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**REALIZATION OF RUSSIAN CONSONANTS
IN 3-YEAR-OLDS SPEECH
РЕАЛИЗАЦИЯ СОГЛАСНЫХ РУССКОГО ЯЗЫКА
В РЕЧИ ДЕТЕЙ ТРЁХ ЛЕТ**

Abstract

This paper presents an empirical study of errors of various types committed in consonant realization by 20 Russian male and female 3-year-olds. We aimed at ranging Russian consonants according to the difficulty of their articulation focusing on common error tendencies and idiosyncratic error features. The results of the acoustic study of phoneme opposition phonetic manifestation showed that /r/, /rj/, /l/, /li/, /ʃ/, /ʃj/, /z/, /tʃ/ were the most difficult for 3-year-olds performance. A further finding was high across-speaker variability in the studied age group as far as the level of native language acquisition. Coronals and some labials, but not velars, were consistently palatalized. Doubly articulated /ʃj/, /ʃ/, /z/, /tʃ/ underwent [sʲ], [s], [zʲ], [z] and [tʃʲ] fronting. Realization of certain consonant clusters involved reduction and a number of errors found for single consonants including gliding, fronting, and palatalizing.

Аннотация

В настоящей статье представлены результаты эмпирического исследования различных ошибок при реализации согласных, совершённых двадцатью русскими детьми, обоих полов, в возрасте трёх лет. Нашей целью было ранжировать согласные в соответствии с трудностями их артикуляции, фокусируясь на общих тенденциях и особенностях в реализации ошибок. Результаты акустического исследования показали, что фонемы /r/, /rj/, /l/, /li/, /ʃ/, /ʃj/, /z/, /tʃ/ оказались самыми трудными для детей трёх лет. Следующий вывод был сделан о высокой вариантности при овладении родным языком в изучаемой

возрастной группе. Апикальные согласные и некоторые губные, но не велярные, регулярно подвергались палатализации. Фонемы /ʃ/, /f/, /z/, /tʃ/ заменялись на [sʲ], [s], [zʲ], [z] и [tsʲ]. При реализации некоторых согласных кластеров отмечалось их сокращение, а также ошибки были обнаружены для единичных согласных, включая скольжение, продвижение вперед и палатализацию.

Keywords: language acquisition, consonant system, «normal» errors, palatalization, gliding, fronting, reduction.

Ключевые слова: овладение языком, система согласных, «нормальные» ошибки, палатализация, скольжение, продвижение вперед, сокращение.

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1. Introduction

Phonological development of early language learners is a long-standing issue in phonology. A considerable amount of study was performed by American, British, and Australian researchers focusing on both normal development and phonological disorders [Sander, 1972 ; Kilminster & Laird, 1978 ; Chirlian & Sharpley, 1982 ; Grunwell, 1987 ; Stoel-Gammon, 1987 ; Smit et al., 1990; Smit, 1993 ; Robb & Bleile, 1994 ; Shriberg, Kwiatkowski & Gruber, 1994 ; Dodd, 1995 ; Watson, & Scukanec, 1997 ; Selby, Robb & Gilbert, 2000 ; McLeod, van Doorn & Reed, 2001 a, b ; James, van Doorn & McLeod, 2001 ; Donegan, 2002]. Other languages were also studied but with less attention to phonological issue: Arabic [Amayreh & Dyson, 1998]; Cantonese [So & Dodd, 1995]; German [Fox & Dodd, 1999]; Danish [Bloch, 1996] Italian [Bortolini & Leonard, 1991]; Portuguese [Yavas, 1998]; Putonghua (Mandarin) [So & Jing, 1998]; Spanish [Jimenez, 1987]; Turkish [Kopkalli-Yavuz & Topbas, 1998; Xhosa – Mowrer & Burger, 1991].

