Strategies in the acquisition of segments and syllables in Russian-speaking children*

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This study investigates the phonological development of ten children reared in Russian-speaking homes, from the emergence of first words to the age of three years two months.

The paper consists of three parts: acquisition of phonemes and phonological oppositions; acoustic analysis of the consonantal opposition in palatalization emerging in children; acquisition of syllable structure of words and different syllable omission patterns. The focus is made on individual strategies adopted by different children. Some data challenge the literature claim about the acquisition of labials before other consonants and the claim about 'trochaic bias' in early word production.

1. *Introduction*

The aim of this study is to describe some aspects of the typical development of segmental phonology in children acquiring Russian as their first language. Three different aspects will be presented in this paper. First, the data on the order of acquisition of phonemes and phonological oppositions and quantitative relations of acquired phonemes will be presented. Then the focus will be made on the acquisition of the consonantal opposition in palatalization. The results of the acoustic analysis of the palatalization opposition emerging in children will be presented. Finally, acquisition of syllable structure of words will be discussed, and the strategies adopted by different children in syllable omission patterns will be analyzed.

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2. Data

The speech of ten children is studied in this work. The full information on the ages of the children studied and the exact type of data is given in Table 1. For some children a certain longitudinal period in language development was studied, for other children the data were taken from a particular moment in time. The data from two children were based on mothers' diaries. Acoustic data from three other children were recorded by the author. Audio recording of one child was offered by the Department of Child Language, A.I. Herzen State Pedagogical University. Recordings of four children were taken from the Phonetic database of Russian (Ceytlin 1994). The total duration of audio recordings is of approximately five hours.

Table 1. The data used in the work.

Name	Sex	Age	Type of data
Natasha 1	F	0;10 – 2;0	Mother's diary, partly published in Ceytlin (1997)
Natasha 2	F	1;0 – 2;0	Mother's diary, Salakhova (1973)
Ira	F	1;3	Audio recording, 4.05 min. Ceytlin (1994)
Philipp	M	1;9	Audio recording, 1 hour 30 min.
Anya	F	2;1	Audio recording, 45 min.
Vanya	M	2;6	Audio recording, 12.22 min. Ceytlin (1994)
Zhenya	M	2;6	Audio recording, 4.38 min. Ceytlin (1994)
Nyusha	F	2;7	Audio recording, 1.14 min. Ceytlin (1994)
Lyuda	F	3;0	Audio recording, 1 hour 30 min.
Ksenya	F	3;2	Audio recording, 25 min.

3. Acquisition of phonemes and phonological oppositions
3.1. Method

For two children (Natasha 1 and Natasha 2) longitudinal data were analyzed: mothers' diaries, from the emergence of first words to the age of two years. Acoustic data were taken from three other children: Ira (a four-minute recording of the interaction with her mother); Philipp (a 1.5-hour recording of three conversations with his mother, within one month); Lyuda (a 25-minute conversation with her mother).

The data were transcribed phonologically, and, where necessary, phonetic transcription was also made. Acoustic analysis was conducted on the available acoustic data. Various kinds of descriptive statistics were applied to the data, resulting in frequency lists, tables, ratios, etc. Some of those were produced using the CHILDES software (e.g. MacWhinney 1991).

3.2. Order of phoneme acquisition. Results and discussion

First of all, the order of phoneme acquisition will be discussed.[1] It was studied in two girls for whom longitudinal data were available. Let us just note that the only available basis for establishing the sequence is the order of appearance of particular phonemes in the words written down in the mothers' diaries, and so this first generalization should be approached with caution.

The order of acquisition of vowels happened to be the same in both girls:

(1) *a* → *u* → *o* → *i* → *e* → *ɨ*

The vowel /ɑ/ being the first vowel to be acquired is typical both universally (e.g. Jakobson 1968) and for the Russian language (e.g. Bogoroditskij 1939; Shvachkin 1948; Gvozdev 1961). In adult Russian speech /ɑ/ is the most frequent vowel (e.g. Bondarko 1998). The last vowel to be acquired by both children is /ɨ/, which also confirms the results of previous studies (e.g. Shvachkin 1948). This is the most 'complicated' vowel phoneme of Russian, its phonological status is a matter of discussions because of its limited distribution. Besides, /ɨ/ is a phonetically complex sound: it is a diphthong with the second element being very close to [i], the tongue advancing throughout the sound. This phoneme is not infrequent in adult speech in unstressed positions (often in grammatical morphemes), but the words with stressed /ɨ/ are incomparably less frequent than the words with stressed /ɑ/, both in adult speech and in the input the children are getting. Other vowels' order of appearance does not exactly correspond to the 'ideal' order predicted by Jakobson (1968), where the three cardinal vowels are expected to appear first. However, Jakobson mentions that an alternative way of building the vowel system for children is adding the third degree of aperture (e.g. *a* – *i* – *e*). This is apparently what both girls in this study are doing. The exact order of acquisition of vowels in the children in our study depends on their individual preferences, or strategies, partly guided by chance, i.e. by the phoneme distribution in the input and by the children's choice of the words to produce.

The consonants acquired by the two children by approximately the age of 18 months are presented below, in order of acquisition (the complete lists of consonants acquired by the age 2;0 are given in Appendix 2):

(2) Natasha 1: *k b n d j* t^j *m* d^j n^j *t* s^j
Natasha 2: *k g n m t b* t^j *s p v* d^j s^j n^j z^j

[1] The phonemic inventory of the Russian language is presented for reference in Appendix 1.

We can see that there are many stops among these first consonants. Also, by the age of 18 months both girls have acquired three out of four nasals present in the phonological system of Russian. All this corresponds to the results earlier presented in the literature (e.g. Shvachkin 1948; Gvozdev 1961; Beltyukov 1964). There is a considerable overlap in the consonant lists between the two girls.

For comparing these data with some acoustic data, Table 2 presents the phoneme system of the child aged 1;3, based on a four-minute recording. During the conversation with her mother the child used eighteen different words, and the total of seventy-five tokens. The table contains all consonant phonemes used by the girl.

Table 2. Consonant repertoire of Ira (1;3).

	Bilabial	Labio-dental	Dental	Palatal	Velar
Stop	p b		t t^j d d^j		k g
Nasal	m m^j		n n^j		
Fricative		v	s^j		x
Approximant				j	

The small amount of data does not allow us to make a conclusion that the phonemes which are not used during the recording have not been acquired by the child, nor that all the phonemes which were produced are reliably and consistently used. Indeed it is unlikely that all are equally stable and ‘acquired’ to the same level, but the data definitely show the girl’s preferences. The phonemes used by the child are mostly those which are the most frequent in the languages of the world, and this goes along with the claims by Roman Jakobson about the parallels between the order of the phoneme acquisition in children and universal tendencies in phonemic inventories of the languages (Jakobson 1968). We can also see from the comparison of Table 2 and Example 2 that there is quite a big overlap between the early phonetic repertoire at a particular stage in time and the order of acquisition of phonemes over time.

Some data on the acquisition of phonological oppositions do not correspond to the claim that bilabial plosives are generally acquired before other consonants, introduced in Jakobson (1968). In both children in this study, the first consonant phoneme to appear in meaningful words is /k/. In one girl the first word is ‘kakaja’ /kɑˈkɑi/ ‘which, what, how’, realized as /kɑˈkɑ/. The first word of the other girl also sounds as /kɑˈkɑ/, which stands for ‘kar-kar’ /kɑrˈkɑr/ ‘caw-caw’. This goes against the above-mentioned claim about labials being acquired first, and also this does not correspond to some of the existing data on the phoneme acquisition in Russian: e.g. Shvachkin (1948) and Gvozdev (1961) both reported labial consonants to be acquired first.

Is this preference towards the voiceless velar stop accidental, or is it indicative of something? It is easy to see (in Example 2) that in both girls labial consonants appear relatively early, so /k/ being the first consonant might be due to chance. There is, however, more evidence of /k/ being favoured by the children studied in this work. It will be presented in the next section.

3.3. Quantitative distribution of phonemes. Results and discussion

In Table 3 the vowel phonemes are presented with their relative frequencies, for five children. For Ira, Philipp and Lyuda, these are frequencies of occurrence of the phonemes in speech, including all word tokens; for the two Natashas, the frequencies are based on the occurrence of phonemes in different words listed in mothers' diaries.

