test words, for a total of 32 productions. The table is to be read as follows (line 1).

The test word *šəŋa* 'gnat' was produced in phrase-final position with stress on the first syllable by one speaker (LV) and with stress on the second syllable by seven speakers. In sentence-final position, two speakers produced the word with stress on the first syllable, and six speakers stressed the word on the second syllable. Speaker LV was consistent in pronouncing the word with stress on the first syllable; Speaker VN, however, stressed the second syllable in phrase-final position, but the first syllable in sentence-final position.

This kind of behavior can be observed with regard to all the words included in Table 23. Speaker LV, who is a native of Baškortostan, had a tendency to stress the first syllables of disyllabic words more than the other speakers.

In Tables 24 and 25, we summarize the duration and F0 patterns found in disyllabic words with stress on each syllable. Words with

open and closed syllables are treated separately. The words *jereš* 'lake (ill. sg.)', *luaš* 'the ten-piece' and *ijda* 'your (pl.) ice, year' that differ from the regular pattern have not been included in the calculations.

The duration of the vowels in disyllabic words with different stress placement is given in Table 24. Speaker VN produced three sentence-final words (*kəša*, *čəke*, *ida*) with vowel loss in the unstressed syllable. Therefore these words are excluded.

Table 24

The duration of vowels (ms) in disyllabic words with different stress positioning

Position	Syllable combinations		N	First syllable stressed		N	Second syllable stressed	
				V1	V2		V1	V2
Phrase-final	Open-open	$\bar{x}$	16	77	127	40	61	188
		s.d.		21	30		22	45
	Closed-open	$\bar{x}$	14	79	117	34	68	196
		s.d.		21	36		16	36
Sentence-final	Open-open	$\bar{x}$	14	70	131	39	62	183
		s.d.		28	25		34	44
	Closed-open	$\bar{x}$	16	80	119	32	66	185
		s.d.		24	33		21	32

In words with two open syllables (CV.CV), the vowel of the second syllable is longer than the vowel of the first syllable, regardless of stress location. We assume this to be due to preboundary lengthening. Comparing the duration of stressed and unstressed vowels in the same position, stressed vowels are longer both when the stress is on the first syllable and when stress is on the second syllable. This indicates that lengthening is also an identificational characteristic of stressedness. When the second syllable is stressed, both conditions that are associated with lengthening are present at the same time; thus the vowel is longest in this position.

In phrase-final position, the duration ratio of V1/V2 in words with stress on V1 is 0.61; in sentence-final; position, the corresponding ratio is 0.53. In words with stress on V2, the ratio in phrase-final position is 0.32, and in sentence-final position — 0.34. The smaller ratio in words with stress on the second syllable reflects the combined influences of stress and word-final position. There appears to be little difference between phrase-final and sentence-final temporal patterns.

In words with a closed first syllable (CVC.CV), the vowel of the first syllable is even slightly longer than the corresponding vowel in words with an open first syllable, but the difference is well within one

standard deviation. There appears to be no compensation for the duration of the syllable-final consonant, as we had observed in the case of monosyllabic words (cf. Table 4). The vowel of the second syllable behaves in the same way in CVC.CV words as in CV.CV words. The duration ratio of V1/V2 in words with stress on the first syllable is 0.68 in phrase-final position, and 0.67 in sentence-final position. With stress on the second syllable, the V1/V2 ratio of CVC.CV words is 0.35 in phrase-final position, and 0.36 in sentence-final position.

The fundamental frequency patterns associated with stress placement in disyllabic words is considered next. Table 25 summarizes the available information.

Table 25

Average F0 values (Hz) and standard deviations of vowels in disyllabic words with stress on the first and second syllable, produced by female and male speakers (PF — phrase-final, SF — sentence-final, N — number of measurements)

Position	Speaker	N	First syllable stressed				N	Second syllable stressed			
			V1beg	V1end	V2beg	V2end		V1beg	V1end	V2beg	V2end
PF, open-open	Female	9	270	284	263	211	19	231	214	242	300
			28	33	46	55		29	25	36	50
	Male	7	158	174	186	176	21	157	139	157	222
			19	42	44	48		16	13	23	49
PF, closed-open	Female	7	258	281	224	193	17	234	223	242	301
			15	19	35	47		19	23	29	29
	Male	7	174	178	165	158	17	154	141	152	208
			22	27	30	58		22	18	17	42
SF, open-open	Female	8	241	228	230	209	20	242	222	210	199
			12	8	10	12		22	15	14	18
	Male	6	157	146	149	138	19	201	182	152	136
			12	10	11	9		36	34	16	16
SF, closed-open	Female	7	227	230	216	200	15	190	185	136	124
			19	4	8	12		35	36	11	11
	Male	9	157	150	144	133	17	187	179	137	124
			16	8	12	7		34	38	13	10

In phrase-final position, disyllabic words stressed on the first syllable have rising F0 on V1 and falling F0 on the unstressed second syllable. This applies both to female and male speakers and to different word types. In sentence-final position, the stressed first syllable is falling in CV.CV words; with a closed first syllable, female speakers had a slight rise, while male speakers had a similarly slight fall. The unstressed second syllable was falling in all cases.

Words with a stressed second syllable have a falling F0 curve on the unstressed first syllable and a rise on the second syllable in phrase-final position. In sentence-final position, the fundamental frequency is falling on both syllables for both female and male speakers and both word types. The terminal F0 value is lower in sentence-final position than in phrase-final position.

The F0 curve on the words appears to be determined by the intonation curve, which signals continuity at the end of a phrase, but finality at the end of the sentence. The intonation curve overrides the potential role of F0 as a cue to stressedness. This is particularly clear in the case of words stressed on the second syllable occurring in sentence-final position, where F0 continues to fall throughout the word, and the unstressed first syllable has higher F0 than the stressed second syllable.

There was a minimal pair in the corpus — two disyllabic words, where the difference in meaning was associated with difference in stress placement. The words are spelled in the same way; *še·rge*, with stress on the first syllable, means 'dear', and *šerge·*, with stress on the second syllable, means 'comb'. Averaged durations and F0 values for members of this pair are given in Tables 26 and 27. The words were not presented as a contrastive pair, but were included in the set of frame sentences where they appeared in random order. Most speakers evidently chose the first meaning, and pronounced the words in all their appearances with stress on the first syllable. One female speaker (EI) produced the word with stress on the first syllable on its first occurrence, and with stress on the second syllable on its second occurrence. One male speaker (VA) chose to stress the second syllable. The reliability of the averages has to be evaluated in this context.

Table 26

The average duration (ms) of the vowels in the minimal pair *še·rge* **—** *šerge·*

Position	N	First syllable stressed		N	Second syllable stressed	
		V1	V2		V1	V2
PF	13	126	117	3	80	177
SF	13	124	115	3	74	196

As can be seen from Table 26, the overall durational patterns are confirmed: stressed syllables are longer that unstressed syllables in the same position within the word, and preboundary lengthening is present in both unstressed and stressed final syllables.

Table 27

The average F0 values (in Hz) measured in the minimal pair *še·rge* — *šerge·*

Position	N	First syllable stressed				N	Second syllable stressed			
		V1beg	V1end	V2beg	V2end		V1beg	V1end	V2beg	V2end
PF, female	7	267	304	246	224	1	226	215	232	308
PF, male	6	161	158	186	222	2	139	130	161	215
SF, female	7	223	205	210	202	1	248	224	186	200
SF, male	6	165	144	144	138	2	164	132	137	122

The F0 pattern is less clear. Seven words produced by female speakers had a rising F0 on the stressed first syllable in phrase-final position and a falling F0 on that syllable in sentence-final position. Six words produced by male speakers had a level stressed first syllable in phrase-final position, and a falling F0 on that syllable in sentence-final position. The unstressed second syllable had a falling F0 in phrase-final position in productions by female speakers and a rising F0 in productions by male speakers. In sentence-final position, both groups had falling F0.

In productions of the word with stress on the second syllable, the one female speaker (EI) had falling F0 on the unstressed first syllable in both positions, and rising F0 on the stressed second syllable in both positions. The rise in sentence-final position is the opposite of the overall pattern shown in Table 25. The one male speaker (VA) had F0 curves conforming to the patterns shown for the whole group.

The conclusion may be drawn that duration is a reliable cue to stressedness, while F0 may play a subordinate role at the word level; at the sentence level, however, F0 appears to be decisively influenced by sentence-level intonation.

The trisyllabic words represented different structures, and a number of them were produced with stresses on different syllables (with no difference in meaning). 9 trisyllabic words were pronounced with a stressed first syllable, 2 with a stressed second syllable, and 6 with a stressed third syllable. In 7 words there were differences between speakers as to the placement of stress (the words *kudəda* 'your (pl.) summer kitchen', *nələnnan* 'of us four (gen. sg.)', *tolәna* 'we come (1pl.)', *tolənna* 'we came (praet. II)' and *üdərəšt* 'their daughter' could be pronounced with stress on the first or third syllable, the word *kiddavlak* 'your (pl.) hands' with stress on the second or third syllable, and the word *ludənna* 'we read (praet. II)' with stress on the first, second or third syllable).

Two trisyllabic words with similar structure are presented here for comparison: *ludənna*, produced by five speakers with stress on the first syllable and by three speakers with stress on the third syllable in phrase-

final position, and by three speakers with stress on the first syllable, one speaker with stress on the second syllable, and four speakers with stress on the third syllable in sentence-final position. (Measurements made from the production with stress on the second syllable are not included in the averages.) The word *tolənna* was produced with stress on the first syllable by five speakers, and with stress on the third syllable by three speakers. Durations are given in Table 28, and F0 averages in Table 29.

Table 28

The duration of vowels in the trisyllabic words *ludənna* and *tolənna* (ms), the first or the third stressed syllable

Position		N	First syllable stressed			N	Third syllable stressed		
			V1	V2	V3		V1	V2	V3
PF	$\bar{x}$	10	100	61	135	6	54	55	146
	s.d.		23	14	27		18	12	20
SF	$\bar{x}$	8	98	56	131	7	57	56	147
	s.d.		36	14	31		16	11	19

Table 29

F0 patterns on two trisyllabic words, produced with stress on the first or third syllable

Stress	Position	N	V1beg	V1end	V2beg	V2end	V3beg	V3end
Stress on the first syllable	PF, female	4	262	299	316	297	253	245
	PF, male	6	163	177	181	182	212	227
	SF, female	4	216	298	224	212	206	211
	SF, male	4	169	153	152	151	154	150
Stress on the third syllable	PF, female	4	228	219	222	216	231	296
	PF, male	2	153	137	144	139	158	166
	SF, female	4	231	218	226	228	198	217
	SF, male	3	139	125	137	127	140	145

The duration values given in Table 28 confirm the pattern observed earlier. A stressed syllable is longer than an unstressed syllable in the same position within the word. This is true both comparing the first and third syllables. A stressed final syllable is longer than a stressed first syllable because of preboundary lengthening. Note that the stressed first syllable is shorter than the unstressed final syllable; the influence of position within the word is evidently greater than that of word-level stress. In other words, while duration is a stress cue, the stressed syllable need not be the longest syllable in the word; terminal lengthening exercises

greater force on vowel duration than word-level stress. The unstressed vowels have the same duration in first and second position; as already mentioned, the unstressed final V3 is longer than the stressed V1 in the same word, but still somewhat shorter than a stressed final V3.

The F0 patterns are again less clear. F0 is rising on the stressed first syllable for female speakers both when the trisyllabic word occurs phrase-finally and in sentence-final position, but male speakers had rising F0 on the stressed first syllable when the word occurred in phrase-final position and falling F0 on the stressed first syllable when the word occurred in sentence-final position. The unstressed third syllable had falling F0 in productions by female speakers in phrase-final position, but rising F0 in sentence-final position; the reverse pattern was found for male speakers: rising phrase-finally, and (slightly) falling in sentence-final position.

Words with stress on the third syllable had a falling F0 on the vowel of the unstressed first syllable in all cases, and a rising F0 on the stressed final syllable.

There were not enough examples of four-syllable words with stress placement on different syllables to warrant a comparison.

It appears that there are overall tendencies in F0 patterns that may not be fully realized in individual productions. There is a tendency for relatively high F0 values to occur in stressed initial syllables, and for relatively high F0 to be found in phrase-final position. On the other hand, there is a tendency for a continuous F0 fall on words in sentence-final position, regardless of position of stress.

3.5.2. Phonetic manifestation of stress

The results of the analysis of duration and F0 may be summarized as follows. Duration is a reliable cue to the presence of word-level stress: a stressed syllable is longer than an unstressed syllable in the same position within a word. But indication of the presence of stress is not the only function of duration: it serves also to signal the presence of a boundary — in our data, the boundary of a word occurring in phrase-final and sentence-final position. In the analyzed materials, a final syllable of a word regularly had a lengthened vowel, regardless of location of word-level stress.

The two functions of duration interact: a stressed final syllable is longer than an unstressed final syllable. However, in cases where word-level stress is on a non-final syllable, lengthening to signal the presence of the boundary is greater than the lengthening due to the presence of stress.

Duration alone thus does not constitute an unambiguous cue to stressedness. We analyzed the F0 patterns in the test sentences containing the words under study and found some tendencies, but no omnipresent cues. A stressed syllable tends to have higher F0 than an unstressed syllable, but this is subject to the influence of intonation. Two intonation patterns emerged in the study: rising or level phrase-final intonation, and falling sentence-final intonation. The falling sentence-final intonation had the effect of lowering F0 on a final stressed syllable, so that the stressed syllable could be realized with lower F0 than occurred on the preceding unstressed syllable.

Since neither duration nor F0 provided unambiguous cues to the presence of stress, we explored next the possibility that stress cues might be present in the phonetic quality of the vowels constituting the syllable nuclei. The results are presented in the next section.

3.5.2.1. Vowel quality

The possibility exists that stressedness may be reflected in the formant structure of vowels — that stressed vowels are realized with relatively more extreme articulatory positions, and correspondingly with more extreme locations in the acoustic vowel space than vowels produced in unstressed syllables. A spectrographic analysis of the vowels occurring in the test words was therefore carried out; the results are presented in the following section.

The vowel system of Meadow Mari consists of 8 short monophthongs: /a, e, ö, i, ü, ə, o, u/. Their occurrence in stressed and unstressed syllables will be described first. Separate sections will be devoted to the degree of centralization of the mid vowels /e, o, ö/ and to the coarticulatory influence of other vowels on the quality of unstressed /ə/.

3.5.2.1.1. Vowel quality in the speech of female speakers

Phrase-final words

The average formant values of vowels occurring in stressed and unstressed syllables in the speech of female speakers are presented in Table 30 (for data for individual speakers cf. Appendix 4, Table 23A) and in Figures 15 and 16.

Table 30

Average formant values (Hz) and standard deviations (s.d.) of stressed and unstressed vowels in phrase-final words (4 female speakers)

Stressed syllable					Unstressed syllable				
Vowel	N	F1	F2	F3	Vowel	N	F1	F2	F3
/a/	120	857	1540	3151	/a/	47	833	1550	3088
s.d.		84	168	163	s.d.		78	174	188
/e/	58	549	2215	3092	/e/	78	558	2020	3095
s.d.		48	168	171	s.d.		67	246	139
/i/	40	397	2582	3383	/i/	20	439	2478	3232
s.d.		40	118	115	s.d.		25	130	104
/o/	27	541	1031	3024	/o/	45	522	1204	3003
s.d.		52	108	139	s.d.		50	150	176
/u/	49	430	969	3029	/u/	35	439	1069	3045
s.d.		47	113	131	s.d.		32	117	159
/ə/	63	580	1508	3061	/ə/	192	527	1590	3044
s.d.		61	210	160	s.d.		62	243	196
/ö/	13	549	1907	2834	/ö/	39	531	1865	2876
s.d.		17	108	83	s.d.		49	179	151
/ü/	48	400	2191	2874	/ü/	8	405	2293	2904
s.d.		56	133	118	s.d.		15	46	132

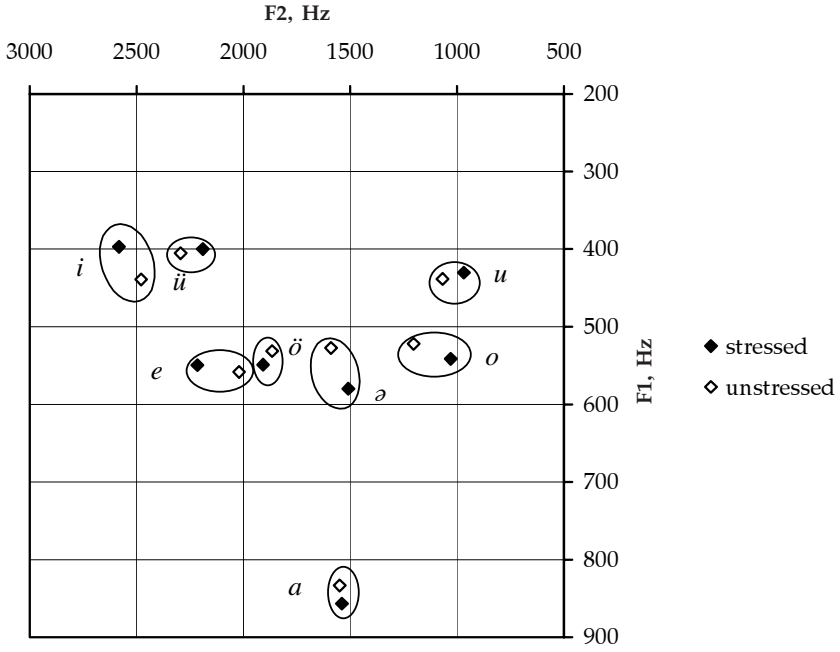

Figure 15. **Acoustical vowel diagram of stressed and unstressed vowels in phrase-final words (4 female speakers).**

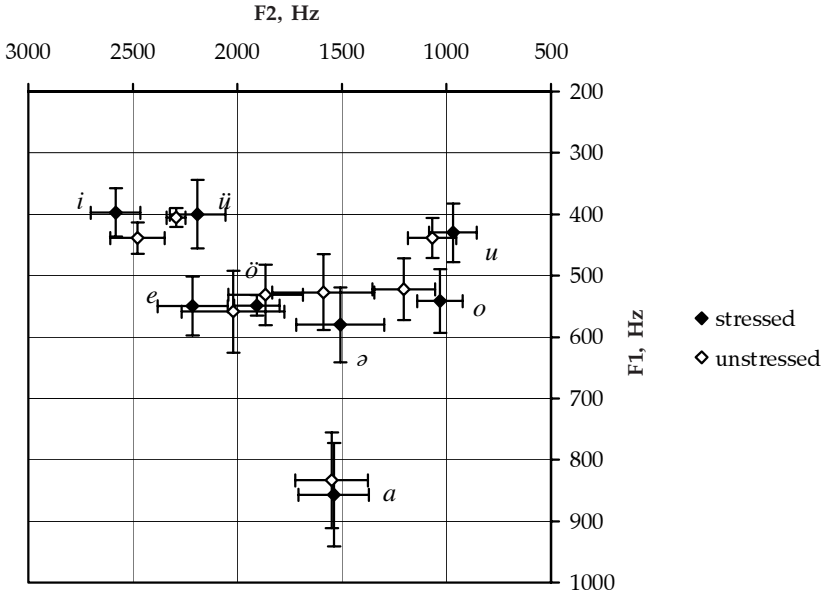

Figure 16. **Average formant positions, with standard deviations, of stressed and unstressed vowels in phrase-final words (4 female speakers).**

The overall shape of the acoustical vowel diagram shown on Fig. 15 corresponds to expectations: the vowels occupy positions in the diagram that would be expected on the basis of general knowledge of acoustic phonetics. The vowels /i, ü, u/ are grouped together as high vowels on the basis of the position of the first formant (F1); the vowels /e, ö, ə, o/ have the F1 values of mid vowels, and /a/ is a low vowel, with the highest frequency value of the first formant. Classification on the basis of the second formant (F2) separates the high vowels into the front vowels /i, ü/ and the back vowel /u/. For mid vowels, there are four steps in the front-back dimension: from /e/ through /ö/ and /ə/ to /o/, which is almost as far back as /u/. The low vowel /a/ is clearly a central vowel on the basis of its F2 position, which is almost identical to that of /ə/. Liprounding in /ü/ and /ö/ is reflected in the lower F3 values of the rounded vowels as compared to /i/ and /e/. The reduced vowel /ə/ occupies the center of the acoustical vowel diagram.

Vowel reduction in unstressed pronunciations is reflected in centralization on the acoustical vowel diagram: the average position of a reduced vowel is closer to the center of the diagram than that of its unreduced counterpart. Figure 14 shows that in all vowels except /ü/, the unstressed vowels show centralization (there were only two productions of unstressed /ü/ by every speaker). Centralization appears

to affect mid vowels more than others (except for /ö/, but there were fewer examples of that vowel). Compared to stressed vowels, the unstressed versions of /e/ and /o/ are characterized by greater change in the value of F2, but /ə/ by greater change in the value of F1. The differences in the quality of stressed and unstressed mid vowels will be analyzed more closely in subsection 3.5.2.1.3.

Centralization of unstressed vowels is not uniform in the speech of individual speakers. In words produced by Speaker EI, the mid vowels /e, ə, o/ are most centralized. In the speech of LV, unstressed /i/ is relatively lower, unstressed /e/ is more retracted, and unstressed /o/ is higher and more fronted than average.