Many scientists studied Russian child's speech acquisition: Shvachkin [Shvachkin, 1948], Zhinkin [Zhinkin, 1958], Leont'ev [Leont'ev, 1965], Slobin [Slobin, 1966], Salahova [Salahova, 1972], Nosikov [Nosikov, 1985], Sikorskiy [Sikorskiy, 1881], Lyakso [Lyakso et al 2017]. However, a child's acquisition of Russian phonology was explored by a limited number of linguists with the data primarily based on diary studies of 1 child speech: Gvozdev [Gvozdev 1927, 1948], Timm [Timm, 1976], and Eliseeva [Eliseeva, 2014]. Such data are now partly available in the CHILDES corpus. Gvozdev, Timm and Eliseeva provided a general description of sound production whereas the main emphases of Vinarskaya and Bogomazov's research was on syllabification [Vinarskaya and Bogomazov, 2005].

Research on language acquisition suggests that early phonological development has some common tendencies in different linguistic environments [Ingram, 2007 ; Liljencrants and Lindblom, 1972 ; Stevens, 1989].

This research is largely inspired by those studies, and it aims to extend the research on Russian speech ontogenesis further with more emphasis on ranging

the consonants according to the difficulty of their articulation and on common consonant error tendencies as opposed to idiosyncratic consonant error features bases on the data received from 20 subjects of the same age. That will enable to describe variability patterns not only within but across children. Before focusing on the subjects consonant performance, a brief review of the Russian consonant system is needed.

1.1. Peculiarities of Russian consonant system

Russian is a dominant language on the territory of the Russian Federation including the Far East of Russia. As noted by Bondarko, the consonant system of Russian language presents the opposition of «hard» vs. «soft» [Bondarko, 2005]. There are thirty-six consonants, and the majority of them are involved in this opposition. All labials are involved in the opposition, e.g. /p – pʲ/ as in *palʲtsy-pʲalʲtsy*, /b – bʲ/ as in *truba-trubʲa*, /f – fʲ/ as in *grafa-grafʲa*. Coronals are contrasted by this feature, e.g. /t – tʲ/ as in *kota-kotʲata*, /d – dʲ/ as in *doma – Dʲoma*, /s – sʲ/ as in *sok-sʲok*, /z – zʲ/ as in *groza-grozʲa*, /n – nʲ/ as in *nos-nʲos*, /l – lʲ/ as in *klon-klʲon*, /r – rʲ/ as in *pravʲyj-prʲamo*. Coronal affricates (as in *tsepkij – tcheptchik*) can also be considered as opposing each other as hard vs. soft, although unlike the ones listed before, this particular opposition is not privative. There also exists a long soft coronal consonant which claims phonemic status, i.e. /ʃ:/ as in *shchʲotka*. Consonants /ʃ/ and /ʒ/ are not involved in this opposition having no soft pairs. Velar consonants have such opposition, although not all researchers accept the fact that velar palatalized consonants are actual phonemes, e.g. /k – kʲ/ as in *kot – tkʲot*, /g – gʲ/ as in *berega – beregʲa*, /h – hʲ/ as in *Hempshyr – heres – xeris*. Many researchers doubt that the hard-soft opposition is as significant for velar consonants as it is for the others, as there are few occasions of soft velar consonants before back vowels (loan words). Soft consonants can occur in any word position: word-initially (in *sʲadu*), medially (in *otsʲuda*), and word-finally (in *vesʲ*). They may precede both vowels and consonants, e.g. *bolʲno, mʲenʲshe*.

A few other peculiarities should be added. First, Russian forelingual consonants are dorsal (not apical-alveolar) with the tip of the tongue lowered and moved towards the upper teeth. Second, «voiceless-voiced» opposition is based primarily on F0 contrast (absent or present) unlike, for instance, in English where it is based more on «fortis-lenis» feature. Therefore, F0 loss leads to phonological substitute of the voiced with the voiceless.

1.2. «Normal» errors in Russian young children speech

It was shown that early learners, due to immaturity of their vocal apparatus, have certain mispronunciations (in other words, distortion in performance or malperformance) that can be classified as normal deviations from adults patterns including place of articulation, stopping, fronting, gliding, vocalization, vowel neutralization, consonant harmony, progressive vowel assimilation, voicing, palatalizing, homophony.