Table 3. Frequencies of occurrence of vowel phonemes in five children.

	Ira 1;3	Philipp 1;9	Natasha 1 0;10 – 2;0	Natasha 2 1;0 – 2;0	Lyuda 3;0
ɑ	50%	43%	52%	47%	41%
i	20%	24%	17%	15%	17%
u	24%	9%	10%	12%	15%
o	5%	13%	12%	15%	14%
e	1%	7%	8%	7%	12%
ɨ	–	4%	1%	4%	1%

It can be seen from Table 3 that the distributions of the phonemes in speech and in children's vocabularies are not greatly different from each other, and they also have some common features with the order of acquisition of vowels (see Example 1). The phoneme /ɑ/, the first vowel to be acquired, is the most frequent in Table 3, taking nearly one half of all the vowels in all the children. The vowel /ɨ/ is the least frequent, and it does not occur in the speech of the youngest child at all. All the other vowels are in-between these two, with /i/ being the second most frequent vowel in most of the children, reflecting its frequency in adult speech (e.g. Bondarko 1998).

Quantitative relation of consonant phonemes in four children is presented in Table 4 (the full lists of consonant phonemes with their relative frequencies can be found in Appendix 2). Again, for the two Natashas the data were mothers' diaries, and for the other two children the count included all the occurrences of the phonemes in speech.

Table 4. Ten most frequent consonant phonemes in four children.

Philipp 1;9		Natasha 1 0;10 – 2;0		Natasha 2 1;0 – 2;0		Lyuda 3;0	
t^j	15%	t	12 %	k	17%	k	14%
k	14%	m	9%	s^j	13%	t^j	11%
s^j	14%	k	7%	j	12%	d^j	9%
m	7%	t^j	6%	t^j	11%	n^j	8%
p	5%	n^j	6%	t	6%	t	7%
j	5%	j	5%	b	5%	j	7%
l^j	4%	d	5%	p	4%	p	5%
t	4%	n	5%	m	3%	b	5%
n^j	4%	s^j	4%	n	3%	m	4%
d^j	3%	p	4%	d^j	3%	n	4%

There are some common features in the consonant distribution in all children. Dental stops (particularly voiceless) are very frequent, as well as the bilabial nasal /m/ and the palatal approximant /j/. Six out of the ten most frequent consonants occur in all the four children: /t^j/, /k/, /m/, /p/, /j/, /t/. Often the consonants have a high frequency of occurrence partly because they are used by the children as substitutes for other consonants; for example, palatalized /t^j/ and /s^j/ very often substitute other sounds, most often affricates, /ʃ/ and /$ʃ^j$ː/.

Interestingly, Table 4 reminds us of the peculiar detail in the consonant acquisition order, discussed above. The phoneme /k/ was the first consonant to be acquired by both children. Here we see that /k/ is very frequent both in children's speech (Philipp and Lyuda) and in vocabularies (two Natashas). There is more interesting evidence found in the recordings of Philipp. During the conversations with his mother, the boy was producing not only real speech, but also some meaningless babbling sequencies (2% of all his vocal production). Calculating the frequency of occurrence of different sounds in Philipp's babble revealed that the sound [k] was the most frequent consonant. Considering that /k/ is the second most frequent consonant phoneme in Phillipp's speech, this seems to support the claims that babble repertoire is reflected in the children's choice of speech sounds (e.g. Oller 1980; Locke 1983; Ferguson, Menn & Stoel-Gammon 1992; Boysson-Bardies 1996; Vihman 1996; MacNeilage 1999). Some data supporting these claims also come from the mother's diary for Natasha 1. The mother claims in the diary that the girl was producing the syllable [ka] more often than other sound sequences as early as at the age of six months, but the sequence [kaka] that she could reliably and consistently interpret as a meaningful word only appeared at the age of ten months.

All these data also stand as more evidence of the presence of *k* in the first words of the children learning Russian. We also found some data confirming our observations in the following works: Sikorsky (1899), Kiterman (1913), Stanchinskaya (1924), Rybnikov (1926), Gvozdev (1960), Vojejkova & Chistovich (1994), Ceytlin (1997). In adult speech the phoneme /k/ is frequent, but not very outstanding among other consonants. High frequency of occurrence of /k/ and its relatively early acquisition might be due to the high frequency of this sound in the input words, and, thus, in the words the children start to produce themselves.

4. Acquisition of the consonantal opposition in palatalization
4.1. Background

The opposition of palatalized and non-palatalized ('hard') consonants is one of the most important characteristics of the phonological system of Russian. This feature is very difficult to acquire for most learners of Russian as their second language. In Russian, palatalized consonants are characterized by the secondary articulation of raising the middle part of the tongue towards the hard palate, as if to an [i]-like position. This produces a corresponding acoustic effect: very characteristic formant transitions from palatalized consonants into following vowels, most noticeable in back vowels. And, indeed, back vowels' allophones occurring after palatalized consonants are phonetic diphthongs (for illustration, see Figure 1).

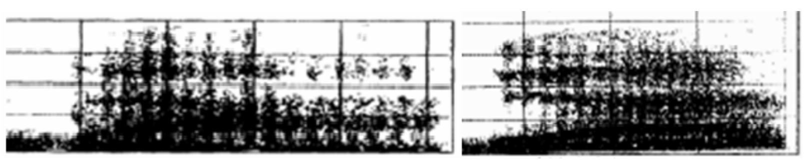


Figure 1. Spectrograms of the syllables /dɑ/ (on the left) and /b^{j}ɑ/ (on the right) produced by an adult speaker of Russian (adapted from Kuznetsov 1997).

The speech of young children learning Russian as their first language has some phonetic characteristics which make even hard consonants perceived as palatalized by the native speakers of Russian. This phenomenon has long been noticed by linguists. Professor I. Sikorsky was writing in 1899 that child language is 'characterized by the overall softness of consonants, especially lingual consonants… This feature – very important in theoretical respect – is a highly prominent and significant phenomenon' (Sikorsky 1899:141). In fact, the 'overall softness of consonants' perceived by adults is characteristic of the speech of not only Russian-speaking children: it can be explained by the morphology of the children's vocal tract (e.g. Eguchi & Hirsh 1969; Kent & Read 2002). However, in the Russian language, as opposed to many other languages, the opposition in palatalization is phonologically significant. All children acquiring Russian make profit out of this: palatalized consonants are the most frequent substitutes for other consonant phonemes in children's speech (e.g. Zharkova 2002b). In the phonological system of Russian palatalized consonants are marked, they have an extra feature compared to unmarked hard consonants. In the speech of adults hard consonants are more frequent than palatalized; principal allophones of most vowels occur after hard consonants. All this considered, it seems very interesting to understand how the palatalization opposition is acquired by young children, how the two opposed types of consonants emerge out of the ‘overall softness’.

4.2. Method

The process of acquisition of the palatalization opposition in children was analyzed, from the first words period until the moment when the two groups of consonants correspond to the ‘adult’ ones, both acoustically and perceptually. Combinations of hard and palatalized consonants with vowels were studied. The data were taken from the speech of seven children aged from one year three months to three years two months. The data were stressed syllables CV and C^jV with the back open vowel /ɑ/. The values of the first two formants were calculated at two time points: at the vowel onset and at the middle of the vowel steady state.

4.3. Results and discussion

A few examples are given below. Let us first consider the oldest child, aged 3;2, whose palatalized consonants sound very much like adults’, unlike all the other children’s productions. In Figure 2 there are two spectrograms, of the syllables /sɑ/ and /s^jɑ/, respectively. It is easy to see that formant transitions are clearly different for the hard and palatalized consonant contexts. After the hard consonant the second formant does not change much, while after the palatalized consonant it radically changes from the onset to the offset of the vowel, making the whole vowel formant pattern look very diphthong-like. Both of these syllables are easily and undoubtedly perceived by the native speakers of Russian as having a hard and a palatalized consonant, respectively.