It can be seen from Table 30 and Figure 16 that unstressed vowels have greater standard deviations than stressed vowels. This concerns especially unstressed mid vowels that have relatively large standard deviations of F2. The large standard deviations show that the quality of these vowels can vary a great deal. Compared to other vowels, the low vowel /a/ has a larger standard deviation in F1.

Sentence-final words

The average formant values of stressed and unstressed vowels in the speech of female speakers are given in Table 31 (for data by individual speakers cf. Appendix 4, Table 24A) and in Figures 17 and 18.

The classification of vowels according to their position on the acoustical vowel diagram resembles what was established on the basis of phrase-final occurrences of the test words. Vowels can be divided into high vowels /i, ü, u/, mid vowels /e, ö, ə, o/, and the low vowel /a/ according to the value of their first formants; and into front vowels /i, ü, u/ and back vowels /u, o/ with reference to their second formants. The vowels /ə/ and /a/ have the same central position for their F2, which justifies calling /ə/ a mid-central vowel and /a/ a low central vowel.

The unstressed vowels are again shown to have moved toward the center of the vowel space. Centralization may affect some vowels more than others, as can be deduced from the distances on the acoustical vowel diagrams between the points standing for stressed vowels and their unstressed counterparts (compare the stressed and unstressed positions of mid vowels, especially /e/, /ə/, and /o/).

Individual speakers show some deviations from the general pattern. Speaker EI has greater than average centralization of unstressed /e, ə, o/ and /i/; ST has greater fronting of /o/ and /u/; LV has greater reduction in /e/, and NK, in unstressed /e, ə, o/.

Table 31

Average formant values and standard deviations (Hz) of stressed and unstressed vowels occurring in sentence-final words produced by four female speakers

Stressed syllable					Unstressed syllable				
Vowel	N	F1	F2	F3	Vowel	N	F1	F2	F3
/a/	122	834	1513	3095	/a/	47	799	1551	3072
s.d.		107	170	149	s.d.		117	186	161
/e/	58	511	2227	3084	/e/	77	535	2027	3095
s.d.		64	158	143	s.d.		69	255	141
/i/	39	391	2601	3403	/i/	21	413	2516	3304
s.d.		29	122	144	s.d.		39	130	126
/o/	27	486	1009	2941	/o/	51	512	1176	2991
s.d.		40	126	160	s.d.		60	178	174
/u/	48	428	916	3017	/u/	39	428	1064	3069
s.d.		27	117	139	s.d.		39	146	160
/ə/	64	553	1501	3086	/ə/	194	505	1595	3060
s.d.		56	194	145	s.d.		65	269	179
/ö/	13	495	1892	2831	/ö/	39	522	1869	2880
s.d.		29	110	66	s.d.		48	175	143
/ü/	48	411	2286	2882	/ü/	8	375	2288	2938
s.d.		34	148	143	s.d.		51	24	81

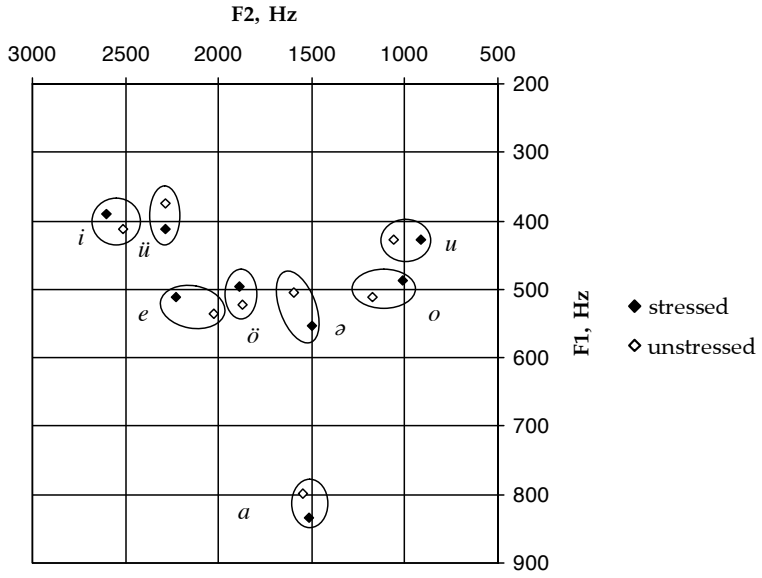

Figure 17. **Acoustical vowel diagram of stressed and unstressed vowels of sentence-final words produced by four female speakers.**

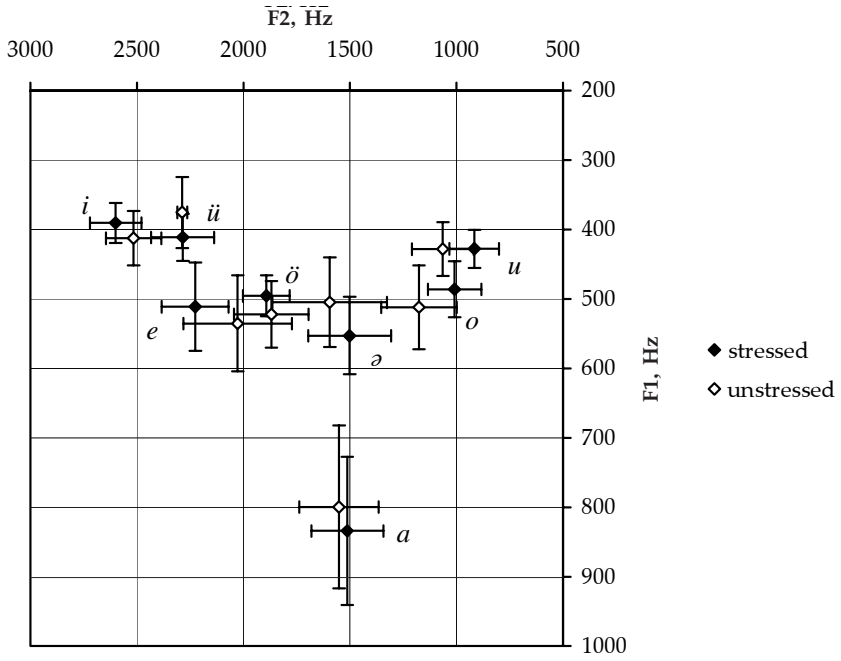

Figure 18. **Average formant positions, with standard deviations, of stressed and unstressed vowels in sentence-final words (4 female speakers).**

3.5.2.1.2. Vowel quality in the speech of male speakers

Phrase-final words

Average formant values and standard deviations of stressed and unstressed vowels of phrase-final words produced by male speakers are given in Table 32 (for data by individual speakers, cf. Appendix 4, Table 25A). The relationship of the vowels to each other in the acoustical vowel space is displayed in Figures 19 and 20.

In general, male speakers have lower formant values than female speakers, and the acoustical vowel diagram reflects that difference. However, the relationship of vowels to each other is effectively the same in words produced by male speakers. The vowels can be divided into high, mid and low vowels on the basis of F1, and into front and back vowels on the basis of F2. The differences between stressed and unstressed vowels appear smaller than in the speech of female speakers, but they are basically in the same direction. Unstressed /ə/ appears to have undergone the greatest degree of change.

There were also some differences between the speakers. In the speech of JT and VA, stressed /ə/ is considerably lower than other mid vowels,

while unstressed /ə/ has an F1 value comparable to other mid vowels. In the speech of VN, unstressed /o/ and /u/ have moved closer to each other, both also being centralized in relation to their stressed versions.

Table 32

Average formant values (Hz) and standard deviations (s.d.) of stressed and unstressed vowels in phrase-final words (4 male speakers)

Stressed					Unstressed				
Vowel	N	F1	F2	F3	Vowel	N	F1	F2	F3
/a/	118	628	1358	2497	/a/	49	602	1349	2471
s.d.		70	102	126	s.d.		74	117	139
/e/	58	434	1868	2719	/e/	77	446	1783	2700
s.d.		43	99	105	s.d.		52	148	111
/i/	41	290	2119	3050	/i/	18	289	2085	3084
s.d.		27	92	171	s.d.		22	39	154
/o/	27	431	873	2412	/o/	51	432	1023	2396
s.d.		46	67	142	s.d.		43	145	126
/u/	49	339	843	2447	/u/	34	349	954	2391
s.d.		33	132	129	s.d.		25	148	130
/ə/	59	511	1358	2420	/ə/	193	442	1405	2459
s.d.		63	149	135	s.d.		62	192	129
/ö/	13	413	1646	2312	/ö/	38	421	1696	2350
s.d.		20	82	120	s.d.		31	135	100
/ü/	48	312	1946	2376	/ü/	8	279	2033	2507
s.d.		26	94	107	s.d.		13	142	51

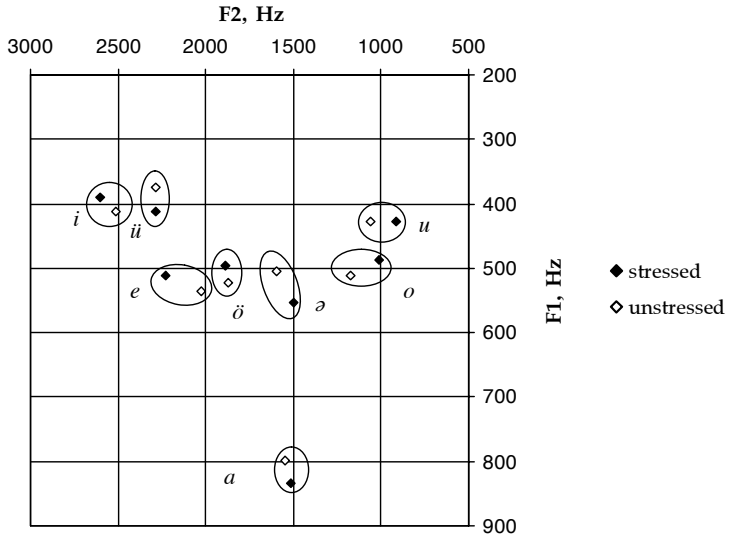

Figure 19. **Acoustical vowel diagram of stressed and unstressed vowels in phrase-final words (4 male speakers).**

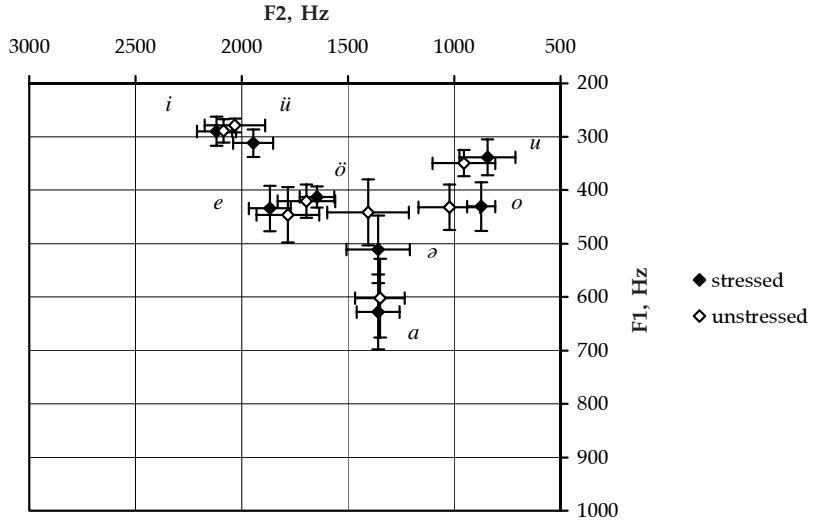

Figure 20. **Average formant positions, with standard deviations, of stressed and unstressed vowels in phrase-final words (4 male speakers).**

Compared to stressed vowels, the vowels in unstressed syllables have greater standard deviations. This is especially so for the second formant values of the mid vowels /e, ö, ə, o/ (cf. Table 32 and Figure 20).

Among stressed vowels, /ə/ has the greatest standard deviations. This suggests that articulation of this vowel may be more variable in stressed syllables as well. The standard deviations of F1 of /ə/ and /a/ show that these vowels can partly overlap in the formant space.

Sentence-final words

Average formant values of stressed and unstressed vowels in sentence-final words are given in Table 33 (for data by individual speakers, cf. Appendix 4, Table 26A). The relative positions of the vowels in the acoustical vowel space are shown on Figures 21 and 22.

The general picture resembles what was described in connection with phrase-final occurrences of the words. Centralization of the vowels in unstressed position appears to affect some vowels more than others; the rounded vowels /ü/ and /ö/ appear hardly changed at all. The difference between stressed and unstressed vowel quality again appears greatest for /ə/. There are also individual differences between speakers; in the speech of both AA and JT, unstressed /ə/ is much higher than in productions by the other speakers, and in the speech of VN, unstressed /a/ is considerably higher, showing a greater degree of centralization.

Table 33

Average formant values and standard deviations (Hz) of stressed and unstressed vowels occurring in sentence-final words produced by four male speakers

Stressed					Unstressed				
Vowel	N	F1	F2	F3	Vowel	N	F1	F2	F3
/a/	118	618	1348	2482	/a/	49	592	1350	2466
s.d.		65	107	122	s.d.		82	119	129
/e/	58	429	1855	2734	/e/	77	442	1757	2704
s.d.		41	101	115	s.d.		52	129	132
/i/	40	285	2100	3125	/i/	19	318	2113	3034
s.d.		28	80	137	s.d.		49	118	137
/o/	28	441	880	2407	/o/	47	449	1008	2439
s.d.		33	84	99	s.d.		46	126	162
/u/	55	334	831	2413	/u/	37	364	941	2300
s.d.		29	125	111	s.d.		29	135	133
/ə/	61	496	1361	2458	/ə/	187	429	1409	2467
s.d.		57	144	141	s.d.		65	198	149
/ö/	13	420	1639	2334	/ö/	39	424	1671	2333
s.d.		18	102	114	s.d.		27	105	107
/ü/	48	301	1923	2344	/ü/	10	280	1950	2422
s.d.		30	90	128	s.d.		36	171	98

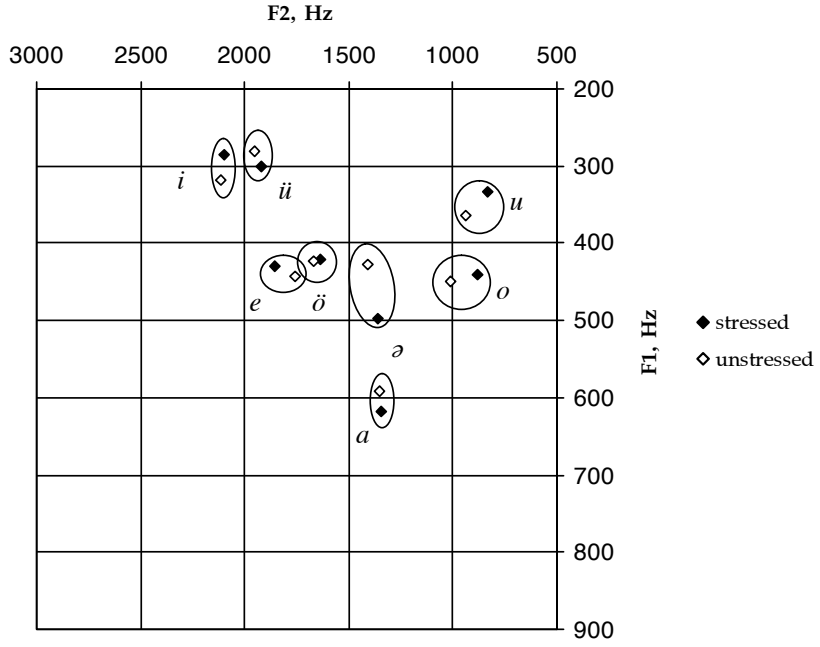

Figure 21. **Acoustical vowel diagram of stressed and unstressed vowels of sentence-final words produced by four male speakers.**

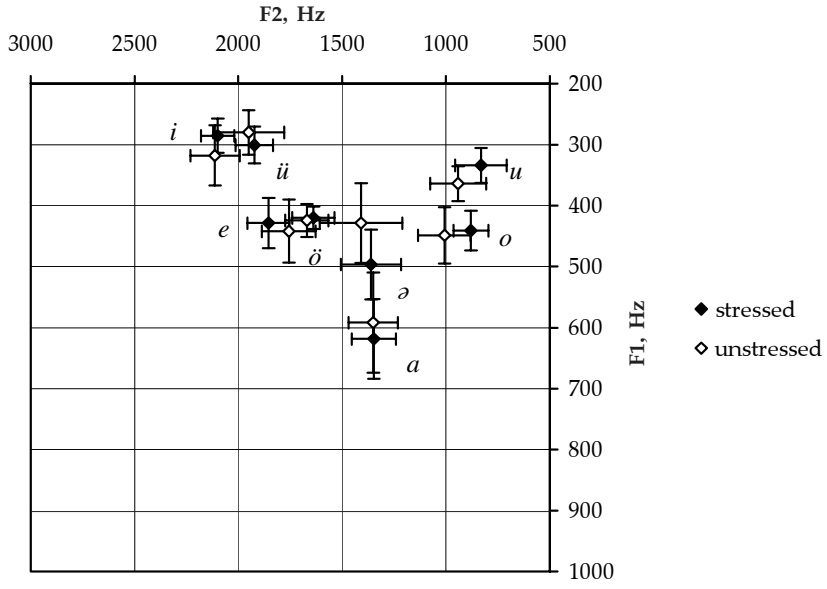

Figure 22. **Average formant positions, with standard deviations, of stressed and unstressed vowels in sentence-final words (4 male speakers).**

Standard deviations show that the regions of stressed /a/ and /ə/ can overlap (due to the large standard deviations in the value of F1). Unstressed high and mid vowels have bigger standard deviations in F2 than their stressed versions (which in the case of /ü/ may be caused by the relatively small number of tokens available for analysis).

3.5.2.1.3. Factors in influencing the degree of vowel reduction

Inspection of the standard deviations of average formant values indicates that mid vowels have greater articulatory variability than high vowels and the low vowel. An attempt was therefore made to identify some factors that might contribute to this variability.

As has been demonstrated above, absence of stress is associated with vowel reduction. We considered the possibility that the position of the unstressed vowel within the word might influence the degree of vowel reduction — in particular, that unstressed vowels in word- final position might differ from unstressed vowels in word-internal position, given the fact that due to preboundary lengthening, the duration of final unstressed vowels is comparable to the duration of stressed non-final vowels.

Repeated listening by a phonetician (P. T., one of the authors) also identified some of the unstressed vowels that differed from expected quality to an extent that suggested the use of a different phonetic sym-

bol ([ɔ], [ɛ], and [ə] for unstressed /o/ by some female speakers, [*a*] for /o/ by some male speakers in phrase-final position, and [*i*] for /e/ and [ə] for /o/ by some female speakers and [ə] and [ɔ] for /o/ by some male speakers in sentence-final position).

Table 34 and Figures 23—26 present some of the relevant information for /e/, /o/, and /ö/; the reduced vowel /ə/ will be treated separately in the following subsection. (For data by individual speakers, cf. Appendix 4, Table 27A).

Table 34 repeats the values for stressed /e, o, ö/ from Tables 30 and 32. Formant frequencies are given both in Hz (cycles per second) and Bark (on the psycho-acoustic scale). The values for unstressed vowels have been re-calculated for word-internal and word-final position. The values for vowels identified as different form the expected quality are presented separately; these values were not included in the sets that were averaged for two positions.

Table 34

Average formant values (Hz, Bark) of mid vowels /e, ö, o/ of stressed syllables, unstressed word-internal syllables, unstressed word-final syllables of phrase-final (PF) and sentence-final (SF) words (N — number of measurements, 4 female and 4 male speakers).

