 doi:10.3176/lu.2012.3.09

DENNIS ESTILL (Helsinki)

REVISITING THE MEADOW MARI VOCALIC SYSTEM

Abstract. The purpose of this article is to define the present system of vowels in standard Meadow Mari based on empirical research and in the light of traditional concepts. The specific objectives of this experiment were (1) to ascertain whether three often-called weak full vowels can be described as such or whether they are better described as reduced vowels, (2) to determine the quality of the central vowel, and (3) to measure the extent of roundedness of all vowels. The paper includes a brief consideration of personal features that may be apparent from analyses of formants 3 and 4. Four perspectives were considered: (a) the positions of the vowels on a chart displaying formants 1 and 2, (b) duration, (c) fundamental frequency and (d) intensity. The method used is statistical analysis of acoustic measurements using a speech analysis computer program. The findings suggest that there are only two vowel categories in Meadow Mari, full and reduced, as opposed to views which add a third category, weak. The central vowel is reduced and is neutral with regard to roundedness. Roundedness can be viewed as occurring on a continuum.

Keywords: Meadow Mari, reduction, central vowel, rounding, individual features.

Introduction

The purpose of this article is to define the present system of vowels in Standard Meadow Mari (Alhoniemi 1985) (SMM) on the basis of empirical experimentation and in the light of traditional concepts. This appraisal will include descriptions of the location of SMM vowels in the vowel space along with an analysis of the degree to which they are reduced, and information regarding the extent to which the vowels may or may not be rounded. In this way it should be possible to determine how far previous descriptions, mostly arrived at without any analysis of the acoustic parameters, fit in with the findings. These findings may create a need to adjust our understanding of at least some aspects of the Meadow Mari vowel system.

Traditional descriptions of the Meadow Mari vowels

A typical description of the Meadow Mari vocalic system is found in N. T. Pengitov (Пенгитов 1958 : 20, 21) and is shown below:

close	*i*	*y*			*u*
			ə		
mid		*e*	*ö*		*o*
open			*a*		

According to this arrangement, there are three levels on the close/open scale, viz. close, mid and open. However, /ə/ is given the position of an unreduced close-mid

central vowel, while /y/ and /ö/ are shown as front vowels. Pengitov considers reduction to be a general feature, presumably meaning that it can occur in the case of any vowel in specific circumstances. J. G. Grigoŕjev (Григорьев 1953 : 7—9), on the other hand, states that in the case of the unstressed vowels /e/, /o/ and /ö/ in word-final position there is reduction, whereas in the case of unstressed /ə/, reduction does not occur and the realisation of the sound is very short. Although valuable research on Mari phonology has been carried out, particularly over the past fifty years, there is still need for more exact definitions, for example, concerning the "full" and "weak" vowels and reduction in general. In Alho Alhoniemi's view (1985 : 17, 39—40), all unreduced vowels except certain final vowels are full vowels; weak vowels, of which he gives the following examples, occur at the end of a word in a specific environment, *kuδo* 'house', *šüδö* 'hundred', *keče* 'day'. Alho Alhoniemi's configuration of the SMM vowel chart in his description of Mari grammar is the following:

i *ü* *u*
e *ö* *o*
a

ə̂

No reason is given by Alhoniemi for drawing a broken line above /ə̂/, but it may suggest the difficulty of allocating a specific point in the vowel space for what he considers to be a reduced vowel. Alhoniemi also considers /ə̂/ to be a back vowel, as opposed to other descriptions. Otherwise the pattern is very similar to Pengitov and Gábor Bereczki (1990 : 23), who also separated the central vowel by drawing a line to separate the central vowels from the others and whose chart is shown on the right below. Another problem with the Alhoniemi description is that it does not show the extent of openness and closedness but, rather, presents three equidistant levels. According to Alhoniemi (1985 : 17) there are three types of vowel in Meadow Mari: strong full, weak full (word final *e*, *o* and *ö*) and the reduced *ə*. One of the most recent descriptions of SMM vowels is that of I. G. Ivanov (Иванов 2000 : 56). In his chart front and back vowels form two separated groups:

	front	back
close	*i, y*	*ə, u*
mid	*e, ö*	*o*
open	*a*	

(Иванов 2000)

ü	*i*	*u*
ö	*e*	*o*
		a
ə		

(Bereczki 1990)

The most important difference between Ivanov's layout and the others is that he places *ə* among the close vowels.