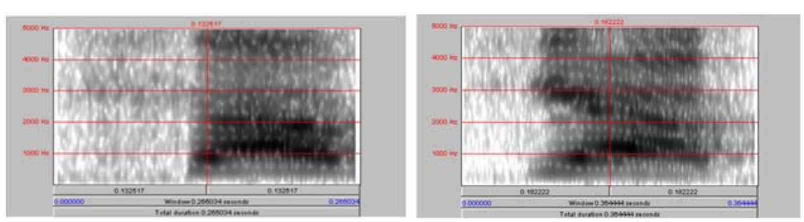
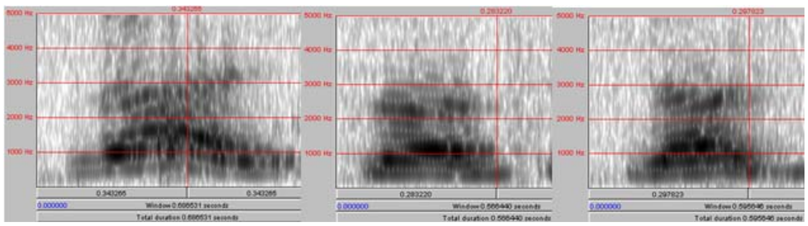


Figure 2. Spectrograms of the syllables /sɑ/ (on the left) and /s^jɑ/ (on the right). Ksenya, 3;2.

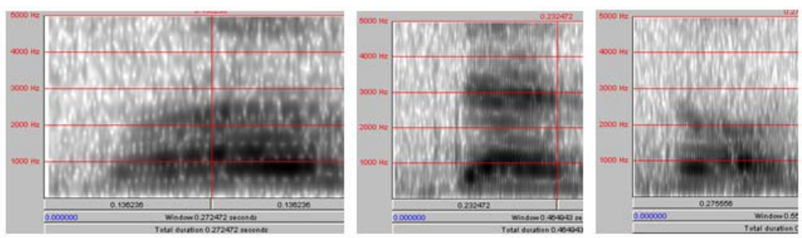
In contrast with the child just described, in Figure 3 (a and b) there are the spectrograms of the syllables with hard and palatalized consonants produced by the youngest child, aged 1;3. There is no such a clear difference between the two syllables as in Figure 2, and there is no clear auditory distinction between them, either. One more example of a C^{j}ɑ syllable produced by this child is given in Figure 3 (c). Its formant picture is different from both other syllables presented in Figure 3, but it is more resembling of the other C^{j}ɑ syllable than of the syllable with the hard consonant.



a) b) c)

Figure 3. Spectrograms of the syllables /dɑ/ (a) and /d^{j}ɑ/ (b and c). Ira, 1;3.

More examples follow from an older child, aged 2;1 (Figure 4). There is a difference between the formant transitions after hard and palatalized consonants, but this difference is not as clear as in the oldest child.



a) b) c)

Figure 4. Spectrograms of the syllables /dɑ/ (a) and /d^{j}ɑ/ (b and c). Anya, 2;1.

Examples from the speech of a child aged 2;6 illustrate an acoustic difference between hard and palatalized consonants, which is perceptually present, as well (Figure 5).

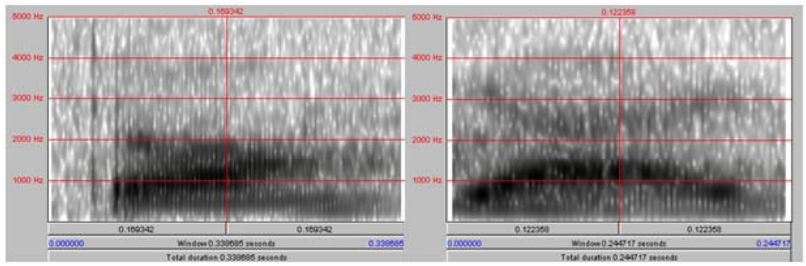


Figure 5. Spectrograms of the syllables /dɑ/ (on the left) and /d^jɑ/ (on the right). Zhenya, 2;6.

Even though sometimes the children produce hard/palatalized consonants opposition very distinctively, the ‘overall softness’ of consonants is still quite noticeable in their speech. In some cases the formant picture of the syllables perceived as CVs resembles more of C^jV syllables. For example, in Figure 6 there is a spectrogram of the word ‘da’ (‘yes’) produced by a three-year-old girl. Both formants’ movements look like a C^jV-like transition. This acoustic effect may be explained by the strong coarticulatory influence of the dental consonant on the vowel. The formant transition typical of dental consonants goes together with the ‘fronted’ articulation characteristic for children and the longer duration of segments than in adults’ speech, all this resulting in the production of a syllable which can be transcribed as [dɛa]. Perception of such a syllable by native speakers of Russian as having a hard consonant can be explained by the influence of the meaning of the word.

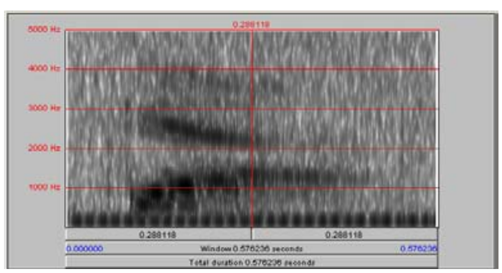


Figure 6. Spectrogram of the syllable /dɑ/. Lyuda, 3;0. Note the extensive, C^jV -like, formant transition.

Figure 7 allows us to make a comparison of all the seven children’s productions. The left plot presents mean values of F1 and F2 frequencies for the vowel /ɑ/ following hard consonants. The plot shows that both formants’ frequencies increase with age. The change of the formants’ values in the C^jɑ syllables is plotted on the right. Comparing the two plots, we can see that in the syllables with palatalized consonants both formants’ values undergo a greater change over age than in the syllables with hard consonants. It is also clearly seen that in C^jɑ syllables, as opposed to Cɑ syllables, all children produce noticeable formant transitions, and that the difference between onset and steady state in Cʲɑ syllables is greater for F2 than for F1.

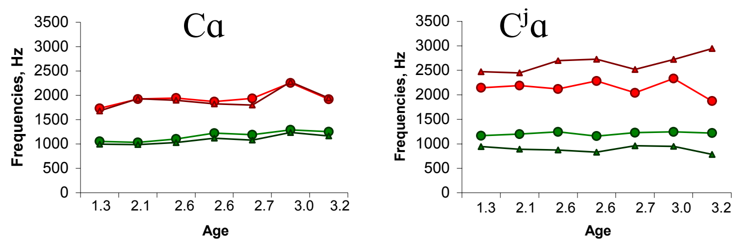


Figure 7. Mean values of F1 and F2 in Cɑ and Cʲɑ syllables in seven children. F1 is in green, F2 is in red. Triangles stand for the frequency values at the beginning of the vowel, – circles at the stable part of the vowel.

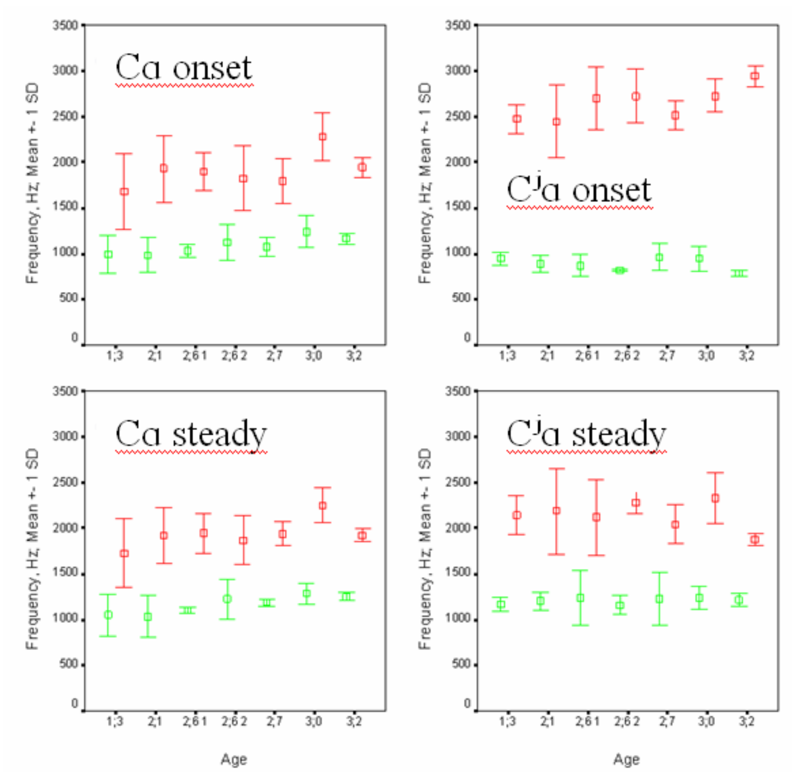


Figure 8. F1 and F2 with standard deviations in seven children.