Position, speakers	Vowel	Allophone	N	F1	F2	F3	Position, speakers	Vowel	Allophone	N	F1	F2	F3
PF, female speakers	/e/	stressed	58	549	2215	3092	PF, male speakers	/e/	stressed	58	434	1868	2719
				5.34	13.69	15.88					4.33	12.55	15.05
		unstressed word-internal	12	497	2258	3104			unstressed word-internal	14	405	1886	2686
				4.89	13.82	15.90					4.06	12.62	14.97
		unstressed word-final	66	569	1975	3089			unstressed word-final	63	455	1759	2703
				5.50	12.92	15.87					4.53	12.15	15.01
	/o/	stressed	27	541	1031	3024		/o/	stressed	27	431	873	2412
				5.27	8.71	15.74					4.30	7.73	14.26
		unstressed word-internal	33	509	1162	3003			unstressed word-internal	35	427	963	2385
				4.99	9.45	15.69					4.26	8.30	14.19
		unstressed word-final	14	513	1375	2923			unstressed word-final	18	444	1133	2414
				5.03	10.53	15.52					4.42	9.29	14.27
		[ɔ]	2	699	1463	2922			[*a*]	2	619	1338	2100
				6.51	10.93	15.52					5.90	10.34	13.34
		[ɛ]	2	687	1808	3437							
				6.43	12.33	16.54							
		[ə]	2	484	1599	2748							
				4.78	11.52	15.12							
	/ö/	stressed	13	549	1907	2834		/ö/	stressed	13	413	1646	2312
				5.33	12.69	15.32					4.13	11.71	13.98
		unstressed word-internal	7	494	1686	2773			unstressed word-internal	7	425	1534	2334
				4.86	11.87	15.18					4.24	11.24	14.04
		unstressed word-final	32	541	1901	2902			unstressed word-final	31	421	1731	2354
				5.27	12.67	15.47					4.21	12.04	14.10

Position, speakers	Vowel	Allophone	N	F1	F2	F3	Position, speakers	Vowel	Allophone	N	F1	F2	F3
SF, female speakers	/e/	stressed	58	511	2227	3084	SF, male speakers	/e/	stressed	58	429	1855	2734
				5.02	13.73	15.86					4.28	12.51	15.08
		unstressed word-internal	11	494	2237	3125			unstressed word-internal	14	426	1860	2769
				4.87	13.76	15.95					4.26	12.52	15.17
		[*i*]	1	395	2784	3339							
				3.97	15.20	16.36							
		unstressed word-final	66	544	1990	3087			unstressed word-final	63	445	1733	2692
				5.29	12.98	15.87					4.43	12.05	14.98
	/o/	stressed	27	486	1009	2941		/o/	stressed	28	441	880	2407
				4.80	8.58	15.56					4.39	7.78	14.25
		unstressed word-internal	33	493	1117	3047			unstressed word-internal	31	450	957	2454
				4.86	9.20	15.79					4.47	8.26	14.38
		unstressed word-final	18	545	1281	2886			unstressed word-final	16	448	1109	2407
				5.30	10.07	15.44					4.46	9.16	14.25
		[ə]	2	533	1606	2926			[ə]	2	484	1256	2553
				5.20	11.54	15.53					4.78	9.94	14.64
									[ɔ]	2	786	1321	2039
											7.14	10.26	13.14
	/ö/	stressed	13	495	1892	2831		/ö/	stressed	13	420	1639	2334
				4.88	12.64	15.31					4.20	11.68	14.04
		unstressed word-internal	7	490	1736	2816			unstressed word-internal	7	432	1582	2411
				4.83	12.06	15.28					4.32	11.44	14.26
		unstressed word-final	32	529	1897	2895			unstressed word-final	32	423	1686	2318
				5.17	12.66	15.46					4.23	11.87	14.00

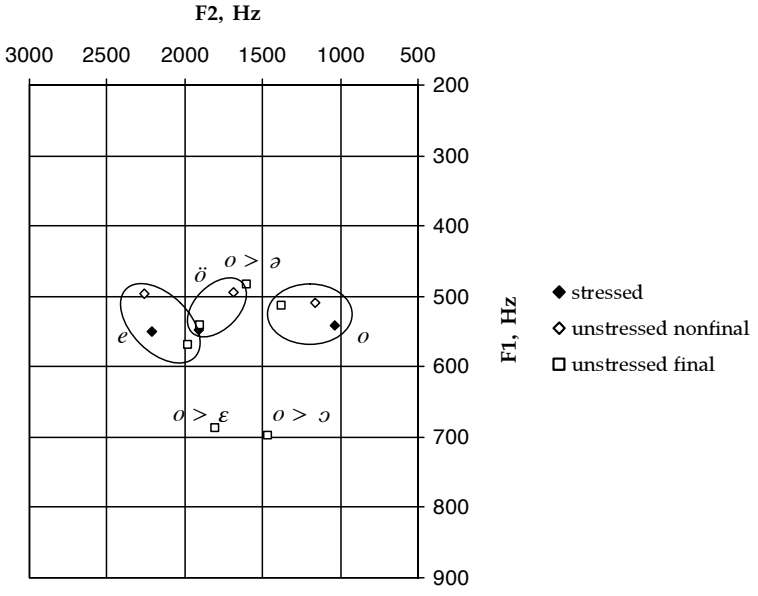

Figure 23. **Average formant values of /e, o, ö/ of stressed, unstressed word-internal and unstressed word-final syllables of phrase-final words (4 female speakers).**

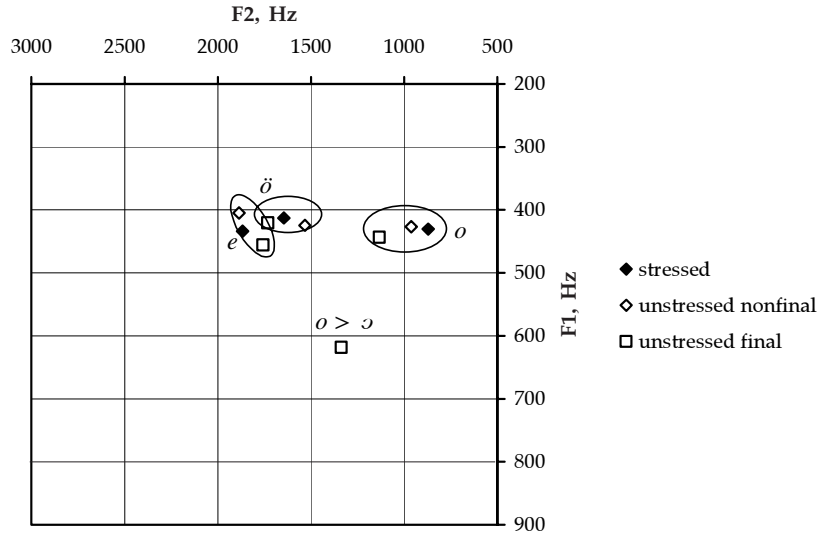

Figure 24. **Average formant values of /e, o, ö/ of stressed, unstressed word-internal and unstressed word-final syllables of phrase-final words (4 male speakers).**

The quality of the realizations of /e, ö, o/ in phrase-final words will be considered first. For both female and male speakers, stressed /e/ occupies a middle position between unstressed non-final [*e*] and unstressed final [*e*], which is closest to the center of the diagram. However, on the psychoacoustic scale the distances between these realizations do not exceed 1 Bark; the biggest is the distance between the F2 values of stressed /e/ and its unstressed word-final realization, which amounts 0.77 Bark. Considering the results by speakers, the distance between the F2 values of these two realizations exceeds 1 Bark for Speaker EI (1.13 Bark), and in her speech these vowels could be differentiated also psycho-acoustically. In the speech of other speakers the reduction of unstressed word-final /e/ is smaller, and its distance from the stressed vowel does not exceed 1 Bark in any instance.

However, in the speech of NK and VN, the word-internal unstressed /e/ in the words *jere·š* 'lake (ill. sg.)', *keče·t* 'your (pl.) day', *kučəneda·* 'you (pl.) want to catch' is more fronted in the formant space than unstressed word-final /e/, and their distance exceeds 1 Bark for F2 (1.12 Bark for NK, 1.3 Bark for VN; cf. Appendix 4, Table 27A).

Unstressed word internal /o/ is fronted relative to stressed /o/, indicating a certain amount of centralization. However, on the psychoacoustic scale the distance between the F2 values of these vowels does not exceed 1 Bark (0.74 Bark for female speakers, 0.57 Bark for male speakers).

The quality of unstressed word-final /o/ is much more variable than either that of unstressed word-internal /o/ or unstressed word-final /e/. Unstressed word-final /o/ is considerably closer to the center of the acoustic vowel space than either unstressed word-internal /o/ or stressed /o/. The distance between the F2 values of unstressed word-final /o/ and stressed /o/ is 1.82 Bark for female speakers and 1.56 Bark for male speakers. The degree of centralization differs for individual speakers, and the distance between the F2 values is greater than 1 Bark in most cases (EI — 2.62 Bark, ST — 1 Bark, LV — 1.12 Bark, AA — 2.38 Bark, JT — 1.68 Bark, VA — 1.29 Bark). The reduction of /o/ is most extensive in the speech of EI and AA. In the speech of NK and VN the distance between F2 values is under 1 Bark (0.6 and 0.98 Bark respectively).

Sometimes the word-final unstressed /o/ can have an [ɔ]-like quality, with a much greater value in Hz for F1 (as in the words [*mokššɔ*] 'his/her liver', [*kudəmšɔ*] 'sixth' produced by Speaker ST, [*joldəmɔ*] 'legless, lame', [*luddəmɔ*] 'unreadable, unread; boneless' produced by Speaker JT); an [ɛ]-like quality with much greater values both for F1 and F2 (as in the words [*joldəmɛ*], [*luddəmɛ*] produced by Speaker ST); or an [ə]-like, completely reduced quality, with a smaller value for F1 and a greater value for F2 (as in the words [*kudəmšə*], [*kudə*] 'summer kitchen' pronounced by Speaker NK). The relative positions of these realizations are shown on Figures 23 and 24.

Both unstressed word-internal and unstressed word-final /ö/ do not differ much from stressed /ö/. Unstressed word-final /ö/ can be fronted relative to stressed /ö/ (speakers EI, LV, AA, VN, VA); unstressed word-internal /ö/ can be relatively farther back on the acoustical vowel diagram than stressed /ö/ (speakers EI, ST, LV, NK, AA, JT, VN). There were relatively fewer productions of unstressed word-internal /ö/, which occurred in only two words (*pörte·m* 'my house', *pörtda·* 'your (pl.) house').

The average formant values of stressed /e, o, ö/ and their unstressed word-internal and word-final realizations in sentence-final words are included on Table 34 and shown on Figures 25 and 26 (cf. also Appendix 4, Table 27A).

As was the case in phrase-final position the formant structure of stressed /e/ in sentence-final words does not differ much from that of unstressed word-internal and word-final realizations in sentence-final words. Unstressed word-final /e/ is lower and more retracted than its stressed realization, but the distance between the values of F2 of these vowels exceeds 1 Bark for only one speaker (EI, 1.19 Bark). Speaker LV pronounced an [*i*]-like vowel in the unstressed first syllable of the word *keče·t*.

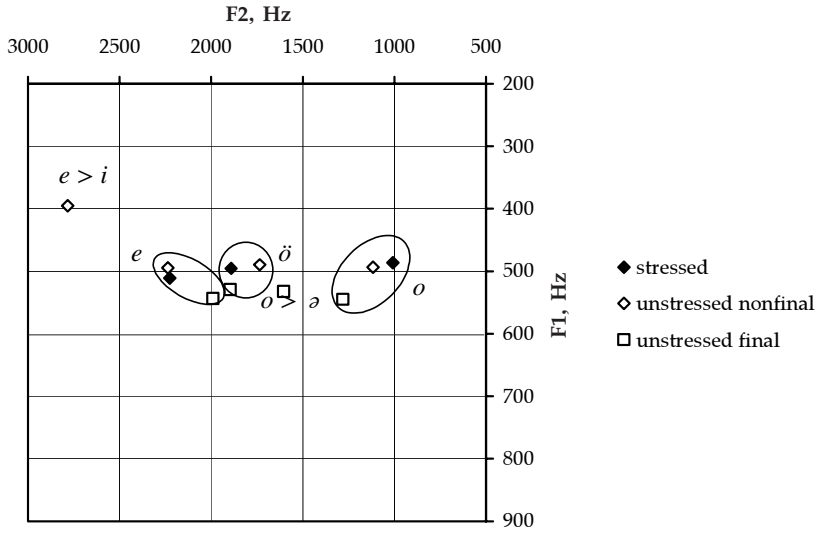

Figure 25. **Average formant values of /**e, o, ö**/ of stressed, unstressed word-internal and unstressed word-final syllables of sentence-final words (4 female speakers).**

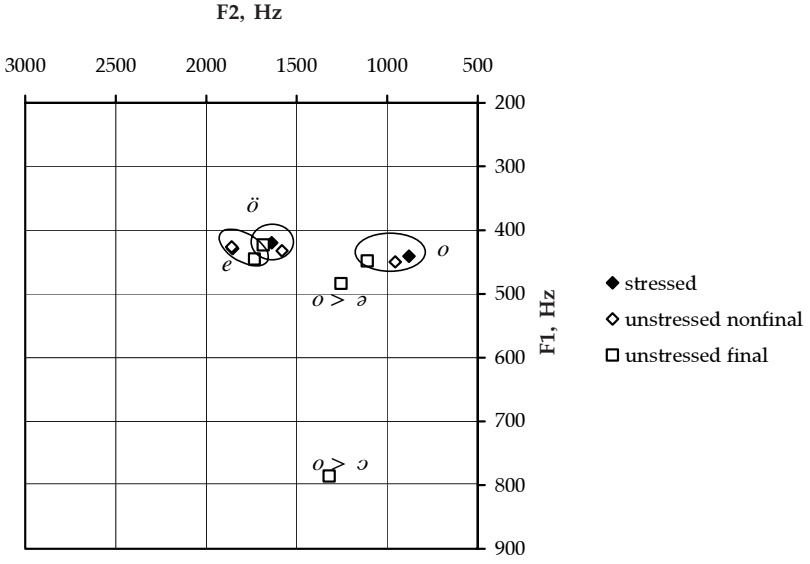

Figure 26. **Average formant values of /**e, o, ö**/ of stressed, unstressed word-internal and unstressed word-final syllables of sentence-final words (4 male speakers).**

Unstressed word-internal /o/ does not differ much from its stressed realization, being only slightly fronted. But unstressed word-final /o/ shows a greater degree of centralization. The distance between the F2

values averages 1.49 Bark for female speakers and 1.38 Bark for male speakers, with considerable individual differences (cf. Appendix 4, Table 27A). The distance between F2 values frequently exceeds 1 Bark, being greatest in the speech of EI (2.73 Bark). Unstressed word-final /o/ is also lower than the stressed one in her speech. The distance between F2 values of stressed /o/ and unstressed word-final /o/ is 1.57 Bark for ST, 1.93 Bark for JT, and 1.74 Bark for VA. In the speech of LV, NK, AA and VN the distance between these vowels remains under 1 Bark (amounting to 0.86 Bark, 0.75 Bark, 0.98 Bark, 0.84 Bark respectively).

Unstressed word-final /o/ sometimes appears to have been realized as a vowel of different quality — [ə] or [ɔ]. Speaker ST produced the word *joldəmo* as *joldəmə*, Speaker AA realized *kudəmšo* as *kudəmšə*, speakers AA and NK produced *kudo* as *kudə*, and Speaker JT pronounced *joldəmo*, *luddəmo* as *joldəmɔ*, *luddəmɔ*.

As was found to be the case in phrase-final position, /ö/ in sentence-final words did not show much change associated either with stress or with position within the word.

3.5.2.1.4. The reduced vowel /ə/ in coarticulation with other vowels

The reduced vowel /ə/ has a bigger standard deviation of F2 than other vowels, which suggests greater variability. This is partly dependent on the speaker: ST, EI, and NK had greater standard deviations, while those in productions by AA, VN, and JT were smaller (cf. Appendix 4, Tables 23A—26A).

Average formant frequencies of stressed /ə/ in monosyllabic words and in a stressed first syllable are given in Table 35 (for data by individual speakers cf. Appendix 4, Table 28A). There were only three monosyllabic words that contained /ə/: *pəl* 'cloud', *təp* 'quietly, quiet', *kərt* 'hardly'. In such words there is no possibility of coarticulation with other vowels, although the influence of surrounding consonants is present.

Formant values show that in monosyllabic words /ə/ is slightly more retracted than in stressed first syllables; however, the distances between their F2 values do not exceed 1 Bark.

It may be assumed that the quality of other vowels in the word could influence the quality of /ə/ in unstressed syllables. For that reason, the variation in the quality of /ə/ in unstressed syllables will be analyzed more closely. Formant values of /ə/ that occurred in a word also containing front vowels, back vowels, both front and back vowels, and other reduced vowels will be considered next (cf. Table 36 and Appendix 4, Table 29A).

Table 35

Formant values (Hz, Bark) of /ə/ in monosyllabic words and in stressed first syllables (PF — phrase-final words, SF — sentence-final words, N — number of measurements)

Monosyllabic					Stressed first syllable				
Female	N	F1	F2	F3	Female	N	F1	F2	F3
PF	12	595	1476	3009	PF	51	577	1515	3118
		5.71	10.99	15.71			5.56	11.16	15.93
SF	12	546	1473	3048	SF	52	553	1508	3094
		5.31	10.98	15.79			5.37	11.13	15.88
Male	N	F1	F2	F3	Male	N	F1	F2	F3
PF	12	540	1299	2471	PF	47	503	1373	2407
		5.26	10.16	14.42			4.95	10.51	14.25
SF	12	521	1301	2500	SF	49	490	1377	2448
		5.10	10.17	14.50			4.84	10.53	14.36

Table 36

Formant values (Hz, Bark) of unstressed /ə/ in environments consisting of front, back, both front and back, and other reduced vowels (PF — phrase-final words, SF — sentence-final words, N — number of measurements)

Position, speaker	/ə/ with front vowels				/ə/ with back vowels				/ə/ with front and back vowels				/ə/ with other /ə/s			
	N	F1	F2	F3	N	F1	F2	F3	N	F1	F2	F3	N	F1	F2	F3
PF, female	57	517	1771	2997	97	518	1476	3082	12	458	1822	3028	32	589	1594	3054
		5.05	12.19	15.65		5.06	10.99	15.84		4.52	12.37	15.73		5.65	11.49	15.72
SF, female	59	493	1689	3014	89	503	1478	3073	12	437	1825	3107	32	556	1607	3101
		4.84	11.88	15.70		4.93	10.99	15.81		4.32	12.39	15.89		5.38	11.55	15.88
PF, male	54	415	1527	2478	96	451	1307	2442	12	380	1666	2445	31	482	1415	2490
		4.14	11.21	14.42		4.48	10.19	14.31		3.81	11.78	14.34		4.75	10.70	14.42
SF, male	53	405	1495	2445	89	440	1315	2469	11	359	1697	2450	31	467	1398	2476
		4.06	11.07	14.33		4.39	10.23	14.38		3.61	11.90	14.34		4.62	10.62	14.41

The results indicate that coarticulation with the vowels in the environment is indeed present, and that the changes in the quality of unstressed /ə/ are comparable both in phrase-final and sentence-final words. In the speech of all speakers, /ə/ that co-occurred with front vowels was considerably more fronted than /ə/ found in words with back vowels. The distance between the F2 values of these vowels exceeds 1 Bark in productions by EI, ST (phrase-final words), JT, NK, and VA. This fact could also influence the perception of these allophones of

vowel /ə/. In the speech of LV this distance is almost 1 Bark, but in the speech of AA and VN, it is less than 1 Bark. The quality of the allophone of /ə/ that occurs in the neighborhood of back vowels is close to the quality of stressed allophones of /ə/.

When unstressed /ə/ occurs in a word containing other reduced vowels, its quality places it between the allophones that occur with front and back vowels; however, its location in the vowel space is closer to that occupied by allophones of /ə/ co-occurring with back vowels. Still, the position can vary: it can be more front than stressed allophones of /ə/, or — in sentence-final words — it can be even more retracted than the allophone that occurs with back vowels (for example in the speech of VN). In the speech of AA, the allophone of /ə/ that occurs in a word with other reduced vowels is more fronted than the allophone that occurs with front vowels.

When there are both front and back vowels in the word containing the unstressed /ə/, then the occurring allophone is closer to the allophone that occurs in a word containing front vowels, or even more fronted than that allophone. There were three words that fitted into this category: *kučənet* 'you (sg.) want to catch', *kučəneže* 'he/she wants to catch', *kučəneda* 'you (pl.) want to catch'. The distance between the values of F2 of that allophone of /ə/ and the allophone that occurs with back vowels is greater than 1 Bark in almost all productions. This allophone of unstressed /ə/ differs also from the stressed version of /ə/, being much more fronted. The distance between the values of F2 exceeds 1 Bark for all speakers.

CHAPTER 4

CONCLUSIONS

The results of this study of the prosody of Meadow Mari make it possible to draw a number of conclusions, some of which are more firmly supported by the data than others.

4.1. Quantity

It appears certain that there is no contrastive quantity in the language. This conclusion is supported by the fact that duration has another function: it is the most reliable phonetic correlate of stress. If duration had independently contrastive status, it would not be available as a stress correlate to the extent that it is shown to be by the results of this study.

A question might be raised with regard to the geminate consonants found in a number of words. The reasons why we do not consider the existence of geminates to constitute evidence for contrastive quantity are the following. There are intervocalic consonant clusters in the language, and the durational characteristics of geminates resemble those of consonant clusters. In numerous examples, the syllable boundary within a geminate is simultaneously a morpheme boundary (a separate study would be needed to answer the question whether this applies to all occurrences of geminates in the language). And in the sample that we analyzed, gemination did not appear to be systematic, i.e. did seem to be restricted to only a small number of consonants rather than involving the whole consonant system. A final argument is typological: it is unlikely that a language has a quantity opposition in consonants while lacking it in vowels, whereas the opposite case is quite common in languages of the world.

The study revealed another function of duration that appears not to have been described before: lengthening before the boundary of a phonological unit. The preboundary lengthening in the test words occurred in the final syllable in words that were produced in phrase-final and sentence-final position. We found no significant difference between the two positions, but the design of the current study does not enable us to state whether the lengthening is due to presence of the word boundary, or whether its occurrence is determined by the boundary of the higher-level unit — here the phrase and sentence. The possibility also needs to be considered that the phonological hierarchy of Meadow Mari may include intermediate-sized units between syllables and phonological words, namely metric feet. Our materials contained a relatively large number of disyllabic words, which might at the same time constitute disyllabic metric feet; there were not enough polysyllabic words for a reliable analysis of their internal structure. The extensive presence of lengthening in syllables followed by a boundary (word boundary, phrase boundary, sentence boundary) suggests that a separate study of this phenomenon would be worth while.

4.2. The role of fundamental frequency

The study showed no contrastive use of fundamental frequency at the word level, i.e. we found no indication of contrastive tone. The main function of F0 at the word level appeared to be contributing to the identification of a stressed syllable. While stressed syllables usually had higher F0 than unstressed syllables, sentence intonation could override the F0 pattern associated with word-level stress.

The test sentences were constructed in such a way that the test words occurred both at the end of phrases requesting continuation, and at the end of declarative sentences. The F0 patterns showed that the speakers used sustained or rising intonation at the end of the phrase, and falling intonation at the end of the sentence. The sentence-final falling intonation changed the F0 pattern on the word to conform to the falling curve.