Measuring the acoustic parameters — background and methodology

The object of the study described below was to determine as far as possible the exact position of SMM vowels in the vowel space, to consider the role, if any, of reduction, to tackle the issue of the proposed strong-weak division and to examine another dimension to the understanding of Meadow Mari vowels, viz. to describe roundedness.

There were two female informants for the experiment, EA and LS, whose ages and places of birth were respectively 39, Zvenigovskij raion, and 38, Volžskij raion in the Republic of Mari El. Both are teachers of Mari. For the experiment the standard dialect was considered. The text chosen for recording was composed of several short readings from a teaching manual intended for Russian students (Зорина, Крылова,

Якимова 2000 : 107, 119, 139, 140). All told the material consisted of 500 words. The recordings took place in an auditorium in the Department of Finno-Ugrian Studies of the University of Helsinki where every attempt was made to keep outside noise down to a minimum. All doors and windows were closed and electrical interference eliminated as far as possible. A Plextalk recorder was used for the recordings and the sound quality later calibrated for fidelity. Although the quality of the sound was considered satisfactory, it did fall a little short of what might be expected in perfect laboratory conditions. The material was read once by each speaker. The microphone used was an AKG D 660S and the acoustic measurements made using the Praat 5.143 program.

Measurements were taken of the values of formants 1—4, and in addition vowel duration, intensity and fundamental frequency (F0) were recorded. The formant data were means taken from slices of the core of the vowel carefully chosen in order to eliminate as far as possible the possible effects of, for example, co-articulation. The results were then analysed.

The findings

The three objectives of this experiment were (1) to ascertain whether the three so-called weak full vowels should be described as such or whether they are better described as reduced vowels, (2) to determine the quality of the central vowel, and (3) to measure the extent of roundedness of all vowels.

For considering problems (1) and (2) it is necessary to calculate and determine those acoustic parameters that bear on reduction and the integrity of the individual sound of the respective vowels. The vowels were analysed from four perspectives: (a) the positions of the vowels on a chart displaying formants 1 and 2, (b) duration, (c) pitch or fundamental frequency and (d) loudness or intensity. In attempting to resolve the problem referred to in (3) above, formants 2, 3 and 4 were analysed.

1. Reduced SMM vowels

According to a definition given by John Laver (1994 : 157), vowel reduction can mean that "the vowel is pronounced shorter, less loud, lower in pitch and more central in quality". Therefore, vowel reduction is not only a question of shorter duration. Nor is reduction necessarily correlated with centrality; rather an examination of all relevant factors should be made.

1.1. Centrality

To determine the position in the vowel space of the central vowel and the "weak" vowels, measurements were made of formants 1 and 2 and the positions of the vowels were entered into a chart, along with the other seven SMM vowels. These are shown below in Figure 2.

The material read by the informants produced 2,274 vowel tokens whose percentage frequency of occurrence is shown in the Figure 1.

It would be extremely problematic to devise suitable, that is to say fluently readable, material for analysis wherein each vowel would have the same overall frequency, if not least on account of the repetition of the same word(s) — and co-articulation — in the same phonetic environment. Therefore, above all, this analysis took into consideration the need for the reading material to be of the best possible quality, diverse and interesting, in order to produce the right findings. Of course, the readers were given several days to become acquainted with the part to be read, and a number of questions about the text were discussed. There were only 20 occurrences of the "weak" vowel /ö/, but this is unlikely to greatly affect the results as