Figure 8 features the same results, with standard deviations. It is clear from this figure that all the children have higher F2 values at the onset of the vowels following palatalized consonants, as compared to the vowels following hard consonants. However, the dispersion of F2 values in the children of different ages shows that until the age of three the children are experimenting, trying to find the most adequate way of producing palatalized consonants before back vowels. The oldest child, aged 3;2, has the most opposed onset and steady state F2 values for Cʲɑ syllables, when compared to all the other children. This child also has the minimal standard deviations in all formant values. And indeed, this is the only child who sounds nearly like adults in producing hard versus palatalized consonant oppositions (see Figure 2).

These data do not allow us to define the exact mechanism of acquisition of the consonantal opposition in palatalization. We can only trace some tendencies. For example, in the syllables with hard consonants the vowel /ɑ/ becomes more front and open with age. One more change consists in that over age the dispersion of vowel formant values diminishes. It seems that the children gradually drift towards their preferable way of pronouncing the accented vowel /ɑ/, both after hard consonants and after palatalized consonants. These ways of pronunciation are highly individual and they can vary greatly in different children. The possible limits of variation are defined as in the adults' speech – by the possibility to correctly perceive these sounds.

5. Acquisition of syllable structure of words, and syllable omission patterns

5.1. Background

Stress in the Russian language may fall on any syllable of a word. It may also change its position in a word from one morpheme to another: 'lisa' /lʲiˈsɑ/ 'fox' – 'lisy' /ˈlʲisɨ/ 'foxes'. It may be distinctive, but there are a limited number of examples: e.g. 'dama' /ˈdɑmɑ/ 'lady' – 'doma' /dɑˈmɑ/ 'houses'. The stress can join lexical and grammatical words in a whole phonetic word: 'pod oknom' /pɑdɑˈknom/ 'under the window', 'za toboj' /zɑtɑˈboj/ 'after you'.

Duration is the main acoustic correlate of the word stress in Russian. An important feature of unstressed syllables in Russian is that pre-stressed syllables are less subject to quantitative reduction than post-stressed syllables. This feature is represented in a formula describing the unstressed vowels reduction in Russian, suggested by A. Potebnya at the end of the 19th century and experimentally confirmed later (e.g. Bondarko, Verbitskaya & Zinder 1966): '1, 2, 3, 1'. The number 3 stands for the stressed syllable having the greatest duration; two pre-stressed syllables and one post-stressed syllable correspond to the numbers 1, 2, and 1 in the formula, respectively. Besides, there is one more characteristic of unstressed syllables quantitative reduction, not presented in this formula. In word-final position closed unstressed syllables are more reduced than open syllables. In word-initial position unstressed syllables beginning by a vowel are less reduced than syllables beginning by a consonant (e.g. Bondarko 1998).

Acquisition of the syllable structure of words in Russian was first addressed in the late 19th century: some observations on the syllable behaviour and distribution in children's speech were published in, e.g., Sikorskij (1899) and Levonevskij (1914). Kiterman (1913) writes in his article 'A study of syllable deletion in child language': 'It seems to us of some scientific interest to demonstrate and understand which syllables he <the child> acquires earlier and which syllables he omits, why some syllables are produced earlier and more likely than others' (Kiterman 1913:1). Some Russian data on syllable omissions in child language are presented in Gvozdev (1961).

5.2. Method

In this study, the syllable structure of words was analyzed in nine children. The rhythmic patterns used by the children were analyzed, as well as various syllable omission patterns. For acoustic data on the acquisition of relative duration of the syllables depending on the stress position, see Zharkova (2002a).

5.1. Results and discussion

First, each child's productions will be described separately, to fully demonstrate individual strategies in the acquisition of the syllable structure of words. Then the general results for all the children together will be discussed.

It is interesting that during the conversation which lasted for slightly more than four minutes, Ira (1;3) did not use any two-syllable words with the stress on the second syllable (with an iambic stress pattern). All fourteen different two-syllable words used by the girl were trochaic: they had their first syllable stressed. Ira realized the total of 48 tokens of two-syllable words, and the first syllable was always stressed. She shortened just one three-syllable word, 'kapajet' /ˈkɑpɑit/ 'it is dripping', and realized it as /ˈkɑpɑ/.

Philipp (1;9) produced 505 different meaningful words during 90 minutes of the conversation. Fifty-four different words were shortened. In two-syllable words the boy was just producing the stressed syllable, e.g. 'myshi' /ˈmɨʃɨ/ 'mice' was realized as /mʲisʲ/, 'Vova' /ˈvovɑ/ 'Vova' as /of/, 'jazyk' /jiˈzɨk/ 'tongue' as /sʲik/, 'jesche' /jiˈʃʲːo/ 'more' as /tʲe/. There were two ways of reducing three-syllable words with the first syllable stressed: in seven words the last syllable was omitted ('kapajet' /ˈkɑpɑit/ 'it is dripping', realized as /ˈkɑpɑ/); in two words the second syllable was deleted ('serditsya' /ˈsʲerdʲit͡sɑ/ 'is being angry', realized as /ˈsʲet͡sɑ/). For reducing three-syllable words with the second syllable stressed Philipp used four different ways. In six words the boy omitted the first syllable (e.g. 'sobaka' /sɑˈbɑkɑ/ 'dog', realized as /ˈbʲɑkɑ/); in nine words the last syllable was omitted (e.g. 'lozhitsya' /lɑˈʒɨt͡sɑ/ 'is lying down' realized as /ɑˈʒɨt/). In one of the realizations of his own name ('Philyusha' /fʲiˈlʲuʃɑ/), the boy only produced the stressed syllable: /lʲosʲ/. In two words the child omitted everything except for the first, unstressed, syllable: ‘horoshij’ /xɑˈroʃɨj/ ‘good’, realized as /xɑ/; and ‘mashina’ /mɑˈʃɨnɑ/, realized as /mɑsʲ/. Only two words were modified among three-syllable words with the last syllable stressed. In one of them the second syllable was omitted (‘moloko’ /mɑlɑˈko/ ‘milk’, produced as /mɑˈko/), in the other word the first two syllables were deleted (‘petushok’ /pʲituˈʃok/ ‘cockerel’, produced as /tok/). In the four-syllable word ‘malen’kaja’ /ˈmɑlʲinʲkɑi/ ‘little’ Philipp only produced the first two syllables: /ˈmɑlʲɑ/. Several four-syllable words with the stress on the second syllable were reduced by the boy in different ways. In two words he omitted the third syllable (e.g. ‘kusajets’a’ /kuˈsɑi͡tsɑ/ ‘is biting’, realized as /kɨˈsɑtʲsʲɑ/); in the other two words the last syllable was omitted (e.g. ‘horoshaja’ /xɑˈroʃɑi/ ‘good’, realized as /xɑˈjɑtʲɑ/). In two words Philipp only produced two syllables: ‘zelenaja’ /zʲiˈlʲonɑi/ ‘green’, realized as /zʲiˈjonʲ/; and ‘ovs’anaja’ /ɑˈfsʲsɑnɑi/ ‘made of oat’, realized as /ˈfsʲsɑnʲe/. The word ‘odejalo’ /ɑdʲiˈjɑlɑ/ ‘blanket’, like the word ‘ovs’anaja’ just mentioned, was produced without the first syllable: /dʲiˈjɑlɑ/. In the five-syllable word ‘oranzhevaja’ /ɑˈrɑnʲʒɨvɑi/ ‘orange’ (*Adj.*) Philipp produced three middle syllables: /ˈɑtʲnʲemʲi/.