Since the durational signals of stressedness were not affected by the position of words within higher-level units — phrases and sentences — it appears that heightened F0 is a relatively less effective stress cue.

4.3. The prosodic status of stress

Of the three prosodic features, duration and pitch appear to have no contrastive function in Meadow Mari. Stress, on the other hand, has a significant role, even though it is not totally unambiguous.

Our materials contained at least one minimal pair differing in the location of stress. In such cases, stress has a contrastive function — the meaning of the word depends on the placement of stress. There was also a considerable proportion of test words in the corpus where all the speakers agreed as to the location of stress on words lacking minimal pairs. In these cases stress has an identificational function which is likewise significant, distinguishing between a word and a non-word in the Meadow Mari lexicon. However, there was a not insignificant number of instances where speakers differed among themselves as to the location of stress, and instances where the same speaker placed stress on different syllables when the word occurred in a different frame.

It is possible that we are dealing with dialect differences here; the current study was not designed to provide an overview of usage in different dialects.

The phonetic correlates of stress include duration, that is a reliable cue; heightened F0, which is an auxiliary cue; and relatively optimal vowel quality, i.e. lack of vowel reduction. (The study was not designed to test the potential role of relative loudness; there are technical requirements in designing such an experiment which could not be met under actual conditions. It should be noted that hardly any prosodic analyses include an experimental study of loudness, probably due to the subjectivity of its perception.)

The notion of optimal vowel quality should perhaps be elaborated somewhat. Maximally contrastive style is one in which all oppositions are optimally realized. The sentences used in the study were constructed to produce optimal realizations ("I said X, not Y" requires the speaker to be as clear as possible). The same words produced in different contexts might be realized with less precision. But in the test sentences, the vowels in the stressed syllables were produced in such a way that they occupied extreme positions on the acoustical vowel diagram. And the results of the analysis show that the unstressed syllables experienced greater or lesser degrees of reduction — movement of their positions toward the center of the vowel space.

The central vowel /ə/ deserves special consideration. It differs from the other vowels (the so-called "full" vowels) in certain respects, but resembles them in prosodic behavior. The central vowel is intrinsically shorter than full vowels. However, it can be stressed — both when all vowels in the word are central vowels, and when the word also contains unstressed full vowels. When /ə/ bears stress, it is longer than unstressed /ə/ in the same position within a word, but shorter than a stressed full vowel in the same position. It can be proportionally lengthened in preboundary position in the same way as a full vowel

(but the number of instances in the current materials is too small to consider this generalization as more than tentative). It also experiences change in its quality connected with lack of stress. As the idealized position of a central vowel is at the center of the acoustical vowel space, reduction of an unstressed central vowel involves raising and fronting of the vowel compared to its stressed version. The quality of a central vowel is also more likely to be influenced by neighboring full vowels.

One of the identificational characteristics of words containing exclusively central vowels is the localization of stress on the first syllable.

The results of the study also point toward directions where further investigation might be fruitful. The possible existence of metric feet as constituents of polysyllabic words deserves a separate study. Only two terminal intonations were involved in the current materials; there is no doubt that intonation can have many additional functions and realizations. Sentence-level prosody includes also contrastive and emphatic stress. These are possible directions that a more detailed acoustic-phonetic investigation could take.

Some very interesting questions remain outside the scope of a phonetic study. These relate to the reasons why a particular syllable is stressed in a given word — and why speakers may differ in placing stress on that syllable. Instances where the same speaker can stress alternate syllables on different occasions offer a particular challenge. We hope that the prosody of Meadow Mari will receive the interest and dedication of researchers that it deserves.

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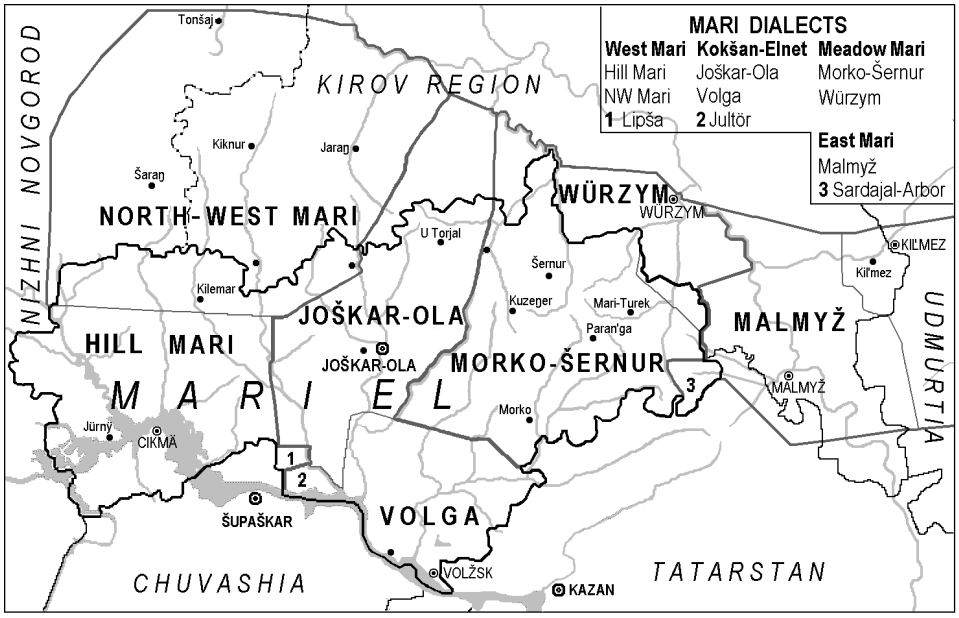
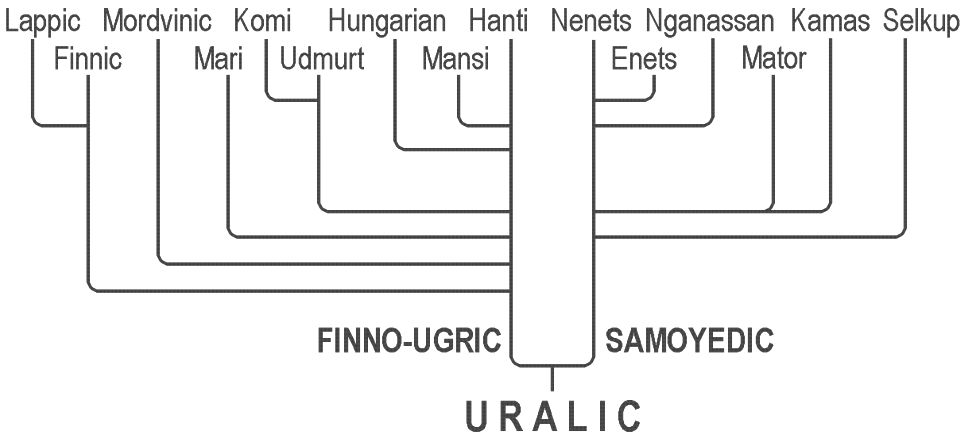
Appendix 1

Mari dialects



Appendix 2

The Uralic languages



Appendix 3

List of test words

Monosyllabic

лу	*lu*	ten, bone
пу	*pu*	tree
пыл	*pəl*	cloud
тып	*təp*	quietly, quiet
кырт	*kərt*	hardly
кол	*kol*	fish
вӱд	*vüd*	water
кид	*kid*	hand
куп	*kup*	swamp
кӱрт	*kürt*	snow crust

Disyllabic

чызе	*čəze*	dug
шыже	*šəže*	autumn
кыне	*kəne*	cannabis
шынга	*šəŋa*	gnat
кыша	*kəša*	footprint
чыке	*čəke*	little haystack
пиже	*piže*	his/her dog
кудо	*kudo*	summer kitchen
тӱгӧ	*tügö*	out
кече	*keče*	day, sun
пӱчӧ	*püčö*	deer
тӱкӧ	*tükö*	horn
ида	*ida*	don't (2pl. imper.)
кугу	*kugu*	big
вита	*vita*	seeps through
нылле	*nəlle*	forty
ийже	*ijže*	let him/her swim (3sg. imper.)
кӧргӧ	*körgö*	interior, inside

шерге	*še·rge*	dear
пӱнчӧ	*pünčö*	pine
пӧртшӧ	*pörtšö*	his/her house
кичше	*kidše*	his/her hand
кӱдшӧ	*küčšö*	his/her fingernail
мокшшо	*mokššo*	his/her liver
ийда	*ijda*	your (pl.) ice, year
шунна	*šunna*	our clay
пурдэ	*purde*	without biting
шерге	*šerge·*	comb
пӧртда	*pörtda*	your (pl.) house
кидда	*kidda*	your (pl.) hand
лудде	*ludde*	without reading
акла	*akla*	he/she evaluates (2sg.)
нылыт	*nələt*	four
шымыт	*šəmət*	seven
ийым	*ijəm*	ice (acc. sg.), I swam
шӱвыл	*šüvəl*	spittle
ӱдыр	*üdər*	daughter
кӱчым	*küčəm*	fingernail (acc. sg.)
толыт	*tolət*	they come (3pl.)
кудыт	*kudət*	six
кокыт	*kokət*	two
шулдыр	*šuldər*	wing
шултыш	*šultəš*	piece
пӧртым	*pörtəm*	house (acc. sg.)
мокшын	*mokšən*	liver (gen. sg.)
луаш	*luaš*	the ten-piece
ереш	*jereš*	lake (ill. sg.)
пылан	*pəlan*	cloudy
пыжаш	*pəžaš*	nest
пыллан	*pəllan*	to the cloud (all. sg.), on the cloud (adess. sg.)
толат	*tolat*	you come (2sg.)
водар	*vodar*	udder
вӱдан	*vüdan*	watery
кечет	*kečet*	your (pl.) day
кӱчет	*küčet*	your (pl.) fingernail
йоллан	*jollan*	to the leg (all. sg.), on the leg (adess. sg.)
кандаш	*kandaš*	eight
йолташ	*joltaš*	friend
пӧртем	*pörtem*	my house
мокшет	*mokšet*	your (sg.) liver

Trisyllabic

нылытын	*nələtən*	foursome
тыгыдын	*təgədən*	fine (transl. sg.)
нылыннан	*nələnnan*	of us four (gen. sg.)
ӱдырышт	*üdərəšt*	their daughter
кудымшо	*kudəmšo*	sixth
шӱдымшӧ	*šüdəmšö*	hundredth
вийдыме	*vijdəme*	powerless
йолдымо	*joldəmo*	legless, lame
киддыме	*kiddəme*	handless
луддымо	*luddəmo*	unreadable, unread; boneless
толына	*toləna*	we come (1pl.)
визыте	*vizəte*	five times
кудыда	*kudəda*	your (pl.) summer kitchen
лудынна	*ludənna*	we read (praet. II)
толынна	*tolənna*	we came (praet. II)
индеше	*indeše*	nine
кандаше	*kandaše*	eight
лудынам	*ludənam*	I read (praet. II)
когыннан	*kogənnan*	of us two (gen. sg.)
кучынет	*kučənet*	you (sg.) want to catch
луаҥаш	*luaŋaš*	to ossify
кудодам	*kudodam*	your (sg.) house (acc. sg.)
таганан	*taganan*	shoed
киддавлак	*kiddavlak*	your (pl.) hands

Four-syllable

нылыньыштым	*nələnəštəm*	these/those four (acc. sg.)
нылытынат	*nələtənat*	foursome
пытадымаш	*pətarəmaš*	completion
витыдымэ	*vitədəme*	waterproof
кучынежэ	*kučəneže*	he/she wants to catch
кучынеда	*kučəneda*	you (pl.) want to catch

Appendix 4

Additional data obtained in the course of acoustic analysis

Table 1A

Vowel duration (ms) in open stressed syllables occurring in non-final and final positions in the test words. Phrase-final (PF) and sentence-final (SF) occurrences are presented separately (N — tokens, x̄ — average, s.d. — standard deviation)

Phrase-final words								
Speaker	/ə/ (nonfinal)		V (nonfinal)		V (final)		Monosyllabic	
	N	x̄	N	x̄	N	x̄	N	x̄
EI	7	96	19	114	21	155	2	139
AA	6	88	23	115	16	188	2	192
ST	10	91	25	106	12	177	2	124
JT	8	111	22	136	15	222	2	220
LV	11	76	23	92	5	148	2	134
NK	7	114	22	119	17	229	2	192
VN	8	62	23	72	11	138	1	139
VA	9	78	23	98	14	185	2	293
Average		**90**		**107**		**180**		**179**
s.d.		**18**		**19**		**33**		**58**
Sentence-final words								
Speaker	/ə/ (nonfinal)		V (nonfinal)		V (final)		Monosyllabic	
	N	x̄	N	x̄	N	x̄	N	x̄
EI	7	111	20	116	21	164	2	170
AA	8	86	20	94	16	158	2	148
ST	10	90	24	99	13	169	2	184
JT	9	120	22	138	15	230	2	236
LV	12	73	22	86	6	135	2	136
NK	7	118	24	126	16	204	2	200
VN	10	60	24	75	8	147	2	139
VA	9	84	21	98	14	185	2	253
Average		**93**		**104**		**174**		**183**
s.d.		**22**		**21**		**31**		**44**
Overall average	**138**	**92**	**357**	**106**	**220**	**177**	**31**	**181**
s.d.		**20**		**20**		**32**		**51**

Table 2A

Vowel duration (ms) in open unstressed syllables in phrase-final (PF) and sentence-final (SF) words (N — number of tokens, $\bar{x}$ — average, s.d. — standard deviation)

Phrase-final words						
Speaker	/ə/ (nonfinal)		V (nonfinal)		V (final)	
	N	$\bar{x}$	N	$\bar{x}$	N	$\bar{x}$
EI	27	62	25	81	26	116
AA	27	51	22	81	31	97
ST	24	60	19	67	35	130
JT	26	51	22	62	32	151
LV	23	56	21	66	42	112
NK	27	79	22	79	30	134
VN	20	44	20	58	39	92
VA	23	58	23	72	33	157
Average		**58**		**71**		**124**
s.d.		**10**		**9**		**24**
Sentence-final words						
Speaker	/ə/ (nonfinal)		V (nonfinal)		V (final)	
	N	$\bar{x}$	N	$\bar{x}$	N	$\bar{x}$
EI	27	58	23	78	27	101
AA	24	55	24	70	31	76
ST	24	55	20	59	34	118
JT	26	46	22	63	32	160
LV	22	54	22	66	41	120
NK	24	59	25	77	29	132
VN	23	49	19	58	38	108
VA	25	56	23	65	33	139
Average		**54**		**67**		**119**
s.d.		**5**		**8**		**25**
Overall average	**392**	**56**	**352**	**69**	**533**	**121**
s.d.		**7**		**8**		**25**

Table 3A

The duration (ms) of the short /i/ and the combination of /i/ and the glide /j/ as well as the vowel of the subsequent syllables (the duration of the vowel in a stressed syllable in boldface)

Phrase-final words								
Speaker	*pi̮že*		*iji̮že*		*ida*		*ijda*	
	V1	V2	V1	V2	V1	V2	V1	V2
EI	**149**	131	**171**	118	105	**186**	180	**175**
AA	**146**	121	**244**	118	104	**197**	*100	**154**
ST	**128**	139	**172**	147	**72	**180**	117	**200**
JT	**220**	167	**230**	183	51	**252**	102	**209**
LV	**95**	124	**173**	136	**112**	149	**175**	173
NK	**169**	186	**245**	88	101	**245**	136	**248**
VN	**70**	92	**146**	71	78	**179**	**120**	158
VA	**102**	197	**174**	197	73	**228**	**225**	197
Average	**135**	145	**191**	132	**112**	149	**173**	176
					85	**215**	134	**208**
Sentence-final words								
Speaker	*pi̮že*		*iji̮že*		*ida*		*ijda*	
	V1	V2	V1	V2	V1	V2	V1	V2
EI	**137**	116	**193**	89	73	**211**	155	**167**
AA	**135**	71	**164**	82	89	**196**	136	**177**
ST	**143**	111	**163**	101	41	**177**	***100	**208**
JT	**175**	147	**216**	168	106	**272**	****105	**217**
LV	**82**	124	**153**	117	**102**	145	**176**	134
NK	**151**	132	**210**	142	119	**195**	179	**231**
VN	**77**	84	**141**	112	*****		**141**	124
VA	**106**	129	**179**	150	81	**219**	158	**179**
Average	**126**	114	**177**	120	**102**	145	**158**	129
					85	**212**	146	**192**
Overall	**131**	130	**184**	126	**107**	147	**166**	153
average					85	**214**	140	**200**

* pronounced [*ida*]
** pronounced [*ijdda*] instead of [*ijda*]
*** pronounced [*idda*] instead of [*ijda*]
**** pronounced [*ida*] instead of [*ijda*]
***** pronounced [*da*] instead of [*ida*]

Table 4A

Average duration (ms) of vowels and coda consonants in monosyllabic words in open and closed syllables (PF — phrase-final, SF — sentence-final, N — number of tokens, s.d. — standard deviation)

Phrase-final words					
Speaker	Open		Closed		
	N	V	N	V	C
EI	2	139	8	115	128
AA	2	192	8	117	95
ST	2	124	8	107	104
JT	2	220	8	154	111
LV	2	134	8	80	90
NK	2	192	8	138	111
VN	1	139	8	70	115
VA	2	293	8	117	70
Average	**15**	**179**	**64**	**112**	**103**
s.d.		**58**		**28**	**40**
Sentence-final words					
Speaker	Open		Closed		
	N	V	N	V	C
EI	2	170	8	114	120
AA	2	148	8	90	94
ST	2	184	8	113	119
JT	2	236	8	165	99
LV	2	136	8	84	87
NK	2	200	8	138	144
VN	2	139	8	68	116
VA	2	253	8	90	169
Average	**16**	**183**	**64**	**108**	**118**
s.d.		**44**		**32**	**45**
Overall average	**31**	**181**	**128**	**110**	**111**
s.d.		**51**		**30**	**43**

Table 5A

Average duration of vowels (ms) and V1/V2 duration ratios in disyllabic CV.CV words (PF — phrase-final, SF — sentence-final, N — number of tokens, s.d. — standard deviation)

Phrase-final words																
Speaker	First syllable stressed								Second syllable stressed							
	N	/ə/	V2	V1/V2	N	V1	V2	V1/V2	N	/ə/	V2	V1/V2	N	V1	V2	V1/V2
EI	2	113	114	0.99	6	125	127	0.99	4	56	144	0.39	3	103	144	0.72
s.d.		11	11			17	11			15	6			3	6	
AA	2	78	102	0.76	6	116	109	1.07	4	50	175	0.28	3	85	216	0.39
s.d.		14	11			31	23			2	20			17	18	
ST	4	105	117	0.90	6	117	139	0.84	2	33	168	0.19	3	65	184	0.35
s.d.		17	11			15	21			22	11			11	20	
JT	3	144	167	0.86	6	165	176	0.94	3	50	237	0.21	3	75	244	0.31
s.d.		25	8			37	9			6	15			28	14	
LV	6	74	102	0.73	9	90	125	0.72	0				0			
s.d.		15	15			12	26									
NK	2	125	140	0.90	6	122	135	0.90	4	60	222	0.27	3	72	212	0.34
s.d.		23	1			28	32			17	42			25	31	
VN	3	74	119	0.62	8	69	96	0.72	3	26	102	0.26	1	78	179	0.44
s.d.		26	5			16	29			7	27					
VA	4	79	148	0.53	7	104	201	0.52	2	50	140	0.35	2	72	235	0.30
s.d.		17	6			15	16			2	1			2	9	
Average	**26**	**99**	**126**	**0.78**	**54**	**113**	**138**	**0.82**	**22**	**46**	**170**	**0.27**	**18**	**78**	**202**	**0.39**
s.d.		**18**	**9**			**21**	**21**			**10**	**17**			**14**	**17**	
Sentence-final words																
Speaker	First syllable stressed								Second syllable stressed							
	N	/ə/	V2	V1/V2	N	V1	V2	V1/V2	N	/ə/	V2	V1/V2	N	V1	V2	V1/V2
EI	2	117	96	1.22	6	120	109	1.10	4	58	158	0.37	3	79	189	0.42
s.d.		6	14			11	16			13	7			15	20	
AA	2	76	57	1.32	6	99	72	1.38	4	44	128	0.34	3	73	177	0.41
s.d.		2	8			20	8			13	39			14	41	
ST	4	87	118	0.74	6	99	137	0.72	2	37	154	0.24	3	51	173	0.30
s.d.		28	22			31	26			8	28			9	20	
JT	3	163	169	0.97	6	160	168	0.95	3	34	234	0.15	3	71	266	0.27
s.d.		18	14			12	16			3	14			30	31	
LV	6	62	115	0.54	8	78	137	0.57	0				1	81	131	0.62
s.d.		21	14			12	20									
NK	2	150	145	1.03	6	131	129	1.01	4	47	196	0.24	3	85	188	0.45
s.d.		5	5			16	32			12	9			29	28	
VN	3	76	107	0.71	8	68	113	0.60	0				0			
s.d.		27	9			11	24									
VA	4	82	127	0.65	6	104	159	0.65	2	52	145	0.36	3	69	218	0.32
s.d.		20	24			15	27			8	35			10	1	
Average	**26**	**102**	**117**	**0.87**	**52**	**107**	**128**	**0.84**	**19**	**45**	**169**	**0.27**	**19**	**73**	**192**	**0.38**
s.d.		16	14			16	21			9	22			18	23	
Overall average	**52**	**101**	**122**	**0.83**	**106**	**110**	**133**	**0.83**	**41**	**46**	**170**	**0.27**	**37**	**76**	**197**	**0.39**
		17	**12**			**19**	**21**			**10**	**20**			**16**	**20**	