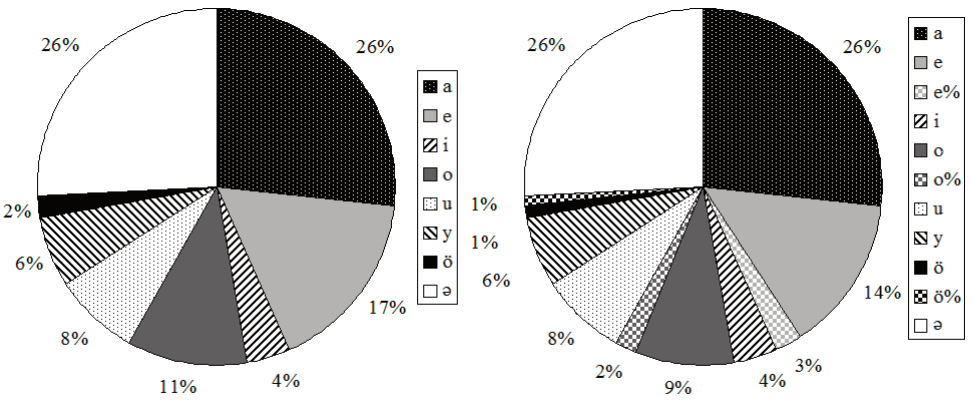

Figure 1. **Percentage of individual SMM vowels in material read by two informants (left), and percentage of individual SMM vowels with /e/, /o/ and /ö/ divided into categories "full" and "weak" (right). A % sign is used to indicate "weak" vowels.**

a whole, and as far as the central vowel is concerned approximately 600 tokens were analysed. There were also very slight differences in the sample totals according to which parameter was under consideration.

Figure 2 displays the SMM vocalic system, based on the measurement of approximately 2,300 tokens.

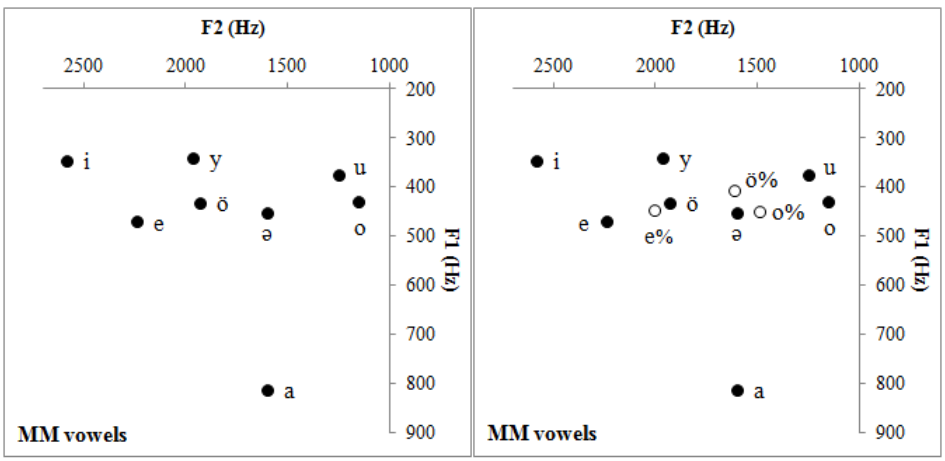

Figure 2. **The eight-vowel SMM vocalic system (left) and the SMM vocalic system plus the "weak" vowels (right). A % sign is used to indicate "weak" vowels.**

The left vowel chart could thus now be converted into the following form:

	front→			←back
close	*i*	*y*		*u*
mid-close	*e*	*ö*	*ə*	*o*
mid-open				
open			*a*	

With slight alterations these conform quite well to the traditional descriptions shown above. Leaving the mid-open row empty emphasises both the nearness of the top two rows to each other and, accordingly, the distance between /a/ and the

other vowels. The right chart in Figure 2 shows the relative position of the "weak" vowels with regard to the "parent" vowel. It will be observed that all three centralise to the same degree. /e/ moves close to the space occupied by /ö/ and /o/ and /ö/ near that occupied by /ə/. This phenomenon can only be called reduction, and a division into full (= having all the properties of the vowel in question) vowel and "weak" (= having all the properties of the vowel in question in a "weaker" form) adds nothing to a definition of the vowel as reduced. This will be further confirmed when the features of phonological length, loudness and pitch are considered.