Anya (2;1) used 98 different words in 45 minutes. Fourteen different words’ syllable structure was changed by the girl. Only once a two-syllable phonetic word was produced as one syllable: ‘k mame’ /ˈkmɑmʲi/ ‘to mother’ was produced as /mɑ/. Two three-syllable words with the first stressed syllable were changed: in the word ‘devochka’ /ˈdʲevɑt͡ʃʲkɑ/ ‘girl’ both unstressed syllables were omitted (/dʲi/); in the word ‘milaja’ /ˈmʲilɑi/ ‘nice’ just one syllable was omitted: /ˈmʲiɑ/. There were four three-syllable words with the stress in the middle which were modified: in all of them the last syllable was omitted (e.g. ‘korova’ /kɑˈrovɑ/ ‘cow’, produced as /kɑˈvo/). Anya modified two three-syllable words with the last syllable stressed, and in both of them she omitted the second syllable (e.g. ‘holodets’ /xɑlɑˈdʲe͡ts/ ‘jellied meat’, realized as /gɑˈdʲetʲ/). In four-syllable words we see largely the same modification tendencies as in three-syllable words. For example, the word ‘malen’kaja’ /ˈmɑlʲinʲkɑi/ ‘little’ with the stress on the first syllable was shortened by the child to a two-syllable sequence, based on the first and the third syllables: /ˈmɑnʲkɑ/. In the word ‘horoshaja’ /xɑˈroʃɑi/ ‘good’ the last syllable was omitted: /kɑˈosʲi/. The word ‘krasivaja’ /krɑˈsʲivɑi/ ‘beautiful’, with the same rhythmic pattern, was shortened by the child to two syllables – /kɑˈsʲi/. One more word with the second syllable stressed was produced without the third syllable: ‘pozhalujsta’ /pɑˈʒɑlustɑ/ ‘please/you are welcome’, realized as /bɑˈdʲɑdʲɑ/. In the word ‘odejalo’ /ɑdʲiˈjɑlɑ/ ‘blanket’ Anya omitted the last syllable: /ɑdʲiˈjɑ/. In the word ‘nachinajem’ /nɑt͡ʃʲiˈnɑim/ the girl did not produce the first syllable, which resulted in /tʲiˈnɑim/. It is not very clear why the onset of the word, which is usually considered to be perceptually salient, in this case is not favoured by the child. Maybe because the first syllable immediately preceding the stressed syllable (had the girl omitted the second syllable /t͡ʃʲi/) would have formed the sequence of similar syllables /nɑnɑ/, so Lyuda made her choice following the strategy of dissimilation. One more possible explanation is also interesting. The sound /tʲ͡ʃʲi/ (produced by the girl as /tʲi/) could have seemed to the girl more perceptually salient than the syllable starting with a nasal consonant, and this could have influenced the choice of the syllable to omit.

Zhenya (2;6) used 174 words during 4.5 minutes of the conversation. There occurred three different ways of syllable reduction. In the word ‘obez’janka’ /ɑbiˈzʲjɑnkɑ/ ‘monkey’ the first syllable was deleted: /iˈzʲɑnkɑ/. Two two-syllable words were produced as one-syllables. In the word ‘seryj’ /ˈserɨj/ ‘grey’ the boy omitted the unstressed syllable. The word ‘eto’ /ˈetɑ/ ‘this’ was several times (but not always) represented in the boy’s speech by only the second syllable: /tɑ/ or /tʲɑ/: e.g. ‘eto pojezd’ /ˈetɑ ˈpoist/ ‘this is a train’ was realized as /tɑ ˈpoisʲ/. It is not very clear why the child omits the stressed syllable. Probably it has to do with the absence of consonant at the onset of the first syllable, which makes both perception and production of the syllable more complicated. It is interesting that in Finnish language there is a typologically similar phenomenon. In conversational speech, adult speakers of Finnish often produce the word ‘mitä’ /mitæ/ ‘what’ as /tæ/, deleting the first syllable. Finally, there is a word in Zhenya’s speech, in which he changes the stress position: he produces the word ‘byla’ /bɨˈlɑ/ ‘was’ as /ˈbʲilɑ/.

Lyuda (3;0) used 461 words in 25 minutes of the conversation. She reduced nine different words. In three two-syllable words Lyuda was only producing the stressed syllable: ‘eto’ /ˈetɑ/ ‘this’, ‘ona’ /ɑˈnɑ/ ‘she’, ‘mishki’ /ˈmʲiʃkʲi/ ‘bears’. The only three-syllable word reduced by the girl was ‘belogo’ /ˈbʲelɑvɑ/ ‘white’ (*Gen.*), realized as /ˈbʲelɑ/. In the phonetic word ‘potomu chto’ /pɑtɑˈmuʃtɑ/ ‘because’ the girl did not pronounce both pre-stressed syllables: /ˈmutɑ/. In the word ‘malen’kije’ /ˈmɑlʲinʲkʲii/ ‘little’ (*Pl.*) the second and the fourth syllables were omitted: /ˈmɑkʲi/. This is one of the cases where the segment structure of the word clearly influences the children’s choice of the syllables to omit: in this case the unstressed syllable starting with the stop consonant /kʲ/ was preserved, as compared to the second syllable, starting with the approximant /lʲ/. The following three words were reduced to result in the rhythmic structure σ σ́ σ: ‘oranzhevyj’ /ɑˈrɑnʲʒɨvɨj/ ‘orange’ (*Adj.*), realized as /ɑˈnɑnʲi/; ‘razv’azyvajets’a’ /rɑzˈvʲɑzɨvɑ͡itsɑ/ ‘it’s getting untied’, realized as /bɑˈdɑzʲɑ/; ‘fioletovyj’ /fʲiɑˈlʲetɑvɨj/ ‘violet’, realized as /vɑˈjetʲi/ (the girl had one more way of reducing this word: /bɑˈdʲetʲitʲi/).

It is interesting to compare the data obtained from audio recordings with the data from mothers’ diaries over a certain period of time. Vocabularies of the two girls were analyzed, containing the words produced by the start of the third year of life. Natasha 1 had 174 words in her active vocabulary by the age of 2 years, Natasha 2 had 231 words. The words subjected to syllable modification take 12% in the vocabulary of Natasha 1, and 3.5% in the vocabulary of Natasha 2. This difference has been interpreted as indicating that Natasha 1 chose the analytic strategy of language acquisition, while Natasha 2 adopted the referential strategy (see, e.g., Sikorskij 1899; Ferguson 1979; Peters & Menn 1993; Boysson-Bardies 1996; Jusczyk 1997). More examples of the differences between the children studied in this work according to these two strategies of the phonological acquisition, including the extensive analysis of phoneme substitutions and omissions, are presented in Zharkova (2002b).

Natasha 1 changed the rhythmic structure of twenty-one different words, in twenty of them she omitted syllables; Natasha 2 modified the syllable structure of eight words, in six of them syllable omissions occurred. Natasha 2 misplaced the stress in one word: ‘kuvshin’ /kufˈʃɨn/ ‘jug’ was produced as /ˈkosʲɑ/. Natasha 1 did not exhibit any cases of stress misplacement. Natasha 2 did not reduce any trochaic two-syllable words; Natasha 1 reduced six such words, in all of them producing just the stressed syllable: e.g. /go/ for ‘gromko’ /ˈgromkɑ/ ‘loud’, /mɨ/ for ‘myt’s’a’ /ˈmɨt͡sɑ/. Each child had one iambic two-syllable word reduced to the stressed syllable: ‘idi’ /iˈdʲi/ ‘go’ (*Imper.*) in Natasha 1, produced as /dʲi/; ‘jesche’ /jiˈʃʲːo/ in Natasha 2, produced as /sʲo/. One more two-syllable word modified by Natasha 1 was the word ‘gul’at’’ /guˈlʲɑtʲ/ ‘to walk’: the girl realized only the first, unstressed syllable: /gu/.

Natasha 2 had two ways of reducing three-syllable words with the first syllable stressed: either omitting the last syllable (/ˈkozʲɑ/ for ‘kozochka’ /ˈkozɑt͡ʃʲkɑ/ ‘a little goat’), or omitting the second syllable (/ˈbʲegʲisʲ/ for ‘begajesh’’ /ˈbʲegɑiʃ/ ‘you run’)[2]. Natasha 1 was using just one way of reducing the words of this syllable structure: she was only realizing the stressed syllable (‘gr’aznaja’ /ˈgrʲɑznɑi/ ‘dirty’), produced as /gʲɑ/, ‘valenki’ /ˈvɑlʲinkʲi/ ‘felt boots’, produced as /vɑ/). In the word ‘igolka’ /iˈgolkɑ/ ‘needle’ Natasha 2 left out the first syllable: /ˈgokɑ/. This girl also had a peculiar way of producing the word ‘spasibo’ /spɑˈsʲibɑ/ ‘thank you’: she realized it as /ˈsʲɑptʲɑ/. It is difficult to say in this case which syllable was omitted by the child; individual, unpredictable realizations of this kind can be found in many children.