Table 6A

Average durations (ms) of vowels and coda consonants and V1/V2 duration ratios in disyllabic CVC.CV words (PF — phrase-final, SF — sentence-final, N — number of tokens, s.d. — standard deviation)

Phrase-final words										
Speaker	First syllable stressed					Second syllable stressed				
	N	V1	C.	V2	V1/V2	N	V1	C.	V2	V1/V2
EI	8	108	110	109	0.99	7	72	155	157	0.46
s.d.		26	45	15			12	31	12	
AA	10	105	160	109	0.97	5	79	127	198	0.40
s.d.		39	70	19			19	39	17	
ST	10	100	96	124	0.81	5	61	111	174	0.35
s.d.		20	27	16			14	25	17	
JT	10	125	117	142	0.88	5	55	127	208	0.26
s.d.		31	27	27			15	44	18	
LV	15	85	96	119	0.72	0				
s.d.		24	38	18						
NK	9	114	112	122	0.94	6	68	121	252	0.27
s.d.		21	39	25			16	44	25	
VN	13	72	100	87	0.84	2	60	86	156	0.38
s.d.		22	41	22			4	4	16	
VA	8	103	111	154	0.67	7	78	104	193	0.40
s.d.		14	49	39			14	34	21	
Average	**83**	**102**	**113**	**121**	**0.84**	**37**	**67**	**119**	**191**	**0.35**
s.d.		**25**	**42**	**23**			**14**	**32**	**18**	
Sentence-final words										
Speaker	First syllable stressed					Second syllable stressed				
	N	V1	C.	V2	V1/V2	N	V1	C.	V2	V1/V2
EI	8	108	117	103	1.05	7	63	169	163	0.39
s.d.		25	46	19			12	61	11	
AA	10	98	144	80	1.23	5	71	165	164	0.43
s.d.		28	69	22			19	72	27	
ST	10	89	114	111	0.80	5	59	133	168	0.35
s.d.		21	41	18			26	25	30	
JT	10	144	121	163	0.88	5	55	112	211	0.26
s.d.		22	33	20			13	29	11	
LV	15	80	105	120	0.67	0				
s.d.		23	42	18						
NK	9	124	125	141	0.88	6	65	121	214	0.31
s.d.		32	43	30			21	49	25	
VN	14	74	110	104	0.71	1	109	113	153	0.71
s.d.		22	35	15						
VA	9	100	120	157	0.63	6	75	129	202	0.37
s.d.		17	34	26			23	50	24	
Average	**85**	**102**	**119**	**122**	**0.83**	**35**	**71**	**135**	**182**	**0.39**
s.d.		**24**	**43**	**21**			**19**	**48**	**21**	
Overall average	**168**	**102**	**116**	**122**	**0.84**	**72**	**69**	**127**	**187**	**0.37**
s.d.		**25**	**42**	**22**			**17**	**40**	**20**	

Table 7A

Average durations (ms) of vowels and coda consonants and V1/V2 duration ratios in disyllabic CV.CVC words (PF — phrase-final, SF — sentence-final, N — number of tokens, s.d. — standard deviation)

Phrase-final words										
Speaker	First syllable stressed					Second syllable stressed				
	N	V1	V2	C	V1/V2	N	V1	V2	C	V1/V2
EI	8	104	74	127	1.41	9	84	139	171	0.60
s.d.		29	18	96			19	15	88	
AA	8	113	53	100	2.13	8	77	126	135	0.61
s.d.		19	16	37			23	26	35	
ST	8	108	81	101	1.33	8	70	134	118	0.52
s.d.		15	18	49			19	25	50	
JT	8	130	64	114	2.04	9	60	165	126	0.37
s.d.		22	18	24			22	25	35	
LV	7	98	75	107	1.31	9	71	135	106	0.53
s.d.		19	13	40			15	25	39	
NK	8	117	88	116	1.34	9	72	151	143	0.48
s.d.		26	14	30			20	27	27	
VN	9	66	61	108	1.08	8	53	109	94	0.49
s.d.		13	25	36			16	29	40	
VA	8	91	91	201	1.01	9	75	127	220	0.59
s.d.		16	11	117			27	28	79	
Average	**64**	**104**	**73**	**122**	**1.41**	**69**	**70**	**136**	**139**	**0.52**
s.d.		**20**	**17**	**54**			**20**	**25**	**49**	
Sentence-final words										
Speaker	First syllable stressed					Second syllable stressed				
	N	V1	V2	C	V1/V2	N	V1	V2	C	V1/V2
EI	8	121	57	123	2.11	7	86	149	136	0.57
s.d.		14	9	65			19	14	77	
AA	9	85	56	116	1.51	7	71	118	134	0.60
s.d.		21	25	52			16	27	43	
ST	9	113	70	96	1.61	8	56	135	112	0.42
s.d.		28	20	27			23	27	37	
JT	8	139	56	105	2.37	9	62	175	115	0.36
s.d.		25	19	23			18	28	17	
LV	8	83	61	104	1.37	9	68	135	117	0.51
s.d.		17	14	34			21	24	47	
NK	8	124	96	129	1.30	9	72	176	163	0.41
s.d.		23	18	31			37	13	75	
VN	9	73	62	124	1.19	8	56	114	122	0.49
s.d.		23	15	47			10	24	40	
VA	8	96	87	193	1.10	9	68	141	186	0.48
s.d.		20	18	97			21	21	50	
Average	**67**	**104**	**68**	**124**	**1.53**	**66**	**67**	**143**	**136**	**0.47**
s.d.		**21**	**17**	**47**			**21**	**22**	**48**	
Overall average	**131**	**104**	**71**	**123**	**1.47**	**135**	**69**	**140**	**137**	**0.50**
s.d.		**21**	**17**	**50**			**21**	**24**	**49**	

Table 8A

Average durations (ms) of vowels and coda consonants and V1/V2 duration ratios in disyllabic CVC.CVC words (PF — phrase-final, SF — sentence-final, N — number of tokens, s.d. — standard deviation)

Phrase-final words												
Speaker	First syllable stressed						Second syllable stressed					
	N	V1	C.	V2	C	V1/V2	N	V1	C.	V2	C	V1/V2
EI	4	119	73	53	94	2.23	6	88	95	138	136	0.64
s.d.		7	22	4	75			13	34	21	72	
AA	4	112	104	55	102	2.04	6	77	142	118	138	0.65
s.d.		40	28	13	40			26	65	8	55	
ST	4	86	79	71	90	1.21	6	62	88	118	129	0.52
s.d.		33	22	17	47			9	16	12	55	
JT	4	108	84	54	85	2.00	6	60	98	160	135	0.38
s.d.		33	24	18	20			7	27	20	37	
LV	5	84	58	52	76	1.62	6	55	71	111	109	0.49
s.d.		21	13	11	33			20	20	19	31	
NK	4	92	82	68	137	1.34	6	68	78	128	131	0.53
s.d.		31	13	11	35			10	23	19	26	
VN	4	83	66	43	95	1.91	6	59	61	92	106	0.65
s.d.		12	21	7	37			10	22	14	28	
VA	4	94	79	81	140	1.16	6	69	75	116	184	0.59
s.d.		19	17	25	73			12	30	28	74	
Average	**33**	**97**	**78**	**60**	**102**	**1.63**	**48**	**67**	**89**	**123**	**133**	**0.55**
s.d.		**25**	**20**	**13**	**45**			**13**	**30**	**18**	**47**	
Sentence-final words												
Speaker	First syllable stressed						Second syllable stressed					
	N	V1	C.	V2	C	V1/V2	N	V1	C.	V2	C	V1/V2
EI	3	132	57	48	107	2.72	7	75	93	146	162	0.51
s.d.		22	15	16	49			17	72	10	79	
AA	4	119	75	58	101	2.05	6	73	78	118	147	0.62
s.d.		26	27	17	45			25	42	23	51	
ST	4	87	87	60	93	1.45	6	62	79	115	139	0.54
s.d.		22	22	33	23			15	28	19	72	
JT	4	108	95	56	95	1.93	6	76	117	164	133	0.46
s.d.		32	23	9	24			23	16	25	15	
LV	4	89	62	55	70	1.62	6	52	98	113	111	0.46
s.d.		16	16	7	8			21	36	14	51	
NK	4	93	85	74	100	1.25	6	75	96	168	165	0.45
s.d.		26	22	20	37			7	36	23	51	
VN	4	89	73	50	85	1.77	6	52	110	106	124	0.49
s.d.		4	11	16	23			12	81	10	37	
VA	4	93	72	71	92	1.31	6	66	148	141	165	0.46
s.d.		9	15	30	29			12	78	28	83	
Average	**31**	**101**	**76**	**59**	**93**	**1.71**	**49**	**66**	**102**	**134**	**143**	**0.50**
s.d.		**20**	**19**	**18**	**30**			**17**	**49**	**19**	**55**	
Overall average	**64**	**100**	**77**	**60**	**97**	**1.69**	**97**	**67**	**96**	**129**	**138**	**0.53**
s.d.		**23**	**19**	**16**	**37**			**15**	**39**	**19**	**51**	

Table 9A

Duration (ms) of vowels in the stressed and unstressed syllables of trisyllabic words in closed and open syllables

Phrase-final words																				
Speaker	Syllable type	N			Stressed V1			N			Stressed V2			N			Stressed V3		
					V1	V2	V3				V1	V2	V3				V1	V2	V3
EI	open	6	7	6	98	60	117		2	2		138	128	11	7	4	72	84	150
	s.d.				25	8	18					15	6				16	16	14
	closed	3	2	3	92	58	56	3	1	1	76	134	93		4	7		66	124
	s.d.				17	7	5				29							9	12
AA	open	8	7	8	98	63	84		2	2		141	67	9	7	2	72	63	172
	s.d.				23	10	11					16	1				18	21	33
	closed	3	4	3	79	49	62	3	1	1	64	128	66		2	7		57	129
	s.d.				23	10	11				18							10	11
ST	open	9	10	11	83	73	140		2	2		135	96	5	4	3	55	70	104
	s.d.				13	19	18					4	13				15	27	20
	closed	5	4	3	69	63	94	2			58			2	3	4	33	78	128
	s.d.				8	5	12				0						8	23	13
JT	open	8	7	8	102	52	138		2	2		185	178	8	6	2	59	59	209
	s.d.				24	8	23					24	59				15	22	1
	closed	3	4	3	85	43	75	2			69			2	4	8	37	66	136
	s.d.				26	8	20				17						1	23	20
LV	open	6	7	6	72	63	97		2	2		134	79	10	6	5	55	68	136
	s.d.				12	15	35					16	4				15	21	34
	closed	3	2	3	58	51	56	2			53			2	6	7	34	69	108
	s.d.				11	7	17				38						3	28	18
NK	open	8	7	8	104	76	137		2	2		143	164	8	6	2	71	78	198
	s.d.				21	9	21					6	6				18	29	71
	closed	3	4	3	111	70	89	2			82			2	4	8	64	102	154
	s.d.				32	16	4				30						16	12	21
VN	open	6	5	6	56	43	69		2	2		97	95	10	5	4	51	68	145
	s.d.				11	4	17					6	9				17	23	23
	closed	3	2	6	53	51	54	1			50			2	6	8	85	64	112
	s.d.				10	2	23										50	33	20
VA	open	8	7	8	81	66	125		2	2		121	135	8	6	2	65	62	152
	s.d.				19	20	17					4	7				12	21	23
	closed	3	4	3	73	57	77	2			57			2	4	8	50	56	119
	s.d.				8	10	19				0						21	12	27
Average	open	**59**	**57**	**61**	**87**	**62**	**113**	**0**	**16**	**16**		**137**	**117**	**69**	**47**	**24**	**62**	**69**	**158**
	s.d.				**18**	**12**	**20**					**11**	**13**				**16**	**22**	**27**
	closed	**26**	**26**	**27**	**77**	**55**	**70**	**17**	**2**	**2**	**64**	**131**	**80**	**12**	**33**	**57**	**50**	**70**	**126**
	s.d.				**17**	**8**	**14**				**19**						**16**	**19**	**18**

Sentence-final words																				
Speaker	Sylla-ble type	N			Stressed V1			N			Stressed V2			N			Stressed V3		
					V1	V2	V3				V1	V2	V3				V1	V2	V3
EI	open	6	7	6	93	56	100		2	2		145	87	10	5	4	66	73	166
	s.d.				16	10	5					8	12				19	14	27
	closed	3	2	3	98	44	55	2			81			2	7	8	52	85	131
	s.d.				23	2	23				0						0	31	6
AA	open	6	6	7	87	61	81	1	2	3	45	119	85	9	7	2	63	65	153
	s.d.				21	5	20					8	33				20	19	16
	closed	3	3	2	87	50	56	3	2	1	64	96	91	1	3	8	45	67	124
	s.d.				25	19	1				12	78						24	15
ST	open	10	8	9	84	68	120		2	2		123	98	6	5	1	55	64	139
	s.d.				15	10	17					0	30				17	15	
	closed	3	5	4	65	50	83	2			57			2	3	7	39	80	126
	s.d.				14	6	16				6						6	34	19
JT	open	8	7	8	114	50	148		2	2		173	176	8	6	2	55	56	243
	s.d.				37	7	29					1	5				16	27	23
	closed	3	4	3	120	41	67	2			80			2	4	8	42	72	142
	s.d.				8	3	22				10						1	26	22
LV	open	7	7	6	80	58	110		2	2		118	105	9	6	4	56	67	136
	s.d.				20	6	15					6	0				10	20	18
	closed	3	3	4	52	51	77	2			76			2	5	7	26	69	111
	s.d.				12	9	14				2						6	27	17
NK	open	8	7	8	104	72	118		2	2		159	148	8	6	2	61	81	202
	s.d.				19	23	29					12	25				20	26	39
	closed	3	4	3	109	57	101	2			98			2	4	8	50	93	174
	s.d.				42	17	19				14						5	30	17
VN	open	8	8	7	61	49	108		2	2		115	117	8	5	3	50	60	142
	s.d.				13	16	16					6	2				19	8	17
	closed	3	3	4	63	48	62	2			65			2	5	7	51	73	109
	s.d.				10	11	20				3						8	40	16
VA	open	7	7	7	75	63	114	1	2	3	60	134	136	8	6	2	59	59	136
	s.d.				18	14	25					1	41				21	26	38
	closed	3	3	3	78	49	81	2	1		59	71		2	4	8	42	59	112
	s.d.				27	2	25				17						6	10	10
Average	open	**60**	**57**	**58**	**87**	**60**	**112**	**2**	**16**	**18**	**53**	**136**	**119**	**66**	**46**	**20**	**58**	**66**	**165**
	s.d.				**20**	**11**	**19**					**5**	**19**				**18**	**19**	**25**
	closed	**24**	**27**	**26**	**84**	**49**	**73**	**17**	**3**	**1**	**72**	**84**	**91**	**15**	**35**	**61**	**43**	**75**	**129**
	s.d.				**20**	**9**	**17**				**8**	**78**					**5**	**28**	**15**
Overall average	open	**119**	**114**	**119**	**87**	**61**	**113**	**2**	**32**	**34**	**53**	**136**	**118**	**135**	**93**	**44**	**60**	**67**	**161**
	s.d.				**19**	**12**	**20**				**11**	**8**	**16**				**17**	**21**	**26**
	closed	**50**	**53**	**53**	**81**	**52**	**71**	**34**	**5**	**3**	**68**	**107**	**83**	**27**	**68**	**118**	**46**	**72**	**127**
	s.d.				**18**	**9**	**16**				**13**	**78**	**15**				**10**	**23**	**16**

Table 10A

Average duration (ms) of vowels in four-syllable words

Phrase-final words								
Speaker	V1		V2	V3		V4		
	primary	secondary	unstressed	primary	unstressed	primary	secondary	unstressed
EI	96	52	55	113	69	122	59	121
AA	93	42	37	162	52	147	38	64
ST	78	42	60	134	53	130	101	127
JT	68	36	47	120	52	154	73	96
LV	65	35	55	120	56	121	53	58
NK	104	40	65	167	71	171	120	182
VN	44	39	51	117	51	123	61	93
VA	75	49	59	133	59	149	94	170
Average	**78**	**42**	**54**	**133**	**58**	**140**	**75**	**114**
s.d.	**20**	**6**	**9**	**21**	**8**	**18**	**28**	**45**
Sentence-final words								
Speaker	V1		V2	V3		V4		
	primary	secondary	unstressed	primary	unstressed	primary	secondary	unstressed
EI	97	43	52	130	63	137	64	111
AA	102	39	60	129	52	134	48	53
ST	70	37	43	92	61	140	77	129
JT	63	36	45	117	48	167	94	128
LV	97	43	52	130	63	137	64	111
NK	93	51	54	143	60	198	103	107
VN	48	32	53	120	64	131	87	80
VA	85	53	61	136	50	155	95	53
Average	**82**	**42**	**52**	**125**	**58**	**150**	**79**	**97**
s.d.	**20**	**7**	**6**	**16**	**7**	**23**	**19**	**31**
Overall average	**80**	**42**	**53**	**129**	**58**	**145**	**77**	**105**
s.d.	**20**	**7**	**7**	**18**	**7**	**21**	**23**	**38**

Table 11A

The duration (ms) of short and long consonants and the duration of vowels preceding them (N — tokens)

Phrase-final words							
Speaker	N	V	/n/	N	V	/nn/	V+/n/
EI	9	67	76	5	66	237	227
s.d.		26	7		8	38	
AA	9	44	88	5	63	250	157
s.d.		20	21		16	89	
ST	8	60	75	6	69	187	180
s.d.		27	11		16	25	
JT	9	45	75	5	54	177	157
s.d.		13	14		17	44	
LV	9	58	69	5	57	121	109
s.d.		20	15		15	31	
NK	9	70	102	5	82	218	198
s.d.		25	20		12	26	
VN	9	47	71	5	48	165	142
s.d.		14	20		11	14	
VA	9	54	81	5	57	157	134
s.d.		15	33		14	20	
Average	**71**	**56**	**80**	**41**	**62**	**189**	**163**
s.d.		**20**	**18**		**14**	**36**	
Speaker	N	V	/d/	N	V	/dd/	V+/d/
EI	19	82	76	5	66	238	228
s.d.		24	20		17	29	
AA	19	91	80	5	65	251	236
s.d.		34	15		24	63	
ST	18	76	73	5	53	184	164
s.d.		19	29		18	22	
JT	19	79	71	5	68	189	186
s.d.		36	15		30	31	
LV	19	70	67	5	53	155	141
s.d.		23	14		13	23	
NK	19	84	100	5	76	202	178
s.d.		29	31		22	32	
VN	19	58	59	5	49	148	138
s.d.		17	13		10	29	
VA	19	74	65	5	63	179	177
s.d.		18	10		16	29	
Average	**151**	**77**	**74**	**40**	**62**	**193**	**181**
s.d.		**25**	**18**		**19**	**32**	

Phrase-final words							
Speaker	N	V	/l/	N	V	/ll/	V+/l/
EI	10	78	67	3	99	196	229
s.d.		14	29		6	8	
AA	10	77	72	3	71	272	272
s.d.		32	24		26	38	
ST	10	86	57	3	67	159	169
s.d.		23	6		21	23	
JT	8	80	58	4	64	189	194
s.d.		41	18		35	68	
LV	10	73	71	3	59	159	147
s.d.		26	17		16	25	
NK	10	88	82	3	77	185	180
s.d.		28	16		13	17	
VN	10	55	59	3	55	135	131
s.d.		14	16		2	20	
VA	10	74	63	3	76	153	166
s.d.		14	9		12	5	
Average	**78**	**76**	**66**	**25**	**71**	**181**	**186**
s.d.		**24**	**17**		**17**	**26**	
Sentence-final words							
Speaker	N	V	/n/	N	V	/nn/	V+/n/
EI	9	61	81	5	65	250	234
s.d.		24	10		8	36	
AA	9	55	96	5	64	282	250
s.d.		20	35		22	76	
ST	8	50	78	6	60	198	179
s.d.		23	14		14	13	
JT	9	40	78	5	62	192	175
s.d.		15	14		33	51	
LV	9	51	77	5	54	161	138
s.d.		20	15		7	48	
NK	9	61	109	5	75	220	186
s.d.		32	21		8	30	
VN	9	45	70	5	58	191	180
s.d.		16	9		22	23	
VA	9	54	66	5	62	166	162
s.d.		24	18		15	32	
Average	**71**	**52**	**82**	**41**	**62**	**207**	**188**
s.d.		**22**	**17**		**16**	**39**	

Sentence-final words							
Speaker	N	V	/d/	N	V	/dd/	V+/d/
EI	19	80	82	5	65	249	232
s.d.		23	20		21	53	
AA	19	73	83	5	63	266	247
s.d.		20	17		19	47	
ST	17	72	83	5	51	205	173
s.d.		29	19		21	20	
JT	19	91	76	5	73	194	191
s.d.		41	22		39	15	
LV	19	72	74	5	50	168	144
s.d.		19	12		19	19	
NK	19	83	119	5	70	209	160
s.d.		31	21		22	23	
VN	18	59	65	4	64	195	195
s.d.		17	12		12	21	
VA	19	67	68	5	58	199	190
s.d.		25	13		20	24	
Average	**149**	**75**	**81**	**39**	**62**	**211**	**191**
s.d.		**26**	**17**		**22**	**28**	
Speaker	N	V	/l/	N	V	/ll/	V+/l/
EI	10	87	63	3	88	209	234
s.d.		32	13		28	19	
AA	10	80	72	3	81	186	196
s.d.		23	18		29	55	
ST	10	89	68	3	67	187	186
s.d.		30	12		27	21	
JT	8	97	62	4	81	176	196
s.d.		42	11		38	14	
LV	10	73	69	3	58	139	128
s.d.		22	11		15	9	
NK	10	86	96	3	88	220	212
s.d.		36	13		17	13	
VN	10	48	57	3	53	176	171
s.d.		11	9		15	20	
VA	10	77	56	3	77	172	193
s.d.		20	8		5	17	
Average	**78**	**80**	**68**	**25**	**74**	**183**	**189**
s.d.		**27**	**12**		**22**	**21**	