As far as the central vowel /ə/ is concerned Figure 2 also shows that it is placed in a mid-close position between /ö/ and /o/. For the moment we can only locate the position of /ə/. Whether it is full or reduced must be resolved by looking at the other properties of the vowel, which are treated below.

1.2. Duration

The feature most often related to reduction is the phonological length or duration of a vowel. So much so that for some it often seems that this parameter alone is enough to label a vowel as reduced. I have referred to this problem earlier in connection with Moksha (Estill 2011). However, the Moksha central vowel is in fact reduced. Comparisons I made between the Moksha /ə/ and the Romanian central vowel clearly indicated this. What about Meadow Mari? The bar chart (Figure 3) compares the duration of the eight SMM vowels and the three "weak" vowels.

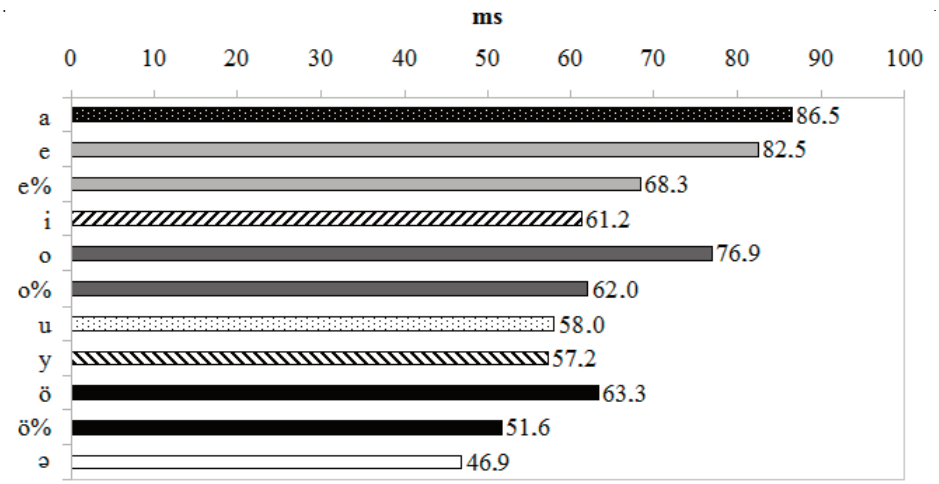

Figure 3. **Duration of eight SMM vowels and three "weak" vowels in milliseconds. A % sign is used to indicate "weak" vowels.**

If duration is the criterion by means of which reduction is determined, then there can be no doubt whatsoever that not only the SMM central vowel, but also the three "weak" vowels are reduced. As percentages of the full vowels the "weak" vowels were 83 (/e/), 78 (/o/) and 82 (/ö/). The pairs in Figure 3 illustrate this. As far as the central vowel is concerned, it was the shortest of all in duration, with /a/ almost twice as long. Considering the evidence from Romanian, a full central vowel — and the Romanian central vowel is such — is not shorter, at least to any notable degree, than the other full vowels. In fact in Romanian only /a/ was significantly longer than the central vowel. In the case of SMM /ə/ is the shortest vowel of all. The intrinsic relative length of SMM vowels is very close to Romanian: from long to short (as shown in Figure 3) a — e — o — i/ö — u/y — ə, and for Romanian

a — ă/e — o — â — i — u (ă = ə, â = y). This means that while the Romanian central vowel is long, that of SMM is very short, all other things — almost all — being equal. This seems to be a case for describing the SMM central vowel as reduced. But the matter should be further verified by examining loudness and pitch, which are the next subjects for consideration.

1.3. Intensity

The acoustic correlation of loudness is intensity. The mean intensity of SMM vowels is shown in Figure 4.