Natasha 1 had six modified three-syllable words with the second syllable stressed. In five of these words the girl omitted the last syllable: e.g. the word ‘igrushki’ /iˈgruʃkʲi/ ‘toys’ was produced as /iˈgu/. In the sixth word, ‘kartinki’ /kɑrˈtʲinkʲi/ ‘pictures’, Natasha 1 only produced the first syllable: /kɑ/. Three-syllable words with the last syllable stressed were not modified by Natasha 1. Natasha 2 had one such word, and she realized it without the second syllable: ‘karandash’ /kɑrɑnˈdɑʃ/ ‘pencil’, produced as /kɑˈjɑsʲ/. In one four-syllable word Natasha 2 omitted the second syllable: ‘vorotnichok’ /vɑrɑtʲnʲiˈt͡ʃʲok/ ‘a little collar’ was produced by the girl as /vʲitʲiˈtʲok/. Natasha 1 reduced two four-syllable phonetic words in a similar way: in both cases she omitted everything following the stress (‘na kacheli’ /nɑkɑˈt͡ʃʲelʲi/ ‘to the swing’ was produced as /ɑkɑˈt͡ʃʲe/; ‘na ulitsu’ /nɑ ˈulʲit͡su/ ‘to the street’ was produced as /ɑˈu/). Finally, one word was lengthened rather than shortened by Natasha 1. She produced the word ‘mechtajet’ /mʲit͡ʃʲˈtɑit/ ‘is dreaming’ as /mʲit͡ʃʲiˈtɑit/. Apparently, by inserting a vowel, the girl made the pronunciation of the word easier for herself, and avoided an inconvenient consonant cluster. This reminds us of one more typological parallel, the way in which loan words are adapted in Japanese: a vowel is usually inserted between two consonants of

[2] We should note that in some cases, like in this one, it is not obvious which syllable is omitted by the child, as the segments belonging to both unstressed syllables are retained.

a consonant cluster (e.g. the English word ‘film’ becomes *hirumu*, ‘cream’ – *kurimu*). Thus, the Russian child, not realizing that, is making a thing well-known to the languages of the world, demonstrating some common phenomena we can meet in different human languages.

Table 5 features the distribution of different syllable structures attempted by each child.

Table 5. Distribution of the syllable structures attempted by the children (percentages, to two decimal points).

	Ira	Philipp	Natasha 1	Natasha 2	Anya	Vanya	Zhenya	Nyusha	Lyuda
	1;3	**1;9**	**0;10-2;0**	**1;0-2;0**	**2;1**	**2;6**	**2;6**	**2;7**	**3;0**
σ	14.86	31.68	23.56	10.82	20.00	38.08	29.89	38.64	29.72
σ́ σ	82.43	32.08	27.59	32.03	28.45	19.57	32.18	18.18	27.55
σ σ́		11.09	25.86	17.32	23.94	15.66	20.11	15.91	15.84
σ́ σ σ	2.70	3.37	5.75	5.63	5.35	1.42	3.45		6.51
σ σ́ σ		14.85	8.62	20.35	4.79	11.74	12.07	9.09	10.85
σ σ σ́		1.98	5.17	7.79	8.45	7.12	0.57	10.23	3.69
σ́ σ σ σ		1.19		0.87	0.56				0.65
σ σ́ σ σ		3.17	1.15	2.16	4.79	2.85	1.15		1.52
σ σ σ́ σ		0.59	2.30	1.73	3.10	3.20	0.57	6.82	3.04
σ σ σ σ́				0.43					
σ σ́ σ σ σ		0.40			0.56	0.36		1.14	
σ σ σ́ σ σ				0.87					0.43
σ σ σ σ́ σ									0.22

It is clear from Table 5 that all the children most often use one-syllable and two-syllable words, and that in all the children there are more trochaic than iambic words. Among three-syllable words most children prefer using the words with the second syllable stressed.

Table 6 presents the syllable deletion models in the children who did omit syllables. We can see in Table 6 that in two-syllable words the children mostly omit the unstressed syllable. In case of three-syllable words with the first syllable stressed we can not draw from our data a firm conclusion about any strong preference towards one or another strategy of syllable omission, though the last syllable is deleted slightly more often. According to Gvozdev, in Russian words with this rhythmic structure the first post-stressed syllable is more often omitted, because it is ‘weaker’ than the final syllable (Gvozdev 1961). Interestingly, our data do not confirm this claim, but rather correspond to the results presented in Savinainen-Makkonen (2001): Finnish children, while reducing three-syllable words with the first syllable stressed, were omitting the last syllable in 65% of cases, and the second syllable was deleted in 29% of words (Savinainen-Makkonen 2001).

Table 6. Syllable deletion patterns in seven children (percentages, to two decimal points).

Attempted	**Realized**	Ira	Philipp	Natasha 1	Natasha 2	Anya	Zhenya	Lyuda
		1;3	**1;9**	**0;10-2;0**	**1;0-2;0**	**2;1**	**2;6**	**3;0**
$\acute{\sigma}\ \sigma$	$\acute{\sigma}$		25.93	30.00		6.67	33.33	22.22
	σ_2						33.33	
$\sigma\ \acute{\sigma}$	$\acute{\sigma}$		3.70	5.00	16.67			11.11
	σ_1			5.00				
$\acute{\sigma}\ \sigma\ \sigma$	$\acute{\sigma}\ \sigma_2$	100	12.96		16.67			11.11
	$\acute{\sigma}\ \sigma_3$		3.70		16.67	6.67		
	$\acute{\sigma}$			10.00		6.67		
$\sigma\ \acute{\sigma}\ \sigma$	$\acute{\sigma}\ \sigma_3$		11.11		16.67			
	$\sigma_1\ \acute{\sigma}$		16.67	25.00		26.67		
	$\acute{\sigma}$		1.85					
	σ_1		3.70	5.00				
$\sigma\ \sigma\ \acute{\sigma}$	$\sigma_1\ \acute{\sigma}$		1.85		16.67	13.33		
	$\acute{\sigma}$		1.85					
$\acute{\sigma}\ \sigma\ \sigma\ \sigma$	$\acute{\sigma}\ \sigma_2$		1.85					
	$\acute{\sigma}\ \sigma_3$					6.67		11.11
$\sigma\ \acute{\sigma}\ \sigma\ \sigma$	$\sigma_1\ \acute{\sigma}\ \sigma_3$		3.70			6.67		
	$\sigma_1\ \acute{\sigma}\ \sigma_4$		3.70			6.67		11.11
	$\sigma_1\ \acute{\sigma}$		1.85	5.00		6.67		
	$\acute{\sigma}\ \sigma_3$		1.85					
	σ_1			5.00				
$\sigma\ \sigma\ \acute{\sigma}\ \sigma$	$\sigma_2\ \acute{\sigma}\ \sigma_4$		1.85			6.67	33.33	
	$\sigma_1\ \sigma_2\ \acute{\sigma}$			5.00		6.67		
	$\acute{\sigma}\ \sigma_4$							11.11
	σ_1			5.00				
$\sigma\ \sigma\ \sigma\ \acute{\sigma}$	$\sigma_1\ \sigma_3\ \acute{\sigma}$				16.67			
$\sigma\ \acute{\sigma}\ \sigma\ \sigma\ \sigma$	$\acute{\sigma}\ \sigma_3\ \sigma_4$		1.85					
$\sigma\ \sigma\ \acute{\sigma}\ \sigma\ \sigma$	$\sigma_1\ \acute{\sigma}\ \sigma_5$							11.11
	$\sigma_2\ \acute{\sigma}\ \sigma_4\ \sigma_5$							11.11
$\sigma\ \acute{\sigma}\ \sigma\ \sigma\ \sigma\ \sigma$	$\sigma_1\ \acute{\sigma}\ \sigma_6$							11.11

Out of the two most frequent ways of reducing three-syllable words with the stress in the middle, according to Table 6, two children prefer omitting the first syllable, and three other children have somewhat stronger preferences to omitting the last syllable. These data do not quite confirm the claim by Gvozdev that in these cases the first syllable is usually omitted (Gvozdev 1961). Equally, these data do not confirm the claim made in, e.g., Juszcyk, Cutler & Redanz (1993); Allen & Hawkins (1978); Gerken (1994), about ‘trochaic bias’, i.e. the preference in children towards trochaic patterns. We should also note here that the evidence contradicting the trochaic bias idea has also been presented in the literature (e.g. Vihman, DePaolis & Davis 1998; Tzakosta 2004, where more works are referred to).