Table 12A

The F0 contours of monosyllabic words (Hz) in phrase-final and sentence-final position (PF — phrase-final, SF — sentence-final, N — number of measurements)

Female	PF, N	V1beg	V1end	SF, N	V1beg	V1end
EI	10	258	350	10	211	182
s.d.		27	30		13	6
ST	10	307	351	10	236	224
s.d.		24	25		12	8
LV	10	260	286	10	222	231
s.d.		15	27		12	19
NK	10	200	268	10	196	184
s.d.		26	49		6	6
Average	**40**	**256**	**314**	**40**	**216**	**205**
s.d.		**23**	**33**		**11**	**10**
Male	PF, N	V1beg	V1end	SF, N	V1beg	V1end
AA	10	163	197	10	168	120
s.d.		24	36		24	9
JT	10	144	221	10	151	133
s.d.		17	51		8	14
VN	9	161	165	10	164	165
s.d.		6	9		8	10
VA	10	189	244	10	163	165
s.d.		19	14		20	17
Average	**39**	**164**	**207**	**40**	**161**	**146**
s.d.		**17**	**27**		**15**	**12**

Table 13A

The F0 of disyllabic words with a stressed first syllable, followed by an unstressed second syllable with rising F0 (Hz) in phrase-final and sentence-final position (PF — phrase-final, SF — sentence-final, N — number of measurements)

Female		PF, N	V1beg	V1end	V2beg	V2end	SF, N	V1beg	V1end	V2beg	V2end
EI	x̄						9	229	194	198	206
	s.d.							16	8	8	9
ST	x̄	2	268	310	299	315	20	225	221	221	226
	s.d.		6	15	1	3		14	10	7	9
Average	x̄	**2**	**268**	**310**	**299**	**315**	**29**	**227**	**208**	**209**	**216**
	s.d.		**6**	**15**	**1**	**3**		**15**	**9**	**8**	**9**
Male		PF, N	V1beg	V1end	V2beg	V2end	SF, N	V1beg	V1end	V2beg	V2end
AA	x̄	22	185	161	229	268	3	212	158	142	156
	s.d.		20	22	33	23		54	27	27	32
JT	x̄	27	149	141	177	236					
	s.d.		24	34	21	43					
Average	x̄	**49**	**167**	**151**	**203**	**252**	**3**	**212**	**158**	**142**	**156**
	s.d.		**22**	**28**	**27**	**33**		**54**	**27**	**27**	**32**

Table 14A

The F0 of disyllabic words with a stressed first syllable, followed by an unstressed second syllable with falling F0 (Hz) in phrase-final and sentence-final position (PF — phrase-final, SF — sentence-final, N — number of measurements)

Female		PF, N	V1beg	V1end	V2beg	V2end	SF, N	V1beg	V1end	V2beg	V2end
EI	$\bar{x}$	30	279	338	230	181	21	241	190	206	194
	s.d.		31	30	36	8		27	14	20	17
ST	$\bar{x}$	33	301	328	318	294	14	232	233	240	228
	s.d.		20	19	21	18		17	25	18	14
LV	$\bar{x}$	45	259	280	234	187	44	234	233	226	204
	s.d.		14	22	29	25		13	13	15	10
NK	$\bar{x}$	31	244	277	240	200	31	219	195	202	188
	s.d.		16	11	22	23		13	8	13	7
Average	$\bar{x}$	**139**	**271**	**306**	**255**	**215**	**110**	**232**	**213**	**219**	**203**
	s.d.		**20**	**20**	**27**	**18**		**17**	**15**	**17**	**12**
Male		PF, N	V1beg	V1end	V2beg	V2end	SF, N	V1beg	V1end	V2beg	V2end
AA	$\bar{x}$	10	258	242	173	150	29	228	160	135	122
	s.d.		31	44	62	62		37	25	13	12
JT	$\bar{x}$	6	172	215	190	172	33	158	145	153	144
	s.d.		13	14	25	40		11	10	11	10
VN	$\bar{x}$	40	157	159	152	138	41	151	153	150	142
	s.d.		10	10	11	7		9	9	10	9
VA	$\bar{x}$	34	176	216	201	156	34	155	146	149	132
	s.d.		21	20	27	36		15	13	15	11
Average	$\bar{x}$	**90**	**191**	**208**	**179**	**154**	**137**	**173**	**151**	**147**	**135**
	s.d.		**19**	**22**	**31**	**36**		**18**	**14**	**12**	**11**

Table 15A

The F0 of disyllabic words with a stressed second syllable with rising F0 (Hz) in phrase-final and sentence-final position (PF — phrase-final, SF — sentence-final, N — number of measurements)

Female		PF, N	V1beg	V1end	V2beg	V2end	SF, N	V1beg	V1end	V2beg	V2end
EI	x̄	30	228	215	228	320	8	223	205	179	196
	s.d.		14	13	19	16		33	26	10	8
ST	x̄	21	261	253	285	314	16	235	218	227	236
	s.d.		19	25	22	18		17	13	13	20
LV	x̄	15	231	217	239	290	13	205	194	211	237
	s.d.		12	6	15	13		11	5	13	13
NK	x̄	29	218	206	228	275	8	232	211	196	206
	s.d.		18	15	20	35		16	13	6	7
Average	x̄	**95**	**235**	**223**	**245**	**300**	**45**	**224**	**207**	**203**	**219**
	s.d.		**16**	**14**	**19**	**21**		**19**	**14**	**11**	**12**
Male		PF, N	V1beg	V1end	V2beg	V2end	SF, N	V1beg	V1end	V2beg	V2end
AA	x̄	28	178	159	190	255					
	s.d.		18	20	47	52					
JT	x̄	27	149	136	146	242					
	s.d.		10	9	14	26					
VN	x̄	13	147	143	154	167	18	139	136	150	157
	s.d.		4	5	4	7		5	5	5	6
VA	x̄	20	143	139	171	224	11	150	125	129	141
	s.d.		13	18	19	17		18	10	10	11
Average	x̄	**88**	**154**	**144**	**165**	**222**	**29**	**144**	**130**	**139**	**149**
	s.d.		**11**	**13**	**21**	**26**		**12**	**8**	**7**	**9**

Table 16A

The F0 of disyllabic words with stressed second syllable with falling F0 (Hz) in phrase-final and sentence-final position (PF — phrase-final, SF — sentence-final, N — number of measurements)

Female		PF, N	V1beg	V1end	V2beg	V2end	SF, N	V1beg	V1end	V2beg	V2end
EI	x̄						22	253	237	206	186
	s.d.							18	17	13	9
ST	x̄	4	252	260	301	283	10	224	207	229	211
	s.d.		25	45	15	20		10	9	8	3
LV	x̄						3	209	208	209	179
	s.d.							14	23	10	27
NK	x̄						21	235	214	204	191
	s.d.							13	14	11	9
Average	x̄	**4**	**252**	**260**	**301**	**283**	**56**	**230**	**216**	**212**	**192**
	s.d.		**25**	**45**	**15**	**20**		**14**	**15**	**10**	**12**
Male		PF, N	V1beg	V1end	V2beg	V2end	SF, N	V1beg	V1end	V2beg	V2end
AA	x̄						28	225	215	163	120
	s.d.							23	21	21	8
JT	x̄						27	194	191	153	137
	s.d.							20	17	15	8
VN	x̄	7	147	145	161	150					
	s.d.		13	8	9	7					
VA	x̄	6	138	121	130	106					
	s.d.		13	4	12	7					
Average	x̄	**13**	**142**	**133**	**146**	**128**	**55**	**209**	**203**	**158**	**128**
	s.d.		**13**	**6**	**10**	**7**		**21**	**19**	**18**	**8**

Table 17A

The F0 of trisyllabic words with a stressed first syllable (Hz) in phrase-final and sentence-final position (PF — phrase-final, SF — sentence-final, N — number of measurements)

Phrase-final words								
Female		N	V1beg	V1end	V2beg	V2end	V3beg	V3end
EI	x̄	10	275	342	278	211	192	176
	s.d.		35	37	61	18	14	8
ST	x̄	15	295	309	323	301	300	285
	s.d.		24	20	21	22	16	11
LV	x̄	10	253	280	268	227	197	182
	s.d.		22	16	33	31	11	17
NK	x̄	12	238	278	293	257	217	190
	s.d.		19	15	36	31	19	13
Average	x̄	**47**	**265**	**302**	**290**	**249**	**226**	**208**
	s.d.		**25**	**22**	**38**	**26**	**15**	**12**
Male		N	V1beg	V1end	V2beg	V2end	V3beg	V3end
AA	x̄	12	266	291	203	167	168	153
	s.d.		69	64	45	45	67	76
JT*	x̄	11	147	137	152	156	203	248
	s.d.		8	11	17	21	24	32
VN	x̄	10	165	170	171	159	149	138
	s.d.		10	7	8	10	7	6
VA	x̄	12	163	189	177	137	123	106
	s.d.		27	47	42	22	10	8
Average	x̄	**34**	**198**	**217**	**184**	**154**	**146**	**132**
	s.d.		**35**	**39**	**31**	**26**	**28**	**30**
Sentence-final words								
Female		N	V1beg	V1end	V2beg	V2end	V3beg	V3end
EI	x̄	10	219	187	197	187	202	193
	s.d.		43	11	13	13	19	16
ST	x̄	13	222	218	224	214	220	223
	s.d.		13	8	10	7	7	12
LV	x̄	11	219	228	233	216	208	196
	s.d.		17	7	9	15	12	6
NK	x̄	12	226	201	206	190	196	187
	s.d.		13	7	13	7	12	11
Average	x̄	**46**	**221**	**209**	**215**	**202**	**207**	**200**
	s.d.		**22**	**8**	**11**	**10**	**12**	**11**
Male		N	V1beg	V1end	V2beg	V2end	V3beg	V3end
AA	x̄	10	229	188	153	136	137	129
	s.d.		30	27	11	16	18	22
JT	x̄	12	170	145	145	140	148	138
	s.d.		18	10	10	15	15	16
VN	x̄	12	153	156	158	148	148	142
	s.d.		8	7	7	7	4	3
VA	x̄	12	143	133	140	127	134	122
	s.d.		10	12	11	7	10	10
Average	x̄	**46**	**174**	**156**	**149**	**138**	**142**	**133**
	s.d.		**17**	**14**	**10**	**11**	**12**	**13**

* Results were not taken into account at averaging.

Table 18A

The F0 of trisyllabic words with a stressed second syllable (Hz) in phrase-final and sentence-final position (PF — phrase-final, SF — sentence-final, N — number of measurements)

Phrase-final words								
Female		N	V1beg	V1end	V2beg	V2end	V3beg	V3end
EI	x̄	3	231	224	257	351	223	183
	s.d.		7	17	27	34	18	5
ST	x̄	2	232	235	267	334	313	298
	s.d.		27	17	29	17	19	22
LV	x̄	2	228	219	228	280	217	194
	s.d.		1	2	11	13	21	7
NK	x̄	2	230	204	228	291	246	195
	s.d.		1	6	13	6	1	7
Average	x̄	**9**	**230**	**220**	**245**	**314**	**250**	**217**
	s.d.		**9**	**10**	**20**	**18**	**15**	**10**
Male		N	V1beg	V1end	V2beg	V2end	V3beg	V3end
AA	x̄	3	185	161	158	260	220	200
	s.d.		12	8	23	22	104	130
JT*	x̄	2	160	157	148	137	181	244
	s.d.		3	5	1	4	18	25
VN	x̄	2	144	144	147	164	146	139
	s.d.				3	4	8	2
VA	x̄	2	147	141	163	191	150	104
	s.d.		6	5	6	15	4	1
Average	x̄	**7**	**159**	**149**	**156**	**205**	**172**	**148**
	s.d.		**9**	**7**	**10**	**14**	**39**	**44**
Sentence-final words								
Female		N	V1beg	V1end	V2beg	V2end	V3beg	V3end
EI	x̄	3	283	281	209	190	203	192
	s.d.		19	23	11	8	25	3
ST*	x̄	3	245	212	225	221	223	230
	s.d.		9	7	4	8	4	6
LV*	x̄	2	207	196	205	243	236	206
	s.d.		9	1	1	6	4	8
NK	x̄	2	263	251	204	190	217	192
	s.d.		19	1	8	8	4	1
Average	x̄	**5**	**273**	**266**	**207**	**190**	**210**	**192**
	s.d.		**19**	**12**	**10**	**8**	**14**	**2**
Male		N	V1beg	V1end	V2beg	V2end	V3beg	V3end
AA	x̄	4	230	216	164	142	152	151
	s.d.		53	37	11	25	25	17
JT*	x̄	2	184	195	154	136	152	141
	s.d.		11	8	2	1	6	2
VN*	x̄	2	130	133	137	158	146	145
	s.d.		5	4	1	1	13	4
VA	x̄	2	149	129	121	122	128	112
	s.d.		34	21	2	0	1	2
Average	x̄	**6**	**189**	**172**	**142**	**132**	**140**	**131**
	s.d.		**43**	**29**	**7**	**12**	**13**	**10**

* Results were not taken into account at averaging.

Table 19A

The F0 of trisyllabic words with a stressed third syllable (Hz) in phrase-final and sentence-final position (PF — phrase-final, SF — sentence-final, N — number of measurements)

Phrase-final words								
Female		N	V1beg	V1end	V2beg	V2end	V3beg	V3end
EI	x̄	11	231	216	220	215	229	344
	s.d.		12	12	13	18	22	17
ST	x̄	7	242	234	246	242	279	303
	s.d.		25	18	18	24	21	21
LV	x̄	12	238	224	229	219	235	291
	s.d.		11	7	9	9	8	12
NK	x̄	10	226	210	218	206	223	287
	s.d.		16	17	18	18	15	17
Average	x̄	**40**	**234**	**221**	**228**	**220**	**241**	**306**
	s.d.		**16**	**13**	**15**	**17**	**17**	**17**
Male		N	V1beg	V1end	V2beg	V2end	V3beg	V3end
AA	x̄	9	186	164	167	155	181	280
	s.d.		21	23	22	21	41	16
JT	x̄	10	158	145	147	140	142	223
	s.d.		7	8	7	8	6	36
VN	x̄	12	149	142	148	143	158	170
	s.d.		10	6	5	5	4	8
VA	x̄	10	139	125	138	132	149	180
	s.d.		8	10	6	11	22	53
Average	x̄	**41**	**158**	**144**	**150**	**142**	**158**	**213**
	s.d.		**11**	**12**	**10**	**11**	**18**	**28**
Sentence-final words								
Female		N	V1beg	V1end	V2beg	V2end	V3beg	V3end
EI	x̄	11	256	234	259	250	198	191
	s.d.		29	25	37	26	11	12
ST	x̄	8	238	216	225	208	223	223
	s.d.		16	7	16	9	8	14
LV*	x̄	11	211	196	202	191	199	230
	s.d.		13	6	8	6	8	7
NK	x̄	10	241	223	229	214	198	192
	s.d.		14	12	20	19	10	9
Average	x̄	**29**	**245**	**225**	**238**	**224**	**206**	**202**
	s.d.		**20**	**15**	**24**	**18**	**10**	**11**
Male		N	V1beg	V1end	V2beg	V2end	V3beg	V3end
AA	x̄	10	229	218	243	238	179	132
	s.d.		23	18	28	22	19	12
JT	x̄	10	182	177	191	192	160	136
	s.d.		15	9	11	13	9	12
VN*	x̄	10	145	136	142	135	145	155
	s.d.		5	3	5	4	7	7
VA	x̄	10	139	121	130	120	125	122
	s.d.		7	8	9	10	5	9
Average	x̄	**30**	**183**	**172**	**188**	**183**	**155**	**130**
	s.d.		**15**	**11**	**16**	**15**	**11**	**11**

* Results were not taken into account at averaging.

Table 20A

The F0 of four-syllable words with primary stress on the first syllable and a secondary stress on the fourth syllable (Hz) (PF — phrase-final, SF — sentence-final, N — number of measurements)

Phrase-final words										
Female		N	V1beg	V1end	V2beg	V2end	V3beg	V3end	V4beg	V4end
EI	x̄	2	266	388	367	286	223	204	200	182
	s.d.		9	22	45	66	6	1	17	4
ST	x̄	2	266	300	341	286	291	281	273	270
	s.d.		27	28	31	25	21	22		3
LV	x̄	2	236	291	305	245	223	204	188	188
	s.d.		16	29	14	12	1	5	11	13
NK	x̄	2	237	271	314	282	261	231	211	193
	s.d.		22	2	18	15	5	0	6	9
Average	x̄	**8**	**251**	**312**	**331**	**275**	**249**	**230**	**218**	**208**
	s.d.		**18**	**20**	**27**	**30**	**8**	**7**	**11**	**7**
Male		N	V1beg	V1end	V2beg	V2end	V3beg	V3end	V4beg	V4end
AA	x̄	2	177	274	271	230	164	127	125	122
	s.d.		28	10	66	83	18	1	1	2
JT*	x̄	2	138	129	149	138	164	169	219	246
	s.d.		6	11	12	0	1	7	18	29
VN	x̄	2	156	160	170	144	158	149	145	136
	s.d.		1	1	1	40	11	8	6	4
VA	x̄	2	155	168	174	138	124	119	125	107
	s.d.		19	56	52	35	6	6	21	4
Average	x̄	**6**	**162**	**201**	**205**	**170**	**149**	**131**	**131**	**121**
	s.d.		**16**	**22**	**40**	**53**	**12**	**5**	**9**	**3**
Sentence-final words										
Female		N	V1beg	V1end	V2beg	V2end	V3beg	V3end	V4beg	V4end
EI*	x̄	2	199	184	200	185	184	193	208	205
	s.d.		4	4	12	3	1	1	18	16
ST	x̄	2	223	230	259	228	244	241	251	242
	s.d.		13	35	50	18	31	22	13	24
LV	x̄	2	221	249	255	234	223	214	210	200
	s.d.		2	6	0	28	16	12	10	14
NK*	x̄	2	219	206	217	197	205	193	203	192
	s.d.		11	6	22	1	18	6	9	9
Average	x̄	**4**	**222**	**240**	**257**	**231**	**234**	**227**	**231**	**221**
	s.d.		**8**	**20**	**25**	**23**	**23**	**17**	**12**	**19**
Male		N	V1beg	V1end	V2beg	V2end	V3beg	V3end	V4beg	V4end
AA*	x̄	2	209	199	168	139	137	126	122	128
	s.d.		6	4	15	11	0	4	1	4
JT	x̄	3	155	156	153	138	142	134	137	124
	s.d.		12	29	18	11	12	1	10	18
VN	x̄	3	151	155	163	154	152	144	148	142
	s.d.		4	4	3	1	6	1	3	6
VA*	x̄	2	137	144	145	129	133	124	127	118
	s.d.		2	7	12	2	13	4	1	2
Average	x̄	**6**	**153**	**156**	**158**	**146**	**147**	**139**	**143**	**133**
	s.d.		**8**	**16**	**10**	**6**	**9**	**1**	**7**	**12**

* Results were not taken into account at averaging.

Table 21A

The F0 of the four-syllable word *kučəneže* 'she/he wants to catch' with a stressed third syllable (Hz) (PF — phrase-final, SF — sentence-final, N — number of measurements)

Phrase-final words										
Female		N	V1beg	V1end	V2beg	V2end	V3beg	V3end	V4beg	V4end
EI		1	229	197	224	203	238	353	218	187
ST		1	245	242	282	267	297	317	299	295
LV		1	204	189	240	224	239	298	215	197
NK		1	236	198	230	214	219	274	228	196
Average	$\bar{x}$	**4**	**229**	**206**	**244**	**227**	**248**	**311**	**240**	**219**
	s.d.		**18**	**24**	**26**	**28**	**34**	**33**	**40**	**51**
Male	N		V1beg	V1end	V2beg	V2end	V3beg	V3end	V4beg	V4end
AA		1	206	168	186	175	193	280	134	119
JT		1	155	139	153	144	181	196	145	114
VN		1	144	142	160	145	152	179	159	135
VA		1	155	131	170	150	178	212	142	112
Average	$\bar{x}$	**4**	**165**	**145**	**167**	**154**	**176**	**217**	**145**	**120**
	s.d.		**28**	**16**	**14**	**15**	**17**	**44**	**10**	**10**
Sentence-final words										
Female		N	V1beg	V1end	V2beg	V2end	V3beg	V3end	V4beg	V4end
EI		1	253	236	266	259	167	169	188	183
ST*		1	247	226	219	210	214	215	203	213
LV		1	205	206	232	219	202	174	186	169
NK		1	251	222	237	219	190	177	198	185
Average	$\bar{x}$	**3**	**236**	**221**	**245**	**232**	**186**	**173**	**191**	**179**
	s.d.		**27**	**15**	**18**	**23**	**18**	**4**	**6**	**9**
Male		N	V1beg	V1end	V2beg	V2end	V3beg	V3end	V4beg	V4end
AA		1	210	191	228	194	150	118	146	125
JT		1	192	164	192	170	143	118	120	121
VN		1	155	132	123	129	126	133	135	129
VA		1	138	121	147	116	119	109	115	107
Average	$\bar{x}$	**4**	**174**	**152**	**173**	**152**	**135**	**120**	**129**	**121**
	s.d.		**33**	**32**	**47**	**36**	**14**	**10**	**14**	**10**

* Results were not taken into account at averaging.