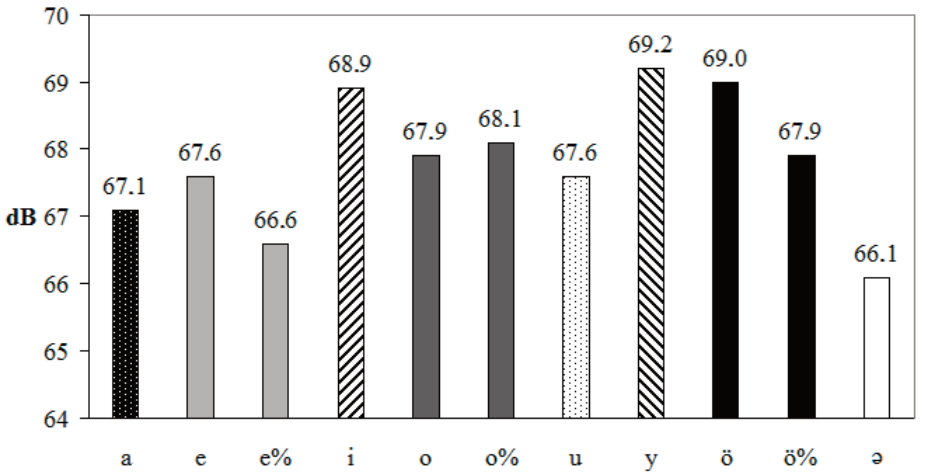

Figure 4. **Intensity of eight SMM vowels and three "weak" vowels in decibels. A % sign is used to indicate "weak" vowels.**

Although there is a significant difference between the intensity of /e/ and /ö/ and their "weak" counterparts, the same cannot be said of /o/. In this case there is no significant difference in intensity between full and "weak". Calculated as totals the difference between these two categories (full and "weak") is 0.5 dB. Therefore, although the degree of intensity seems to be less affected, some reduction does appear to take place. The intensity chart accords with the findings for duration, insofar as the central vowel occupies the last place in the comparison. That is, the level of intensity does not appear to be what should be expected of a full vowel. The case for reduction gathers support from intensity measurements. The final feature for consideration in this section is pitch. Figure 5 depicts the situation in this respect.

1.3.1. Fundamental frequency

Figure 5 presents calculations of the fundamental frequency (F_0) of the SMM vowels. As far as the three full vowels are concerned, these figures indicate that there is no difference in this property, be the vowels in question full or "weak". There is, however, enough evidence from the other parameters to show that in this case reduction does take place, since reduction is not defined on the basis of a consensus between the factors causing it. On the other hand, the central vowel still finds itself in the "jumbo" position, although not perhaps to the same extent as earlier. The position of the central vowel in this chart showing F_0 does not conflict with other measurements demonstrating reduction.

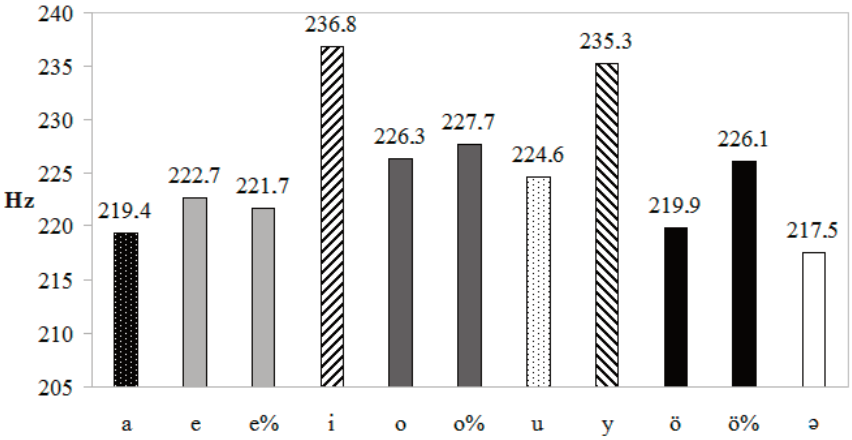

Figure 5. **Fundamental frequency (F_0) of eight SMM vowels and three "weak" vowels in Hertz. A % sign is used to indicate "weak" vowels.**

2. Roundedness

Since grammars describe and show Mari vowels as either rounded or unrounded, it is important to establish the criteria for roundedness, while at the same time determining the acoustic parameters related to this feature, in this case in SMM. Using experimental methods, detection of roundedness is generally associated with formants 2 (strongly connected with front ~ back articulation), 3 and 4. Roundedness is considered to be related to low readings in frequency in these formants. Three formant charts are presented in Figure 6 and these display 2D combinations of formants 2, 3 and 4.