Eliseeva reports that there are mistakes typical for normal language development of children [Eliseeva, 2008]. It is acceptable for 2–3-year-olds to have: palatalizing, assimilation; syllable elision; consonant cluster reduction; single consonant elision: /ts/, /tʃ/, /ʃ/, /ʒ/, /ʃʲ/, /r/, /rʲ/, /l/, /lʲ/ (to 3 years); metathesis. Up to the age of 6,5 children demonstrate much less variety of those «normal» errors with /ʃ/ remaining the most difficult [Lyakso et al., 2017]. These «normal» errors often lead to phoneme substitutes.

Palatalizing is often mentioned as a universal feature of child-language-acquisition process in the early age. Jakobson [Jakobson, 1980] calls it the initial inclination of children to palatalize dentals that possess distinct lightness; palatalization (i.e. flattening of the resonating area) intensifies distinct lightness of a consonant. Jakobson notes that children speaking a certain language abandon palatalized consonants early if there are no palatalized consonants in the corresponding linguistic model (e.g. in French) and, on the contrary, children cling to the palatalization more obstinately and consistently if the linguistic model of the language has hard-soft (non-palatalized vs palatalized) opposition (e.g. in Russian, Polish, and Japanese).

Gvozdev [Gvozdev, 1961] and Eliseeva [Eliseeva, 2013], studying Russian language acquisition of their own children, noted that at the age of 3 Russian children have hard-for-soft substitutes quite often. Eliseeva [Eliseeva, 2008] gives the following examples show phoneme substitutes and cases of metathesis:

1) typical substitutes: /r/→/l/ or /j/, /tʃ/→/tʲ/ or /sʲ/, /ʃ/→/sʲ/ or /s/, /ʒ/→/zʲ/ or /z/, /ts/→/tʲ/, /l/→/j/ e.g. *ruka* «hand» – *luka, juka*; *čaj* «tea» – *tyaj, syaj*; *shuba* «fur coat» – *syuba / suba*; *zhuk* «beetle» – *zyuk / zuk*; *tsirk* «circus» – *tijk*; *luk* «onion» – *juk*;

2) untypical substitutes: *ne hochu* «don't want» – *ni fasu, homyachok* «hamster» – *samatyak, gulyati* «walk» – *giyati*;

3) metathesis: *zajka* «bunny» – *kazyaj*; *petuh* «rooster» – *tipuh, paketik* «bag» – *kapetik*.

Tseitlin et al. mentioned that those errors as a result of underdeveloped articulation ability cause child homophony [Tseitlin et al. 2001, p. 58].

We hypothesize the following:

(i) consonants /r/, /rʲ/, /l/, /lʲ/, /ʃ/, /ʃʲ/, /ʒ/, /tʃ/ would be the most difficult for Russian 3-year-olds' pronunciation with the largest amount of «normal» mistakes; we do not expect consonant /ts/ to be most difficult for articulation compared to the mentioned phonemes;

(ii) massive palatalizing is expected leading to hard-for-soft phoneme substitutes, and it is expected to go beyond coronals;

(iii) the use of metathesis is expected although its amount does not seem clear at the point.

To prove the hypothesis an acoustic study was performed.

2. Method

The study included twenty native speakers of Russian (Ch1–Ch20) from two kindergartens in Blagoveshchensk (Far East of the Russian Federation) aged

from three years and one month to three years and three months old ($M_{age} = 3.2$ years), 8 boys and 12 girls. Table 1 summarizes the participant data on the two characteristics. Children were born in Blagoveshchensk and their parents were monolingual. The parents were given an information letter, containing the study objectives and ensuring confidentiality. Out of 26 parents who received our letter, 20 agreed to let their children participate in this research.

Table 1. Participant information concerning gender (f – female, m – male) and age (years:months)

Subject	Gender	Age at the time of recording	Subject	Gender	Age at the time of recording
Ch1	F	3:3	Ch11	f	3:3
Ch2	M	3:3	Ch12	m	3:2
Ch3	F	3:2	Ch13	m	3:1
Ch4	F	3:3	Ch14	f	3:3
Ch5	M	3:3	Ch15	f	3:1
Ch6	M	3:2	Ch16	f	3:2
Ch7	F	3:3	Ch17	m	3:3
Ch8	F	3:1	Ch18	f	3:1
Ch9	F	3:2	Ch19	f	3:3
Ch10	M	3:2	Ch20	m	3:3

Children's physical health was evaluated by the doctors who filled out medical records for the two kindergartens. The purpose of this assessment was to identify children with neurological, mental and phonetic disorders and exclude them from the research.