Table 22A

The F0 of four-syllable words with primary stress on the fourth syllable and secondary stress on the first syllable (Hz) (PF — phrase-final, SF — sentence-final, N — number of measurements)

Phrase-final words										
Female		N	V1beg	V1end	V2beg	V2end	V3beg	V3end	V4beg	V4end
EI	x̄	3	229	207	225	206	213	203	232	359
	s.d.		11	25	15	20	19	31	35	34
ST	x̄	3	230	229	239	228	245	245	273	299
	s.d.		9	5	11	15	17	12	12	16
LV	x̄	3	233	212	224	221	229	213	233	309
	s.d.		10	10	18	13	14	19	17	8
NK	x̄	3	222	200	213	203	213	202	215	292
	s.d.		24	14	21	20	15	21	23	11
Average	x̄	**12**	**229**	**212**	**225**	**214**	**225**	**216**	**238**	**314**
	s.d.		**13**	**13**	**17**	**17**	**16**	**21**	**22**	**17**
Male		N	V1beg	V1end	V2beg	V2end	V3beg	V3end	V4beg	V4end
AA	x̄	3	170	151	175	155	162	151	173	289
	s.d.		9	19	20	12	21	21	23	20
JT	x̄	3	159	142	153	136	145	132	146	231
	s.d.		6	7	11	7	8	3	15	16
VN	x̄	3	152	143	157	149	149	146	158	178
	s.d.		3	9	8	3	2	6	6	13
VA	x̄	3	147	130	149	137	150	146	172	224
	s.d.		5	3	8	10	3	6	8	18
Average	x̄	**12**	**157**	**142**	**158**	**144**	**151**	**144**	**162**	**231**
	s.d.		**6**	**10**	**12**	**8**	**9**	**9**	**13**	**17**
Sentence-final words										
Female		N	V1beg	V1end	V2beg	V2end	V3beg	V3end	V4beg	V4end
EI	x̄	3	297	264	288	285	300	263	193	191
	s.d.		12	17	14	18	23	31	11	11
ST	x̄	3	230	220	239	214	237	212	226	229
	s.d.		13	5	28	4	25	5	7	11
LV*	x̄	3	217	189	210	199	204	189	197	240
	s.d.		18	9	11	9	6	9	4	13
NK	x̄	3	246	226	236	225	236	223	206	190
	s.d.		19	10	30	28	16	24	12	6
Average	x̄	**9**	**258**	**236**	**254**	**241**	**257**	**233**	**208**	**203**
	s.d.		**14**	**11**	**24**	**17**	**21**	**20**	**10**	**9**
Male		N	V1beg	V1end	V2beg	V2end	V3beg	V3end	V4beg	V4end
AA	x̄	3	209	208	202	194	228	229	163	119
	s.d.		11	27			39	26	3	4
JT	x̄	2	193	170	194	179	181	169	138	123
	s.d.		6	1	0	8	8	7	6	4
VN*	x̄	2	139	131	145	134	142	129	141	151
	s.d.			1	4	2	12	0	1	15
VA	x̄	3	148	126	148	125	134	122	127	118
	s.d.		13	11	12	3	5	4	5	3
Average	x̄	**8**	**183**	**168**	**181**	**166**	**181**	**173**	**143**	**120**
	s.d.		**10**	**13**	**6**	**5**	**17**	**12**	**4**	**4**

* Results were not taken into account at averaging.

Table 23A

**Average formant values and standard deviations (Hz)
of stressed and unstressed vowels in phrase-final words (4 female speakers)**

Speaker	Stressed syllable					Unstressed syllable				
	Vowel	N	F1	F2	F3	Vowel	N	F1	F2	F3
EI	/a/	34	856	1592	3301	/a/	8	866	1496	3129
	s.d.		65	180	132	s.d.		55	178	154
	/e/	16	597	2304	3167	/e/	18	612	1999	3089
	s.d.		57	97	85	s.d.		48	206	128
	/i/	9	464	2761	3513	/i/	6	465	2669	3383
	s.d.		37	113	103	s.d.		12	122	126
	/o/	6	576	942	3063	/o/	14	633	1233	3147
	s.d.		60	71	141	s.d.		96	226	234
	/u/	12	471	909	3122	/u/	11	448	954	3054
	s.d.		48	145	199	s.d.		32	133	161
	/ə/	14	727	1457	3304	/ə/	51	609	1557	3128
	s.d.		62	191	171	s.d.		63	287	196
	/ö/	3	555	1838	2787	/ö/	10	585	1826	2872
	s.d.		9	65	89	s.d.		62	171	196
	/ü/	12	441	2128	2853	/ü/	2	402	2335	2963
	s.d.		70	130	102	s.d.		1	73	154
ST	/a/	28	797	1417	3142	/a/	13	783	1522	3199
	s.d.		56	182	158	s.d.		55	164	279
	/e/	14	634	2005	3137	/e/	20	651	1952	3197
	s.d.		58	146	135	s.d.		78	191	141
	/i/	9	452	2303	3091	/i/	6	466	2272	2976
	s.d.		65	167	127	s.d.		67	94	79
	/o/	8	618	1049	3184	/o/	8	549	1169	3110
	s.d.		26	60	150	s.d.		38	126	172
	/u/	13	417	961	3212	/u/	7	488	986	3212
	s.d.		70	81	97	s.d.		39	135	176
	/ə/	17	612	1568	3196	/ə/	48	573	1619	3153
	s.d.		54	319	147	s.d.		54	281	155
	/ö/	3	670	1973	3012	/ö/	10	642	1852	3048
	s.d.		38	119	114	s.d.		84	199	146
	/ü/	12	455	2180	3025	/ü/	2	495	2161	2742
	s.d.		52	162	88	s.d.		7	27	100

Speaker	Stressed syllable					Unstressed syllable				
	Vowel	N	F1	F2	F3	Vowel	N	F1	F2	F3
LV	/a/	26	854	1608	3257	/a/	16	806	1613	3314
	s.d.		123	136	192	s.d.		84	175	155
	/e/	12	495	2261	3144	/e/	22	483	2084	3269
	s.d.		31	145	163	s.d.		52	313	115
	/i/	13	329	2628	3512	/i/	2	445	2438	3116
	s.d.		24	112	128	s.d.		4	132	117
	/o/	6	521	1108	3229	/o/	13	456	1249	3197
	s.d.		48	147	100	s.d.		28	110	137
	/u/	13	420	1003	3198	/u/	7	425	1136	3365
	s.d.		39	130	169	s.d.		22	85	186
	/ə/	18	475	1547	3144	/ə/	46	459	1616	3296
	s.d.		38	151	136	s.d.		52	209	149
	/ö/	4	503	1708	2869	/ö/	9	457	1804	2952
	s.d.		7	84	101	s.d.		25	182	155
	/ü/	12	356	2045	2747	/ü/	2	373	2228	3055
	s.d.		62	136	138	s.d.		39	81	71
NK	/a/	32	920	1541	2903	/a/	10	879	1569	2710
	s.d.		92	176	172	s.d.		117	178	165
	/e/	16	471	2288	2922	/e/	18	488	2046	2824
	s.d.		47	282	302	s.d.		90	276	172
	/i/	9	343	2637	3415	/i/	6	379	2533	3455
	s.d.		33	79	100	s.d.		19	173	94
	/o/	7	450	1024	2620	/o/	10	449	1168	2557
	s.d.		74	155	164	s.d.		39	139	158
	/u/	11	411	1003	2584	/u/	10	393	1200	2548
	s.d.		33	98	61	s.d.		36	113	114
	/ə/	14	506	1462	2599	/ə/	47	467	1567	2597
	s.d.		91	179	186	s.d.		77	195	285
	/ö/	3	465	2110	2669	/ö/	10	442	1980	2634
	s.d.		13	166	29	s.d.		27	166	106
	/ü/	12	348	2411	2869	/ü/	2	351	2450	2858
	s.d.		39	105	142	s.d.		14	2	203

Table 24A

Average formant values and standard deviations (Hz) of stressed and unstressed vowels in sentence-final words (4 female speakers)

Speaker	Stressed syllable					Unstressed syllable				
	Vowel	N	F1	F2	F3	Vowel	N	F1	F2	F3
EI	/a/	35	890	1550	3294	/a/	8	862	1553	3286
	s.d.		63	172	149	s.d.		93	210	146
	/e/	16	597	2330	3137	/e/	18	641	2014	3114
	s.d.		62	121	82	s.d.		88	231	109
	/i/	9	387	2715	3477	/i/	6	455	2620	3422
	s.d.		43	135	125	s.d.		56	129	116
	/o/	6	553	924	3068	/o/	14	612	1167	3122
	s.d.		35	108	163	s.d.		117	267	178
	/u/	11	421	815	3098	/u/	12	423	900	3110
	s.d.		35	94	134	s.d.		28	105	171
	/ə/	14	717	1393	3235	/ə/	49	605	1570	3142
	s.d.		47	167	129	s.d.		68	307	176
	/ö/	3	533	1848	2800	/ö/	10	606	1869	2921
	s.d.		50	80	61	s.d.		71	160	194
	/ü/	12	423	2236	2920	/ü/	2	428	2236	2846
	s.d.		25	165	104	s.d.		47	2	2
ST	/a/	29	681	1401	3089	/a/	13	694	1463	3085
	s.d.		93	168	169	s.d.		76	148	204
	/e/	14	558	1999	3055	/e/	20	596	1925	3139
	s.d.		60	154	152	s.d.		97	200	131
	/i/	9	447	2404	3056	/i/	6	403	2278	3015
	s.d.		23	173	152	s.d.		57	152	93
	/o/	8	537	1006	3146	/o/	11	556	1140	3051
	s.d.		55	126	182	s.d.		51	179	168
	/u/	13	457	934	3153	/u/	9	472	1004	3153
	s.d.		26	114	161	s.d.		33	169	167
	/ə/	17	537	1655	3111	/ə/	47	533	1593	3143
	s.d.		57	274	173	s.d.		64	248	150
	/ö/	3	569	2043	2947	/ö/	10	598	1884	3014
	s.d.		44	158	99	s.d.		68	152	128
	/ü/	12	454	2309	2921	/ü/	2	438	2157	2907
	s.d.		36	156	106	s.d.		1	25	184

Speaker	Stressed syllable					Unstressed syllable				
	Vowel	N	F1	F2	F3	Vowel	N	F1	F2	F3
LV	/a/	26	826	1568	3236	/a/	16	763	1628	3260
	s.d.		131	166	131	s.d.		161	196	152
	/e/	12	446	2303	3159	/e/	21	468	2076	3219
	s.d.		29	160	155	s.d.		56	311	166
	/i/	12	366	2639	3573	/i/	3	415	2604	3499
	s.d.		32	79	145	s.d.		32	106	97
	/o/	6	438	1056	3019	/o/	14	441	1193	3235
	s.d.		39	121	119	s.d.		32	135	161
	/u/	13	437	979	3258	/u/	8	397	1184	3389
	s.d.		26	128	153	s.d.		50	186	157
	/ə/	19	450	1500	3257	/ə/	46	447	1607	3276
	s.d.		22	159	129	s.d.		54	267	183
	/ö/	4	458	1659	2924	/ö/	9	448	1783	2963
	s.d.		7	104	68	s.d.		19	132	145
	/ü/	12	402	2102	2781	/ü/	2	324	2390	2992
	s.d.		44	171	158	s.d.		69	49	25
NK	/a/	32	940	1532	2758	/a/	10	878	1561	2655
	s.d.		139	173	146	s.d.		139	191	144
	/e/	16	444	2276	2985	/e/	18	435	2094	2908
	s.d.		104	196	183	s.d.		35	279	159
	/i/	9	364	2645	3504	/i/	6	376	2565	3279
	s.d.		15	98	155	s.d.		12	134	197
	/o/	7	417	1049	2531	/o/	12	439	1205	2556
	s.d.		32	149	177	s.d.		41	130	188
	/u/	11	398	937	2559	/u/	10	421	1168	2624
	s.d.		23	132	110	s.d.		43	123	146
	/ə/	14	508	1458	2743	/ə/	51	436	1603	2676
	s.d.		97	178	148	s.d.		73	256	208
	/ö/	3	421	2017	2652	/ö/	10	437	1941	2622
	s.d.		16	98	37	s.d.		34	257	105
	/ü/	12	368	2497	2908	/ü/	2	313	2368	3007
	s.d.		32	101	203	s.d.		87	18	114

Table 25A

Average formant values and standard deviations (Hz) of stressed and unstressed vowels in phrase-final words (4 male speakers)

Speaker	Stressed syllable					Unstressed syllable				
	Vowel	N	F1	F2	F3	Vowel	N	F1	F2	F3
AA	/a/	30	736	1445	2505	/a/	12	672	1412	2494
	s.d.		91	77	122	s.d.		80	107	154
	/e/	16	492	1925	2539	/e/	18	480	1865	2519
	s.d.		60	88	107	s.d.		52	99	73
	/i/	9	289	2069	3117	/i/	6	261	2075	3566
	s.d.		35	72	211	s.d.		29	51	126
	/o/	7	402	717	2586	/o/	13	456	951	2530
	s.d.		55	78	104	s.d.		55	219	144
	/u/	14	274	736	2434	/u/	8	314	855	2382
	s.d.		32	142	177	s.d.		37	175	141
	/ə/	14	524	1413	2467	/ə/	49	478	1472	2531
	s.d.		50	166	156	s.d.		77	165	142
	/ö/	3	456	1625	2272	/ö/	10	484	1713	2439
	s.d.		35	67	142	s.d.		25	143	104
	/ü/	12	301	1871	2270	/ü/	2	241	1994	2313
	s.d.		34	92	67	s.d.		40	91	95
JT	/a/	30	674	1404	2243	/a/	11	653	1429	2166
	s.d.		44	149	118	s.d.		86	180	118
	/e/	15	446	1777	3060	/e/	19	479	1735	3049
	s.d.		58	73	113	s.d.		58	104	123
	/i/	9	253	1986	3251	/i/	6	252	1907	3197
	s.d.		31	44	99	s.d.		25	50	103
	/o/	7	457	881	2023	/o/	11	456	1035	2000
	s.d.		45	67	160	s.d.		39	117	112
	/u/	12	318	837	2225	/u/	9	336	971	2128
	s.d.		32	103	109	s.d.		19	92	179
	/ə/	16	575	1403	2054	/ə/	50	463	1411	2078
	s.d.		83	140	146	s.d.		62	198	152
	/ö/	3	401	1684	2115	/ö/	10	419	1559	2046
	s.d.		12	80	159	s.d.		31	159	118
	/ü/	12	272	1947	2296	/ü/	2	279	1948	2411
	s.d.		36	66	135	s.d.		3	8	23

Speaker	Stressed syllable					Unstressed syllable				
	Vowel	N	F1	F2	F3	Vowel	N	F1	F2	F3
VN	/a/	28	520	1318	2620	/a/	14	505	1302	2630
	s.d.		56	75	123	s.d.		50	75	130
	/e/	14	398	1797	2622	/e/	19	408	1647	2585
	s.d.		31	109	122	s.d.		48	187	112
	/i/	12	294	2177	2922	/i/	2	302	2163	2771
	s.d.		14	146	198	s.d.		4	2	216
	/o/	6	432	976	2524	/o/	14	401	1084	2529
	s.d.		42	79	146	s.d.		36	99	147
	/u/	11	370	895	2608	/u/	8	368	1048	2539
	s.d.		41	142	140	s.d.		27	166	105
	/ə/	15	436	1330	2632	/ə/	45	394	1348	2606
	s.d.		49	126	108	s.d.		66	177	125
	/ö/	4	415	1556	2422	/ö/	8	367	1705	2438
	s.d.		21	87	135	s.d.		38	136	107
	/ü/	12	311	1931	2450	/ü/	2	289	2117	2593
	s.d.		15	125	113	s.d.		1	291	8
VA	/a/	30	581	1266	2622	/a/	12	579	1255	2594
	s.d.		90	104	140	s.d.		79	108	153
	/e/	13	400	1974	2656	/e/	21	419	1885	2647
	s.d.		22	125	79	s.d.		49	203	134
	/i/	11	324	2243	2911	/i/	4	341	2196	2800
	s.d.		28	107	178	s.d.		30	52	172
	/o/	7	432	916	2515	/o/	13	415	1021	2524
	s.d.		40	43	159	s.d.		40	146	101
	/u/	12	392	906	2520	/u/	9	380	943	2516
	s.d.		28	141	90	s.d.		16	157	96
	/ə/	14	510	1288	2528	/ə/	49	432	1391	2622
	s.d.		70	166	128	s.d.		42	227	98
	/ö/	3	380	1717	2437	/ö/	10	414	1806	2477
	s.d.		12	93	46	s.d.		30	101	71
	/ü/	12	365	2037	2486	/ü/	2	308	2072	2713
	s.d.		18	95	113	s.d.		8	180	77

Table 26A

**Average formant values and standard deviations (Hz)
of stressed and unstressed vowels in sentence-final words (4 male speakers)**

Speaker	Stressed syllable					Unstressed syllable				
	Vowel	N	F1	F2	F3	Vowel	N	F1	F2	F3
AA	/a/	32	751	1425	2544	/a/	11	683	1427	2501
	s.d.		76	77	155	s.d.		62	115	167
	/e/	16	446	1892	2525	/e/	18	464	1812	2510
	s.d.		56	96	125	s.d.		39	115	114
	/i/	9	240	2028	3306	/i/	6	274	2137	3111
	s.d.		35	68	200	s.d.		34	115	199
	/o/	7	461	760	2548	/o/	10	473	826	2572
	s.d.		60	84	102	s.d.		44	123	202
	/u/	13	283	765	2441	/u/	11	341	849	2499
	s.d.		26	197	140	s.d.		65	123	130
	/ə/	14	522	1443	2484	/ə/	47	445	1466	2547
	s.d.		76	136	178	s.d.		95	208	205
	/ö/	3	464	1531	2312	/ö/	10	464	1701	2385
	s.d.		28	114	124	s.d.		24	93	113
	/ü/	12	280	1830	2240	/ü/	3	239	1892	2306
	s.d.		45	114	140	s.d.		13	185	49
JT	/a/	31	676	1440	2180	/a/	11	652	1461	2200
	s.d.		54	150	86	s.d.		89	180	86
	/e/	15	452	1768	3083	/e/	18	500	1631	3079
	s.d.		44	91	87	s.d.		92	93	108
	/i/	9	269	1995	3369	/i/	6	287	1894	3261
	s.d.		39	73	60	s.d.		49	66	68
	/o/	7	458	875	1950	/o/	11	498	1058	2078
	s.d.		17	46	70	s.d.		59	140	178
	/u/	12	311	786	2226	/u/	9	358	972	2068
	s.d.		36	62	75	s.d.		23	115	188
	/ə/	15	562	1414	2140	/ə/	49	449	1434	2109
	s.d.		66	116	144	s.d.		77	177	162
	/ö/	3	407	1709	2196	/ö/	10	455	1591	2055
	s.d.		13	99	83	s.d.		25	114	148
	/ü/	12	285	1905	2230	/ü/	2	283	1947	2266
	s.d.		28	43	157	s.d.		78	48	109

Speaker	Stressed syllable					Unstressed syllable				
	Vowel	N	F1	F2	F3	Vowel	N	F1	F2	F3
VN	/a/	24	528	1290	2602	/a/	16	463	1295	2599
	s.d.		60	81	107	s.d.		84	90	106
	/e/	14	416	1786	2653	/e/	20	383	1757	2587
	s.d.		41	93	141	s.d.		42	126	144
	/i/	12	313	2131	2978	/i/	2	355	2212	2914
	s.d.		4	112	169	s.d.		87	255	141
	/o/	7	430	1010	2620	/o/	13	411	1086	2565
	s.d.		23	119	113	s.d.		49	119	135
	/u/	16	371	889	2482	/u/	7	363	951	2066
	s.d.		37	118	130	s.d.		11	144	132
	/ə/	16	429	1255	2607	/ə/	45	399	1348	2629
	s.d.		45	97	114	s.d.		52	178	141
	/ö/	4	408	1523	2392	/ö/	9	363	1661	2420
	s.d.		21	56	163	s.d.		33	132	108
	/ü/	12	313	1904	2422	/ü/	2	284	1816	2483
	s.d.		20	141	100	s.d.		1	262	95
VA	/a/	31	519	1236	2604	/a/	11	569	1218	2566
	s.d.		72	119	140	s.d.		94	90	155
	/e/	13	400	1975	2673	/e/	21	421	1828	2642
	s.d.		25	125	106	s.d.		33	181	160
	/i/	10	319	2247	2849	/i/	5	356	2206	2851
	s.d.		35	66	117	s.d.		28	38	140
	/o/	7	414	876	2509	/o/	13	413	1060	2540
	s.d.		30	85	111	s.d.		33	123	132
	/u/	14	370	885	2505	/u/	10	393	994	2568
	s.d.		16	122	97	s.d.		15	157	85
	/ə/	16	472	1333	2599	/ə/	45	420	1388	2580
	s.d.		42	229	128	s.d.		38	231	86
	/ö/	3	400	1792	2436	/ö/	10	414	1731	2473
	s.d.		10	140	87	s.d.		25	80	61
	/ü/	12	325	2053	2485	/ü/	2	314	2145	2634
	s.d.		28	63	117	s.d.		52	190	138