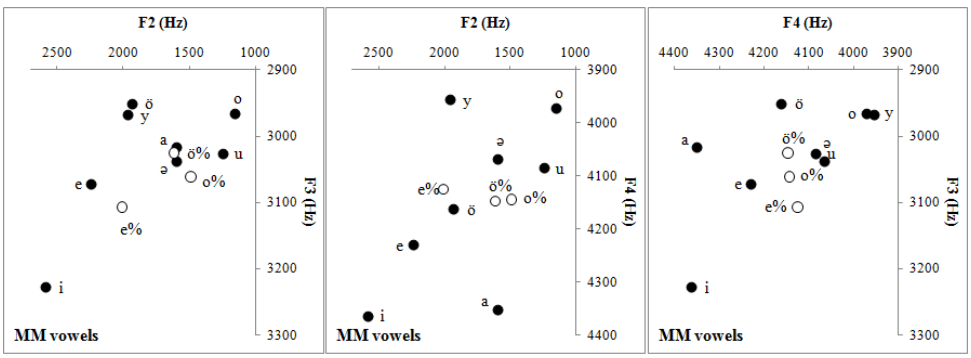

Figure 6. **Formant charts showing 8 SMM vowels and 3 "weak" vowels. Formants 2 and 3 (left), formants 2 and 4 (mid) and formants 3 and 4 (right). A % sign is used to indicate "weak" vowels.**

If the general opinion that low frequency correlates with roundedness is accepted and used as the principal guideline, then the dispersion of points in the three charts suggests that very careful interpretation is demanded. Some rounded vowels such as IPA /ø/ and /y/ are frontal and an interpretation based solely on F_2 would be misleading. F_3 and F_4 are probably more revealing. In theory, if F_3 and F_4 do indicate roundedness this feature should be apparent on a diagonal continuum from top right (roundedness) to bottom left (lip spreading) in charts of the type shown above. In Figure 6 (right) the most obviously rounded /o/ and /y/ and the most clearly unrounded /i/ are precisely where they would be expected, at the limits of the continuum. While keeping an eye on the patterns shown in Figure 6 (left and mid) in which the effect of F_2 is evident, most attention should be paid to Figure 6 (right) in which F_3 and F_4 are

displayed and the drop in frequencies related to backness reduced. In these circumstances /a/, /e/, /u/, /ö/ and /ə/ are located in the area between the two extremes and are either less rounded, /u/, /ö/, /ə/, or less spread, /a/, /e/. The three "weak" vowels are once again centralised, or reduced in terms of roundedness (/o/) varying roundedness (/ö/), and unroundedness (/e/) and their position on the rounded/unrounded continuum should be considered as part of a process of further reduction, thus adding to the evidence already given. /ə/ is so situated that it might well be described as either partially rounded or neutral with respect to the rounded-spread opposition. Conclusion: /ə/ falls in an area between rounded and unrounded and should not be considered an unrounded vowel. The mid-central vowel which has no rounded-unrounded variants in the IPA vowel chart. Adding a third dimension to the vowel chart shown in section 4.1.1 using light grey (rounded) to black (spread) passing through dark grey, the following 3D vowel chart is proposed for SMM:

	front→			←back
close	***i***	***y***		***u***
close-mid	***e***	***ö***	***ə***	***o***
open			***a***	

All of this raises a further question: which IPA and FUT symbols should be used to describe the central vowel? Generally speaking IPA *ɣ* and FUT *ə* have been used in this connection. *ɣ* seems unsatisfactory because it implies unroundedness and should probably be replaced by the roundedness-neutral *ə*. In FUT the central vowel could also very well be represented by the symbol *ə*, although in the vowel chart it occupies the position also held by the rounded, near back and mid-close *o*, that is to say, a central vowel positioned between *o* and *ə*.