2.1. Corpus

For analyzing phonological acquisition, we used a method of minimal pairs first described and used by Trubetzkoy [Trubetzkoy, 1939]. 126 words that formed 63 word pairs, containing all Russian phonemes, were chosen for this study. Some phoneme oppositions were illustrated only by one word-pair while others – by several word-pairs. This imbalance is explained by two reasons: first, natural limitations on quasi-homonyms that exist in Russian, second, different levels of difficulty in phonemic pattern acquisition. Having clear understanding that some sounds are more difficult to pronounce at the targeted age than the other ones, we used several pairs containing more difficult phoneme oppositions. Thus, Russian children around the age of three are not good at pronouncing hard /ʃ/ and /z/ [Gvozdev, 1947; Eliseeva, 2014]. Therefore, we used two pairs containing this phoneme opposition: shar – zhar and Sasha – sazha.

Words used in the current study, were grouped mainly according to the correlative pairs of phonemes. The transliteration of the orthographic form is given on the left, and the translation is given on the right (see Table 2).

Table 2. Word arrangement for the experiment

#	Stimuli	English translation
1	/p/-/b/ in: papa – baba	father – baba
2	/pi/-/bi/ in: pil – bil	drank – beat
3	/f/-/v/ in: faza – vaza, sova – sofa	phase – a vase, owl – sofa
4	/f/-/vi/ in: fint – vint	trick – screw
5	/l/-/v/ in: losk – vosk	polish – wax
6	/li/-/vi/ in: les – ves	forest – weight
7	/l/- /li/ in: el – elj, Yulya – yula, luk – lyuk	ate – spruce, Yulya – whirligig, onion – hatch
8	/l/-/j/ in: stol – stoy, galka – gayka	table – simple, jackdaw – nut
9	/m/-/mi/ in: mishka – myshka, mylo – Mila	bear – mouse, soaps – Mila
10	/ni/-/li/ in: nik – lik	nickname – front
11	/mi/-/si/ in: mig – sig	moment – whitefish
12	/si/-/zi/ in: siyatj – ziyatj	shine – gape
13	/si/-/bi/ in: sila – bila	force – beat
14	/n/-/m/ in: nytj – mytj	whine – wash
15	/hi/-/ki/ in: hit – kit	hit – whale
16	/h/-/s/ in: halat – salat	robe – salad
17	/r/-/l/ in: rozhki – lozhki, rak – lak, ukor – ukol	pasta – spoons, cancer – lacquer, reproach – injection
18	/ri/-/li/ in: zharitj – zhalitj, Rim – Lim	fry – sting, Rome – Lim
19	/ri/-/pi/ in: redjka – Petjka	radish – Petjka
20	/r/-/li/ in: shar – shalj, sor – solj	balloon – shawl, rubbish – salt
21	/r/-/j/ in: marka – mayka	stamp – shirt
22	/s/-/ʃ/ in: sok – shok, miska – mishka	juice – shock, bowl – bear
23	/s/-/ʃ/ in: pisatj – pishchyatj, plyus – plyushch	write – squeak, plus – ivy
24	/s/-/z/ in: sup – zub, sayka – zayka, kosa – koza	soup – tooth, roll – hare, spit – goat
25	/s/-/ts/ in: svet – tsvet, u lisa – litsa	light – color, with a fox – faces
26	/s/-/tʃ/ in: sayka – chayka, nos – noch	roll – seagull, nose – night
27	/s/-/ʒ/ in: suk – zhuk, syr – zhyr	branch – beetle, cheese – fat