The data from Table 6 on reducing three-syllable words with the last syllable stressed also do not correspond to the tendency described by Gvozdev (according to the researcher, in three-syllable words with the stress at the end, the children usually delete the first, ‘weakest’, syllable). There is an explanation to this syllable omission pattern found in our data. Kiterman, writing about phonological acquisition of Russian and syllable reduction in three-syllable words with the last syllable stressed, says that if the first pre-stressed syllable has an approximant or a nasal as its onset, then this syllable is ‘dynamically weaker than the other unstressed syllable – the first one’ (Kiterman 1913:19). In the children studied in this work there occurred only four words reduced in this way. In all these words the second syllable contained a syllable-initial approximant/nasal: ‘kholodets’ /xɑlɑˈdʲet͡s/ ‘jellied meat’, ‘prinesi’ /prʲinʲiˈsʲi/ ‘bring’ (*Imper.*) (Anya); ‘moloko’ /mɑlɑˈko/ ‘milk’ (Philipp); ‘karandash’ /kɑrɑnˈdɑʃ/ ‘pencil’ (Lyuda).

In four-syllable words with the first syllable stressed, the most commonly used syllable reduction model in our data is omitting the second syllable and the fourth syllable. In four-syllable words with the second syllable stressed, the third syllable is most often omitted, but also the last syllable or the last two syllables can be deleted.

An interesting detail is that for some children (Natasha 1 and Philipp in our data) the first syllable of a word, irrespective of its sound structure and of whether it bears the lexical stress or not, is perceptually salient: e.g. ‘gul’at’’ /ɡuˈlʲɑtʲ/ ‘to walk’ is realized as /ɡu/, /kɑrˈtʲinkʲi/ – as /kɑ/, /xɑˈroʃɨj/ – as /xɑ/, /mɑˈʃɨnɑ/ – as /mɑsʲ/. We can then suggest that these children take it as a strategy to produce only the first syllable of a word in certain cases, as opposed to other children studied in this work.

These data show that in the acquisition of rhythmic patterns of words in Russian the stressed syllable and its position in word are very important. The fact that the children very rarely change the stress position confirms the literature claim that the stressed syllable is acquired very early, and that there are generally very few mistakes in choosing the syllable to stress. One more important factor determining the syllable deletion models used by children is the sound structure of words.

Conclusions

The acquisition of phonemes and phonological oppositions was analyzed. The data from the literature on the early acquisition of the vowel /ɑ/ and on the late acquisition of the vowel /ɨ/ were confirmed. The quantitative distribution of vowels in the children studied in this work also corresponds to the existing published data. The order of acquisition of consonants and the data on the quantitative distribution of consonants in children generally correspond to that described in the literature. However, the exact order of acquisition of phonemes and phonemic oppositions does not fully correspond to the literature, and most probably it always depends on the individual strategies adopted by children. It has also been shown in this work, contradictory to some existing data on the acquisition of labial consonants first, that the sound *k* can be important in early acquisition of Russian, both in terms of order of acquisition and in the quantitative distribution of consonants in children's speech.

The results of the analysis of the quantitative distribution of phonemes in children's speech show that palatalized consonants are very frequent in children's productions. This confirms the claim by Sikorskij about the 'overall softness of children's consonants', and it allows us to suggest that in the children's phonological system, as opposed to the adults' one, palatalized consonants may be unspecified. Experimental acoustic analysis conducted in this study shows that during the process of development of the consonantal opposition in palatalization there happens a transition from the 'overall softness' to the two opposed types of consonants.

The analysis of the acquisition of the syllable structure of words was made, and different strategies of syllable omission adopted by the children were illustrated. The ways of syllable reduction described in this study do not always and entirely correspond to the models described in the literature. The claim about 'trochaic bias' in early word production also fails to be confirmed by the data on the syllable omissions analyzed and presented in this work. The data demonstrate that the stressed syllable, its position in word and the sound structure of words are very important for the children in choosing the syllable reduction patterns.

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References

Allen, G.D. & S. Hawkins (1978). The development of phonological rhythm. Bell, A. & J.B. Hooper (eds.), *Syllables and segments*. North-Holland, Amsterdam, NY, Oxford, pp. 173-185.

Bates, S.A.R., J.M.M. Watson & J.M. Scobbie (2002). Context-dependent error patterns in disordered systems. Ball, M.J. & F.E. Gibbon (eds.), *Vowel disorders*. Butterworth Heinemann, London, pp. 145-185.

Beltukov, V.I. (1964). *Ob usvojenii det'mi zvukov rechi*. Prosveschenije, Moscow.

Bogoroditskij, V.A. (1939). *Ocherkii po jazykovedeniju i russkomu jazyku.* 4th edn. Gosudarstvennoje uchebno-pedagogicheskoje izdatelstvo, Moscow.

Bondarko, L.V. (1998). *Fonetika sovremennogo russkogo jazyka*. State University of St. Petersburg Press, St. Petersburg.

Bondarko, L.V., L.A. Verbitskaya & L.R. Zinder (1966). Akusticheskije harakteristiki bezudarnosti. V.V. Ivanov (ed.), *Strukturnaja tipologija jazykov*. Nauka, Moscow, pp. 56-64.

Boysson-Bardies, B. de. (1996). *Comment la parole vient aux enfants*. Odile Jacob, Paris.

Ceytlin, S.N. (ed.) (1994). *Rech russkogo rebenka: zvuchaschaja hrestomatija. B'ulleten' Foneticheskogo Fonda russkogo jazyka. Prilozhenije 4.* Christian Sappok / Liya V. Bondarko, St. Petersburg, Bochum.

Ceytlin, S.N. (ed.) (1997). *From zero to two: mothers' diaries*. Biont, St. Petersburg.

Davis, B.L. & P.F. MacNeilage (1995). The articulatory basis of babbling. *Journal of Speech and Hearing Research*. 38, pp. 1199-1211.

Dodd, B., A. Holm, Z. Hua & S. Crosbie (2003). Phonological development: a normative study of British English-speaking children. *Clinical Linguistics and Phonetics*. 17:8, pp. 617-643.

Eguchi, S. & I.J. Hirsh (1969). Development of speech sounds in children. *Acta Oto-Laryngologica*. Sup. 257, pp. 5-51.

Ferguson, C.A. (1979). Phonology as an individual access system: some data from language acquisition. In Fillmore, C.J., D. Kempler, & W.S.-Y. Wang (eds.), *Individual differences in language ability and language behavior*. Academic Press, New York.

Ferguson, C.A., L. Menn & C. Stoel-Gammon (eds.) (1992). *Phonological development: models, research, implications*. York Press, Timonium, Maryland.

Gerken, L.A. (1994). A metrical template account of children's weak syllable omissions from multisyllabic words. *Journal of Child Language*. 21, pp. 565-584.

Gvozdev, A.N. (1961). *Voprosy izyuchenija detskoj rechi*. Izdatelstvo akademii pedagogicheskih nauk RSFSR, Moscow.

Gvozdev, A.N. (1990). *Razvitije slovarnogo zapasa v pervyje gody zhizni rebenka*. Saratov University Press, Kujbyshev.

Jakobson, R. (1968). *Child Language, aphasia and phonological universals*. Mouton, The Hague.

Jusczyk, P.W. (1997). *The discovery of spoken language*. MIT Press, Cambridge, MA.

Jusczyk, P.W., A. Cutler & N.J. Redanz (1993). Infants' preference for the predominant stress patterns of English words. *Child Development*. 64, pp. 675-687.

Kiterman, B. (1913). Opyt izuchenija slogovoj elizii v detskom jazyke. *Russkij filologicheskij vestnik.* 69:1, pp. 65-83.

Kuznetsov, V.I. (1997). *Vokalizm svyaznoj rechi.* State University of St. Petersburg Press, St. Petersburg.

Levonevskij, A. (1914). *Moj rebenok. Nabl'udenija nad psihicheskim razvitijem mal'chika v techenije pervyh chetyreh let jego zhizni*. Izdanije O. Bogdanovoj, St. Petersburg.