3. Individual features

Not only do formants 3 and 4 provide information about roundedness, but also their wide variation between individuals offers clues concerning speaker-specific vowel quality. The extent to which individual features are visible in formants 3 and 4 probably distorts the data relevant to lip roundedness and, thus, these findings should not be treated as absolute relative values. An example of the variation in these formants between speakers, using my informants, is shown in Figure 7 in which the values for the two individual informants have been separated from the totals.

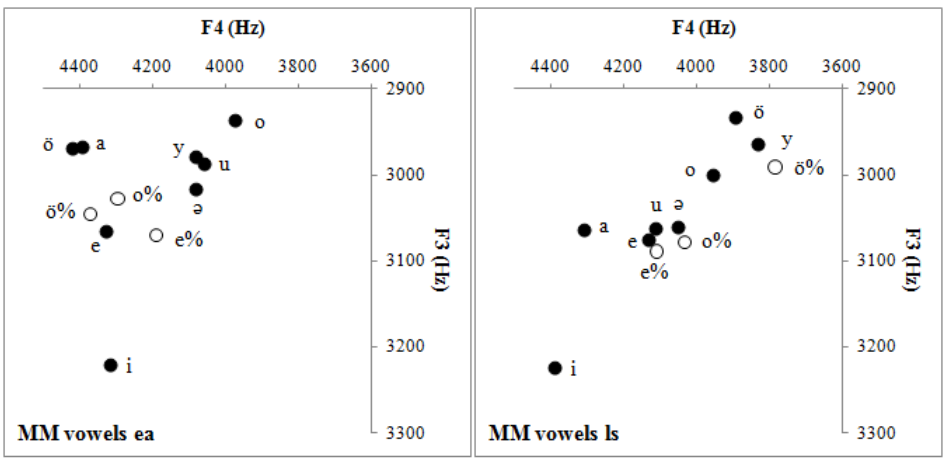

Figure 7. **Charts showing the formant 3 and 4 readings for 8 SMM vowels and 3 "weak" vowels for two informants EA (upper) and LS (lower). A % sign is used to indicate "weak" vowels.**

Informant EA has much lower fundamental frequency (F_0), 195,4 Hz compared to 249.6 Hz for LS, and F_1 and F_4 are higher in the case of EA, 585.9 Hz and 4210 Hz respectively as against 474.5 Hz and 4123 Hz for LS. Bearing this in mind and looking at the F_3/F_4 patterns for both informants, a number of differences can be observed. Most strikingly, while the F_3 values for /ö/ and "weak" /ö/ are similar for both speakers, their F_4 values are located at separate ends of the chart. An examination of the placement in the charts of the other vowels also includes many variations. On the other hand, the F_1/F_2 separate charts for EA and LS show no significant variation in pattern as can been seen in Figure 8 below.

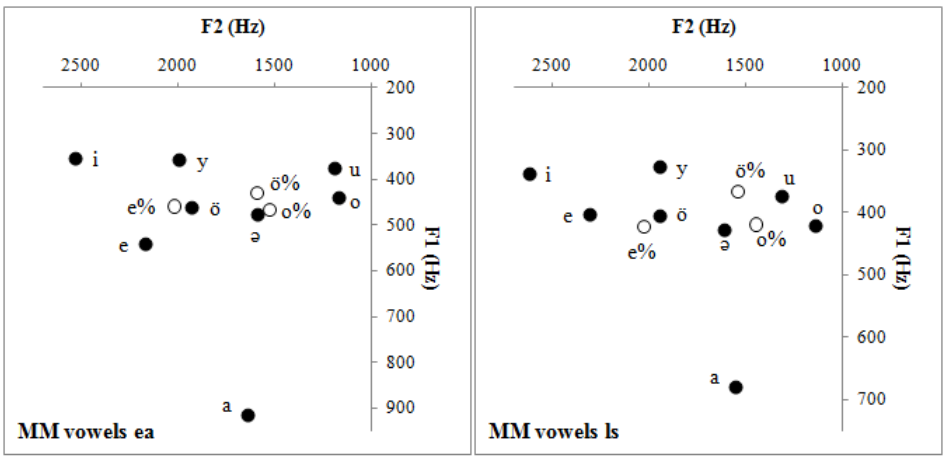

Figure 8. **Charts showing the formant 1 and 2 readings for 8 SMM vowels and 3 "weak" vowels for two informants EA (upper) and LS (lower). A % sign is used to indicate "weak" vowels.**