Table 27A

Average formant values (Hz, Bark) of mid vowels /e, ö, o/ **of stressed syllables, unstressed word-internal syllables, unstressed word-final syllables of phrase-final (PF) and sentence-final (SF) words (N — number of measurements)**

Phrase-final words													
Speaker	Vowel	Allophone	N	F1	F2	F3	Speaker	Vowel	Allophone	N	F1	F2	F3
EI	/e/	stressed	16	597	2304	3167	AA	/e/	stressed	16	492	1925	2539
				5.73	13.96	16.03					4.85	12.75	14.60
		unstressed word-internal	4	574	2184	3124			unstressed word-internal	3	434	1847	2532
				5.54	13.60	15.94					4.33	12.48	14.58
		unstressed word-final	14	622	1947	3079			unstressed word-final	15	489	1868	2517
				5.93	12.83	15.85					4.82	12.55	14.54
	/o/	stressed	6	576	942	3063		/o/	stressed	7	402	717	2586
				5.56	8.17	15.82					4.03	6.65	14.72
		unstressed word-internal	9	593	1122	3124			unstressed word-internal	8	433	866	2510
				5.69	9.23	15.94					4.32	7.69	14.53
		unstressed word-final	5	706	1432	3188			unstressed word-final	5	492	1086	2562
				6.57	10.79	16.07					4.85	9.03	14.66
	/ö/	stressed	3	555	1838	2787		/ö/	stressed	3	456	1625	2272
				5.39	12.45	15.21					4.53	11.62	13.86
		unstressed word-internal	2	503	1638	2742			unstressed word-internal	2	488	1488	2428
				4.95	11.68	15.10					4.81	11.04	14.30
		unstressed word-final	8	605	1873	2904			unstressed word-final	8	483	1769	2441
				5.79	12.57	15.48					4.77	12.19	14.34
ST	/e/	stressed	14	634	2005	3137	JT	/e/	stressed	15	446	1777	3060
				6.02	13.03	15.97					4.44	12.22	15.81
		unstressed word-internal	2	566	2038	3077			unstressed word-internal	3	436	1718	2958
				5.48	13.14	15.85					4.35	11.99	15.60
		unstressed word-final	18	660	1943	3210			unstressed word-final	16	487	1738	3066
				6.23	12.82	16.12					4.80	12.07	15.83
	/o/	stressed	8	618	1049	3184		/o/	stressed	7	457	881	2023
				5.90	8.82	16.07					4.54	7.78	13.09
		unstressed word-internal	7	556	1167	3116			unstressed word-internal	8	445	987	1997
				5.40	9.48	15.93					4.43	8.45	13.00
		unstressed word-final	1	498	1177	3069			unstressed word-final	3	488	1165	2008
				4.90	9.53	15.83					4.82	9.46	13.04
		[ɔ]	2	699	1463	2922			[ɔ]	2	619	1338	2100
				6.51	10.93	15.52					5.90	10.34	13.34
		[ɛ]	2	687	1808	3437							
				6.43	12.33	16.54							
	/ö/	stressed	3	670	1973	3012		/ö/	stressed	3	401	1684	2115
				6.30	12.92	15.71					4.02	11.86	13.39
		unstressed word-internal	2	561	1748	2873			unstressed word-internal	2	411	1404	2019
				5.44	12.11	15.41					4.11	10.66	13.07
		unstressed word-final	8	662	1879	3091			unstressed word-final	8	421	1598	2053
				6.24	12.59	15.88					4.21	11.51	13.19

Phrase-final words													
Speaker	Vowel	Allophone	N	F1	F2	F3	Speaker	Vowel	Allophone	N	F1	F2	F3
LV	/e/	stressed	12	495	2261	3144	VN	/e/	stressed	14	398	1797	2622
				4.87	13.83	15.98					4.00	12.29	14.81
		unstressed word-internal	3	441	2460	3267			unstressed word-internal	3	370	1935	2617
				4.39	14.39	16.23					3.73	12.79	14.80
		unstressed word-final	19	489	2024	3269			unstressed word-final	16	415	1593	2579
				4.83	13.09	16.23					4.15	11.49	14.70
	/o/	stressed	6	521	1108	3229		/o/	stressed	6	432	976	2524
				5.10	9.15	16.15					4.31	8.38	14.56
		unstressed word-internal	8	451	1176	3202			unstressed word-internal	9	415	1050	2524
				4.49	9.52	16.10					4.15	8.82	14.56
		unstressed word-final	5	464	1323	3189			unstressed word-final	5	377	1146	2538
				4.60	10.27	16.07					3.80	9.36	14.60
	/ö/	stressed	4	503	1708	2869		/ö/	stressed	4	415	1556	2422
				4.95	11.95	15.40					4.15	11.34	14.29
		unstressed word-internal	1	461	1514	2940			unstressed word-internal	1	397	1516	2458
				4.58	11.15	15.56					3.99	11.16	14.39
		unstressed word-final	8	457	1840	2953			unstressed word-final	7	363	1732	2435
				4.53	12.45	15.59					3.66	12.05	14.32
NK	/e/	stressed	16	471	2288	2922	VA	/e/	stressed	13	400	1974	2656
				4.67	13.91	15.52					4.02	12.92	14.90
		unstressed word-internal	3	408	2349	2950			unstressed word-internal	5	380	2044	2637
				4.09	14.08	15.58					3.82	13.16	14.85
		unstressed word-final	15	504	1985	2799			unstressed word-final	16	431	1835	2650
				4.96	12.96	15.24					4.30	12.43	14.88
	/o/	stressed	7	450	1024	2620		/o/	stressed	7	432	916	2515
				4.48	8.67	14.81					4.31	8.01	14.54
		unstressed word-internal	7	434	1184	2568			unstressed word-internal	8	415	951	2510
				4.33	9.57	14.67					4.15	8.23	14.52
		unstressed word-final	3	485	1128	2531			unstressed word-final	5	417	1135	2547
				4.79	9.27	14.58					4.17	9.30	14.62
		[ə]	2	484	1599	2748							
				4.78	11.52	15.12							
	/ö/	stressed	3	465	2110	2669		/ö/	stressed	3	380	1717	2437
				4.61	13.37	14.93					3.82	11.99	14.33
		unstressed word-internal	2	450	1844	2537			unstressed word-internal	2	403	1728	2431
				4.47	12.47	14.59					4.04	12.03	14.31
		unstressed word-final	8	440	2013	2658			unstressed word-final	8	417	1826	2489
				4.38	13.06	14.90					4.17	12.40	14.47

Sentence-final words													
Speaker	Vowel	Allophone	N	F1	F2	F3	Speaker	Vowel	Allophone	N	F1	F2	F3
EI	/e/	stressed	16	597	2330	3137	AA	/e/	stressed	16	446	1892	2525
				5.73	14.03	15.97					4.44	12.64	14.56
		unstressed word-internal	4	551	2242	3155			unstressed word-internal	3	445	1914	2651
				5.35	13.78	16.01					4.43	12.72	14.88
		unstressed word-final	14	667	1949	3102			unstressed word-final	15	468	1792	2481
				6.28	12.84	15.90					4.64	12.27	14.45
	/o/	stressed	6	553	924	3068		/o/	stressed	7	461	760	2548
				5.37	8.06	15.83					4.58	6.96	14.62
		unstressed word-internal	9	545	1020	3150			unstressed word-internal	7	459	792	2583
				5.30	8.65	16.00					4.55	7.19	14.71
		unstressed word-final	5	732	1432	3072			unstressed word-final	3	506	905	2545
				6.76	10.79	15.84					4.97	7.94	14.61
									[ɔ]	2	484	1256	2553
											4.78	9.94	14.64
	/ö/	stressed	3	533	1848	2800		/ö/	stressed	3	464	1531	2312
				5.20	12.48	15.24					4.60	11.23	13.98
		unstressed word-internal	2	525	1754	2796			unstressed word-internal	2	495	1647	2452
				5.13	12.13	15.23					4.88	11.71	14.37
		unstressed word-final	8	627	1898	2952			unstressed word-final	8	456	1714	2368
				5.96	12.66	15.58					4.53	11.98	14.14
ST	/e/	stressed	14	558	1999	3055	JT	/e/	stressed	15	452	1768	3083
				5.41	13.01	15.80					4.49	12.18	15.86
		unstressed word-internal	2	541	1968	3024			unstressed word-internal	3	467	1710	3113
				5.27	12.90	15.74					4.63	11.96	15.92
		unstressed word-final	18	602	1920	3152			unstressed word-final	15	506	1615	3072
				5.77	12.74	16.00					4.97	11.58	15.84
	/o/	stressed	8	537	1006	3146		/o/	stressed	7	458	875	1950
				5.24	8.56	15.99					4.55	7.74	12.84
		unstressed word-internal	7	538	1052	3113			unstressed word-internal	8	503	1003	2099
				5.25	8.84	15.92					4.95	8.55	13.33
		unstressed word-final	4	588	1293	2943			unstressed word-final	3	484	1204	2025
				5.65	10.13	15.56					4.78	9.67	13.09
		[ɔ]	1	587	1620	3083			[ɔ]	2	786	1321	2039
				5.65	11.60	15.86					7.14	10.26	13.14
	/ö/	stressed	3	569	2043	2947		/ö/	stressed	3	407	1709	2196
				5.50	13.15	15.57					4.08	11.96	13.64
		unstressed word-internal	2	587	1779	2946			unstressed word-internal	2	452	1578	2192
				5.65	12.22	15.57					4.49	11.43	13.62
		unstressed word-final	8	601	1910	3031			unstressed word-final	8	456	1594	2021
				5.76	12.70	15.75					4.53	11.49	13.08

Sentence-final words													
Speaker	Vowel	Allophone	N	F1	F2	F3	Speaker	Vowel	Allophone	N	F1	F2	F3
LV	/e/	stressed	12	446	2303	3159	VN	/e/	stressed	14	416	1786	2653
				4.44	13.95	16.01					4.17	12.25	14.89
		unstressed word-internal	2	451	2435	3283			unstressed word-internal	3	383	1860	2670
				4.48	14.32	16.26					3.86	12.52	14.93
		[*i*]	1	395	2784	3339							
				3.97	15.20	16.36							
		unstressed word-final	19	470	2038	3212			unstressed word-final	17	382	1739	2573
				4.66	13.14	16.12					3.85	12.07	14.69
	/o/	stressed	6	438	1056	3019		/o/	stressed	7	430	1010	2620
				4.37	8.86	15.73					4.29	8.59	14.81
		unstressed word-internal	9	443	1181	3272			unstressed word-internal	8	430	1041	2557
				4.41	9.55	16.24					4.29	8.77	14.65
		unstressed word-final	5	437	1214	3170			unstressed word-final	5	380	1159	2578
				4.36	9.72	16.04					3.82	9.43	14.70
	/ö/	stressed	4	458	1659	2924		/ö/	stressed	4	408	1523	2392
				4.55	11.76	15.52					4.09	11.19	14.20
		unstressed word-internal	1	412	1623	2920			unstressed word-internal	1	393	1434	2562
				4.13	11.61	15.51					3.95	10.80	14.66
		unstressed word-final	8	452	1803	2969			unstressed word-final	8	359	1689	2403
				4.50	12.31	15.62					3.62	11.88	14.24
NK	/e/	stressed	16	444	2276	2985	VA	/e/	stressed	13	400	1975	2673
				4.43	13.88	15.65					4.01	12.93	14.94
		unstressed word-internal	3	436	2302	3040			unstressed word-internal	5	410	1957	2642
				4.35	13.95	15.77					4.10	12.86	14.86
		unstressed word-final	15	435	2052	2882			unstressed word-final	16	425	1787	2642
				4.34	13.18	15.43					4.25	12.26	14.86
	/o/	stressed	7	417	1049	2531		/o/	stressed	7	414	876.1	2509
				4.17	8.82	14.58					4.15	7.75	14.52
		unstressed word-internal	8	448	1215	2655			unstressed word-internal	8	407	991.8	2578
				4.45	9.73	14.89					4.08	8.48	14.70
		unstressed word-final	4	423	1186	2359			unstressed word-final	5	424	1170	2479
				4.23	9.57	14.11					4.24	9.49	14.44
		[*ə*]	1	478	1591	2769							
				4.73	11.48	15.17							
	/ö/	stressed	3	421	2017	2652		/ö/	stressed	3	400	1792	2436
				4.21	13.07	14.89					4.02	12.27	14.33
		unstressed word-internal	2	436	1790	2604			unstressed word-internal	2	390	1670	2440
				4.34	12.27	14.77					3.92	11.80	14.34
		unstressed word-final	8	437	1978	2627			unstressed word-final	8	420	1746	2481
				4.36	12.94	14.82					4.20	12.10	14.45

Table 28A

Formant values (Hz, Bark) of /ə/ in monosyllabic words and in stressed first syllables (PF — phrase-final words, SF — sentence-final words, N — number of measurements)

Phrase-final words									
Monosyllabic					Stressed first syllable				
Female	N	F1	F2	F3	Female	N	F1	F2	F3
EI	3	758	1411	3137	EI	11	718	1469	3350
		6.95	10.69	15.97			6.66	10.96	16.38
ST	3	625	1565	3146	ST	14	609	1569	3207
		5.95	11.37	15.99			5.83	11.39	16.11
LV	3	483	1515	3056	LV	15	473	1553	3161
		4.77	11.16	15.80			4.69	11.32	16.02
NK	3	514	1414	2697	NK	11	506	1470	2755
		5.04	10.71	15.00			4.97	10.96	15.14
Average	**12**	**595**	**1476**	**3009**	Average	**51**	**577**	**1515**	**3118**
		5.71	**10.99**	**15.71**			**5.56**	**11.16**	**15.93**
Male	N	F1	F2	F3	Male	N	F1	F2	F3
AA	3	534	1331	2511	AA	11	521	1435	2456
		5.21	10.31	14.53			5.10	10.80	14.38
JT	3	557	1281	2044	JT	13	579	1432	2056
		5.41	10.07	13.16			5.58	10.79	13.19
VN	3	457	1275	2684	VN	12	431	1343	2618
		4.54	10.04	14.97			4.30	10.37	14.80
VA	3	610	1309	2645	VA	11	483	1282	2497
		5.84	10.20	14.87			4.77	10.07	14.49
Average	**12**	**540**	**1299**	**2471**	Average	**47**	**503**	**1373**	**2407**
		5.26	**10.16**	**14.42**			**4.95**	**10.51**	**14.25**
Sentence-final words									
Monosyllabic					Stressed first syllable				
Female	N	F1	F2	F3	Female	N	F1	F2	F3
EI	3	766	1385	3250	EI	11	703	1395	3231
		7.00	10.57	16.19			6.55	10.62	16.16
ST	3	465	1551	3070	ST	14	552	1677	3120
		4.61	11.31	15.83			5.36	11.83	15.94
LV	3	438	1543	3176	LV	16	453	1492	3272
		4.36	11.28	16.05			4.50	11.06	16.24
NK	3	514	1414	2697	NK	11	506	1470	2755
		5.04	10.71	15.00			4.97	10.96	15.14
Average	**12**	**546**	**1473**	**3048**	Average	**52**	**553**	**1508**	**3094**
		5.31	**10.98**	**15.79**			**5.37**	**11.13**	**15.88**
Male	N	F1	F2	F3	Male	N	F1	F2	F3
AA	3	571	1306	2450	AA	11	509	1480	2493
		5.52	10.19	14.36			5.00	11.00	14.48
JT	3	527	1393	2176	JT	12	571	1420	2131
		5.15	10.61	13.57			5.52	10.73	13.44
VN	3	459	1193	2641	VN	13	422	1270	2600
		4.56	9.61	14.86			4.22	10.01	14.76
VA	3	525	1313	2734	VA	13	460	1337	2568
		5.14	10.23	15.08			4.57	10.34	14.67
Average	**12**	**521**	**1301**	**2500**	Average	**49**	**490**	**1377**	**2448**
		5.10	**10.17**	**14.50**			**4.84**	**10.53**	**14.36**

Table 29A

Formant values (Hz, Bark) of unstressed /ə/ in environments consisting of front, back, both front and back, and other reduced vowels

Phrase-final words																
Speaker	/ə/ with front vowels				/ə/ with back vowels				/ə/ with front and back vowels				/ə/ with other /ə/s			
	N	F1	F2	F3	N	F1	F2	F3	N	F1	F2	F3	N	F1	F2	F3
EI	15	590	1730	3019	25	610	1386	3124	3	540	1923	3169	8	669	1628	3330
		5.67	12.04	15.73		5.83	10.58	15.94		5.26	12.75	16.04		6.29	11.63	16.35
AA	14	452	1513	2526	24	489	1398	2506	3	348	1709	2459	7	534	1507	2658
		4.50	11.15	14.57		4.83	10.63	14.51		3.51	11.96	14.39		5.21	11.12	14.90
ST	13	581	1777	3103	24	556	1505	3172	3	545	1936	3156	8	625	1586	3174
		5.60	12.22	15.90		5.39	11.11	16.04		5.30	12.79	16.01		5.95	11.46	16.04
JT	14	452	1586	2161	25	453	1295	2038	3	446	1570	2211	8	521	1406	2009
		4.50	11.46	13.53		4.50	10.13	13.14		4.44	11.39	13.68		5.10	10.67	13.04
LV	14	466	1754	3255	23	454	1511	3324	3	366	1749	3067	8	498	1661	3364
		4.62	12.13	16.20		4.51	11.14	16.34		3.69	12.11	15.83		4.90	11.77	16.41
NK	15	433	1822	2611	25	454	1505	2709	3	379	1679	2719	8	563	1499	2349
		4.32	12.39	14.78		4.52	11.11	15.03		3.82	11.84	15.05		5.45	11.09	14.09
VN	13	341	1470	2615	22	421	1284	2601	3	311	1588	2519	8	424	1314	2646
		3.44	10.96	14.79		4.21	10.08	14.76		3.14	11.47	14.55		4.24	10.23	14.87
VA	13	413	1540	2608	25	440	1251	2625	3	413	1798	2592	8	449	1434	2649
		4.13	11.26	14.78		4.38	9.92	14.82		4.14	12.30	14.74		4.46	10.80	14.88
Female	**57**	**517**	**1771**	**2997**	**97**	**518**	**1476**	**3082**	**12**	**458**	**1822**	**3028**	**32**	**589**	**1594**	**3054**
		5.05	**12.19**	**15.65**		**5.06**	**10.99**	**15.84**		**4.52**	**12.37**	**15.73**		**5.65**	**11.49**	**15.72**
Male	**54**	**415**	**1527**	**2478**	**96**	**451**	**1307**	**2442**	**12**	**380**	**1666**	**2445**	**31**	**482**	**1415**	**2490**
		4.14	**11.21**	**14.42**		**4.48**	**10.19**	**14.31**		**3.81**	**11.78**	**14.34**		**4.75**	**10.70**	**14.42**
Sentence-final words																
EI	15	603	1719	3069	23	607	1395	3146	3	529	2000	3326	8	633	1629	3197
		5.78	12.00	15.83		5.81	10.62	15.99		5.17	13.01	16.34		6.01	11.64	16.09
AA	13	426	1447	2449	24	453	1384	2548	2	321	1717	2598	8	519	1530	2586
		4.26	10.86	14.36		4.50	10.57	14.62		3.24	11.99	14.75		5.08	11.22	14.72
ST	12	512	1696	3110	24	521	1505	3173	3	552	1800	3158	8	595	1628	3100
		5.02	11.91	15.91		5.10	11.11	16.04		5.36	12.30	16.01		5.71	11.63	15.89
JT	13	413	1602	2140	25	450	1324	2089	3	396	1624	2111	8	527	1434	2119
		4.13	11.53	13.46		4.48	10.28	13.30		3.98	11.62	13.37		5.15	10.80	13.40
LV	17	441	1603	3213	18	445	1521	3341	3	344	1766	3166	7	495	1534	3336
		4.40	11.53	16.12		4.43	11.19	16.37		3.47	12.18	16.03		4.87	11.24	16.36
NK	15	418	1740	2663	24	437	1489	2635	3	323	1735	2778	9	502	1636	2772
		4.18	12.08	14.91		4.36	11.05	14.84		3.26	12.06	15.19		4.94	11.67	15.18
VN	15	378	1407	2612	20	421	1305	2661	3	335	1616	2509	7	411	1231	2625
		3.80	10.67	14.79		4.21	10.19	14.91		3.38	11.59	14.52		4.12	9.81	14.82
VA	12	403	1525	2578	22	438	1249	2583	3	383	1830	2582	8	411	1398	2575
		4.04	11.20	14.70		4.36	9.90	14.71		3.86	12.42	14.71		4.12	10.63	14.69
Female	**59**	**493**	**1689**	**3014**	**89**	**503**	**1478**	**3073**	**12**	**437**	**1825**	**3107**	**32**	**556**	**1607**	**3101**
		4.84	**11.88**	**15.70**		**4.93**	**10.99**	**15.81**		**4.32**	**12.39**	**15.89**		**5.38**	**11.55**	**15.88**
Male	**53**	**405**	**1495**	**2445**	**89**	**440**	**1315**	**2469**	**11**	**359**	**1697**	**2450**	**31**	**467**	**1398**	**2476**
		4.06	**11.07**	**14.33**		**4.39**	**10.23**	**14.38**		**3.61**	**11.90**	**14.34**		**4.62**	**10.62**	**14.41**

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