Locke, J. (1983). *Phonological acquisition and change*. Academic Press, New York.

MacNeilage, P.F. (1999). *Acquisition of speech*. Hardcastle, W.J. & J. Laver (eds.), The handbook of phonetic sciences. Blackwell, Oxford, pp. 301-332.

MacWhinney, B. (1991). The CHILDES project: tools for analyzing talk. Hillsdale, New Jersey.

Oller, D.K. (1980). The emergence of the sounds of speech in infancy. Yeni-Komshian, G., J.F. Kavanagh & C.A. Ferguson (eds.), *Child phonology, 1: Production*. Academic Press, New York, pp. 93-112.

Peters, A. & L. Menn (1993). False starts and filler syllables: ways to learn grammatical morphemes. *Language*. 69, pp. 742-747.

Rybnikov, N.A. (1926). *Slovar' russkogo rebenka*. Gosudarstvennoje izdatel'stvo, Moscow, Leningrad.

Salakhova, A.D. (1973). *Razvitije zvukovoj storony rechi rebenka*. Pedagogika, Moscow.

Savinainen-Makkonen, T. (2001). Suomalainen lapsi fonologiaa omaksumassa. *Helsingin yliopiston fonetiikan laitoksen julkaisuja*. 42, pp. 1-83.

Shvachkin, N.H. (1948). Razvitije fonematicheskogo vosprijatija rechi v rannem vozraste. *Izvestija akademii pedagogicheskih nauk RSFSR*. 13, pp. 101-132.

Sikorskij, I.A. (1899). *Sbornik nauchno-literaturnyh statej po voprosam obschestv. psihologii, vospitanija i nervno-psihich. gigijeny. Part 2.* Ioganson Press, Kiev.

Stanchinskaya, E.I. (1924). *Dnevnik materi: istorija razvitija sovremennogo rebenka ot rozhdenija do 7 let.* Novaja Moskva, Moscow.

Tzakosta, M. (2004). Multiple parallel grammars in the acquisition of stress in Greek L1. PhD Diss., University of Leiden.

Vihman, M.M. (1996). *Phonological development: the origins of language in the child*. Blackwell, Cambridge, MA.

Vihman, M.M., R.A. DePaolis & B. Davis (1998). Is there a 'trochaic bias' in early word learning? Evidence from infant production in English and French. *Child Development*. 69:4, pp. 935-949.

Vihman, M.M. & L. McCune (1994). When is a word a word? *Journal of Child Language*. 21, pp. 517-542.

Vihman, M.M., S. Nakai, R.A. DePaolis & P. Hallé (2004). The role of accentual pattern in early lexical representation. *Journal of Memory and Language*. 50, pp. 336-353.

Vihman, M.M. & S.L. Velleman (2000). Phonetics and the origins of phonology. Burton-Roberts, N., P. Carr & G. Docherty (eds.), *Phonological knowledge*. Oxford University Press, Oxford, pp. 305-339.

Vojejkova, M.D. & Chistovich, I.A. (1994). Pervyje slova russkogo rebenka. *Bulletin of the Phonetic Database of Russian*. 5, pp. 94-112.

Zharkova, N. (2002). What role can suprasegmental information play in perception of children's speech? Paper presented at the Workshop on Temporal Integration in the Perception of Speech, Aix-en-Provence, April 2002.

Zharkova, N. (2002). Acquisition of the phonological system in child language: experimental phonetic research. MA thesis, Department of Phonetics, State University of St. Petersburg.

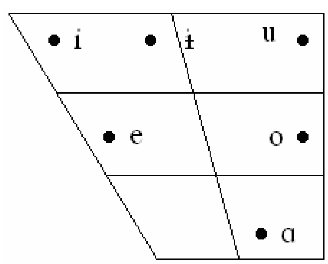
Appendix 1

Phonemic inventory of Russian.

Consonants

	Bilabial	Labioden-tal	Dental	Postalveo-lar	Palatal	Velar
Plosive	p b pʲ bʲ		t d tʲ dʲ			k g kʲ gʲ
Nasal	m mʲ		n nʲ			
Fricative		f v fʲ vʲ	s z sʲ zʲ	ʃ ʒ ʃʲː		x xʲ
Affricate			t͡s	t͡ʃʲ		
Trill			r rʲ			
Approxi-mant					j	
Lateral Approxi-mant			l lʲ			

Vowels



Appendix 2

1. Order of acquisition of consonants by the two girls (until the age 2;0).

Natasha 1: *k b n d j tʲ m dʲ nʲ t sʲ zʲ mʲ pʲ x fʲ v bʲ g s p xʲ gʲ kʲ ʃ t͡ʃʲ l vʲ lʲ z f ʒ r*

Natasha 2: *k g n m t b tʲ s p v dʲ sʲ nʲ zʲ j x bʲ lʲ r mʲ rʲ kʲ pʲ gʲ vʲ f fʲ ʒ*

2. Frequency of occurrence of consonant phonemes in speech (Philipp and Lyuda) and in vocabularies (Natasha 1 and Natasha 2), in descending order. Percentages are given for relative frequencies (to two decimal points).

Philipp 1; 9			Natasha 1 2;0			Natasha 2 2;0			Lyuda 3;0		
	Frequency			Frequency			Frequency			Frequency	
	Abs.	Rel.		Abs.	Rel.		Abs.	Rel.		Abs.	Rel.
t^j	230	14.7	t	36	12.0	k	106	17.0	k	135	14.0
k	214	13.7	m	27	9.00	s^j	78	13.0	t^j	110	11.0
s^j	214	13.7	k	21	7.00	j	72	12.0	d^j	84	9.00
m	111	7.10	t^j	18	6.00	t^j	64	11.0	n^j	76	8.00
p	83	5.30	n^j	18	6.00	t	36	6.00	t	69	7.00
j	77	4.90	j	16	5.35	b	29	5.00	j	66	7.00
l^j	67	4.30	d	15	5.00	p	25	4.00	p	51	5.00
t	66	4.20	n	15	5.00	m	20	3.30	b	45	5.00
n^j	61	3.80	s^j	13	4.35	n	20	3.30	m	43	4.00
d^j	50	3.10	p	12	4.00	d^j	19	3.13	n	43	4.00
k^j	47	3.00	d^j	12	4.00	g	17	2.8	k^j	39	4.00
n	42	2.70	ʃ	12	4.00	k^j	15	2.50	l^j	35	4.00
ʃ	35	2.20	g	11	3.68	z^j	13	2.14	d	31	3.00
b	32	2.00	v	10	3.30	d	12	1.97	z^j	28	3.00
m^j	30	1.90	x	9	3.00	l^j	11	1.81	p^j	21	2.00
v	26	1.70	$\widehat{t^jʃ^j}$	9	3.00	s	9	1.50	v	20	2.00
d	24	1.50	s	8	2.68	n^j	8	1.32	m^j	15	1.60
x	24	1.50	b	5	1.67	r^j	8	1.32	g	13	1.30
p^j	17	1.00	z^j	4	1.30	m^j	7	1.15	b^j	11	1.10
$\widehat{t^jʃ^j}$	16	1.00	k^j	3	1.00	v	7	1.15	v^j	8	0.80
z^j	14	0.90	b^j	3	1.00	x	7	1.15	l	7	0.70
f	14	0.90	m^j	3	1.00	b^j	6	1.00	g^j	5	0.60
f^j	14	0.90	l	3	1.00	p^j	5	0.82	s^j	4	0.40
b^j	13	0.80	l^j	3	1.00	g^j	4	0.66	f	3	0.30
s	10	0.60	p^j	2	0.63	r	4	0.66	s	3	0.30
$ʃ^j$:	10	0.60	g^j	2	0.63	v^j	2	0.33	ʃ	2	0.20
g	7	0.40	x^j	2	0.63	f^j	2	0.33	r^j	2	0.20
g^j	4	0.30	ʒ	2	0.63	f	1	0.16	x	2	0.20
ʒ	4	0.30	r	1	0.30	z	1	0.16	ʒ	1	0.10
l	4	0.30	f	1	0.30						
v^j	2	0.10	z	1	0.30						
z	2	0.10	v^j	1	0.30						
c	1	0.06	f^j	1	0.30						
r	1	0.06									
r^j	1	0.06									

Title: Strategies in the acquisition of segments and syllables in Russian-speaking children

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