It is beyond the object of this article to determine exactly how the complex resonances in the oral cavity actually operate to produce those specific frequencies that reflect personal voice quality and what the particular part played by the third and forth formants (and possibly the second) actually is. What can be ascertained, however, when allowing for these factors, is some general picture of the degree of roundedness that is an important feature of SMM vowels. This being the case it can been said that /i/ is unrounded, /y/ and /o/ rounded and /a/, /e/, /u/, /ö/ and /ə/ either partially rounded or sometimes rounded, for example, depending on the phonetic environment. This diverges from conventional opinion, which regards the SMM as split into two categorical opposites, rounded (/o/, /ö/, /u/, /y/) and spread (/a/, /e/, /i/, /ə/).

Conclusion

The questions posed at the beginning of this article concerned the "weak" vowels, the nature of the central vowel and the roundedness aspect of SMM vowels. Reduction was shown to be the factor involved in the production of the "weak" vowels and this suggests that SMM vowels should be described as reduced, rather than weak, especially when a clear definition of weak has not been forthcoming. The material analysed showed that the central vowel is reduced even if a "control" or equivalent full vowel does not exist in SMM, since full central vowels such as the Romanian /ă/ display more salient acoustic parameters. The central vowel is just as rounded as it is unrounded, presumably depending on the environment. However, the symbol *ə* would seem most suitable in IPA and FUT, since it implies reduction, unlike the FUT *o*.

Address

Dennis Estill
University of Helsinki, Department of Finnish, Finno-Ugrian and Scandinavian Studies
estill@mappi.helsinki.fi

REFERENCES

Alhoniemi, A. 1985, Marin kielioppi, Helsinki (Apuneuvoja suomalais-ugrilaisten kielten opintoja varten 10).
Bereczki, G. 1990, Chrestomathia ceremissica, Budapest.
Laver, J. 1994, Principles of Phonetics, Cambridge.
Estill, D. 2011, The Enigmatic Central Vowel in Moksha. How Central, How Reduced? — XXVI Fonetiikan päivät 2010, Joensuu (University of Eastern Finland electronic publications), 33—37.
Иванов, И. Г. 2000, Кызытсе марий йылме. Фонетика, Йошкар-Ола.
Григорьев, Я. Г. 1953, Марийский язык, Йошкар-Ола.
Пенгитов, Н. Т. 1958, Сопоставительная грамматика русского и марийского языков. Часть первая, Йошкар-Ола.
Зорина З. Г., Крылова Г. С., Якимова Э. С 2000, Марийский язык для всех. Часть 2/3, Йошкар-Ола.

ДЕННИС ЭСТИЛЛ (Хельсинки)

О СИСТЕМЕ ГЛАСНЫХ В ЛУГОВО-ВОСТОЧНОМ МАРИЙСКОМ ЯЗЫКЕ

Автор статьи поставил своей целью определить современную систему гласных в лугово-восточном марийском литературном языке, опираясь на эмпирическое исследование и в свете традиционных понятий. Задачи эксперимента: (1) установить, можно ли три гласных звука, которые часто именуются как слабые полные гласные, описывать именно таковыми или лучше классифицировать их как редуцированные, (2) определить качество центрального гласного и (3) измерить степень округленности всех гласных. Кратко характеризуются особенности, выявленные при анализе формантов 3 и 4. Обсуждаются четыре положения: (а) гласные на диаграмме, демонстрирующей форманты 1 и 2, (б) длительность, (в) фундаментальная частота и (д) интенсивность. Используется метод статистического анализа акустических измерений с применением компьютерной программы анализа речи. Результаты позволяют предполагать, что в лугово-восточном марийском языке существуют только две категории гласного — полный и редуцированный, в противоположность мнению о наличии третьей — слабого гласного. Центральный гласный является редуцированным, он нейтрален относительно округленности. Последняя может рассматриваться как проявление континуума.