Continuation of Table 2

#	Stimuli	English translation
28	/z/-/ʒ/ in: roza – rozha, luza – luzha	rose – face, pocket – puddle
29	/ʃ/-/ʒ/ in: shar – zhar, shitj – zhitj, Sasha – sazha	fever – ball, sew – live, Sasha – soot
30	/tʃ/-/ʃ/: kochka – koshka, noch – nozh	bump – cat, night – knife
31	/tʃ/-/ʃ/ in: chjolka – shchjolka, plach – plashch	bang – slot, cry – raincoat
32	/tʃ/-/ti/: vecher – veter, mech – medj, plechi – pleti	evening – wind, sword – copper, shoulders – whip
33	/t/-/d/ in: tush – dush, trava – drova, tochka – dochka	grass – firewood, dot – daughter, mascara – shower
34	/ti/-/di/ in: telo – delo, Tima – Dima	body – business, Tima – Dima
35	/k/-/g/ in: kolos – golos, kaljka – galjka	ear – voice, tracing paper – pebble
36	/ki/-/gi/ in: kit – gid	whale – guide

2.2. Procedure

The research was conducted in two public kindergartens, selected randomly from the list of kindergartens located in Blagoveshchensk. The children were recorded in a quiet room in their kindergartens, one by one. To encourage children to pronounce the words the interviewer showed each child a set of pictures pair by pair and said what was drawn on each of them and asked to repeat the words after the interviewer. Initially it was planned to make children repeat each word three times. However, this task often discouraged the children from articulating at all. Therefore, we tried to possibly limit the amount of repetitions and did not ask the child to repeat if the word was pronounced correctly. Otherwise, we mildly insisted at least on the second repetition and if we could manage it – the third one. As a result we obtained 3942 words: 1409 words repeated 1 time, 800 words repeated 2 times, and 311 words repeated 3 times.

The speech samples were recorded on a Samsung YP – VP1AB dictaphone. During the recording session, the dictaphone was placed in front of the child while he/she was looking at the pictures. Acoustic study was performed in Praat [Boersma, 2016]. Three – level annotation was performed (see fig. 1): 1) word level, where each word was spelled using transliteration technique; 2) target phoneme level with canonical transcription; 3) allophone level with marked allophone boundaries and detailed transcription for which the International Phonetic Alphabet (IPA) was used (consonant and vowel symbols as well as diacritics).

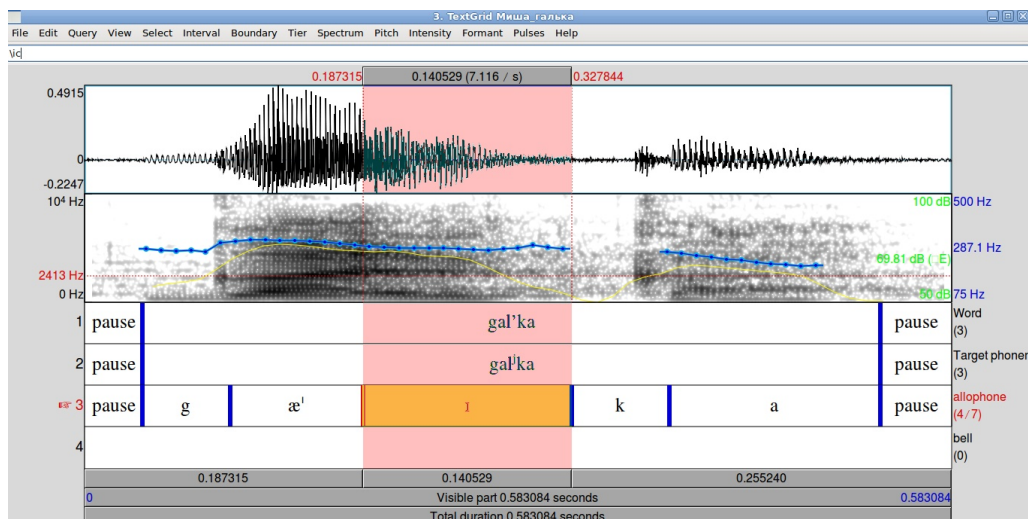


Figure 1. Annotation sample

3. Results

3.1. Phoneme oppositions in quasi-homonyms

Table 3 shows the participants' percent correct discrimination scores.

Table 3. The amount of correct answers (%)

#	Phoneme pairs	%	#	Phoneme pairs	%
1	/p/–/b/	100	19	/rʲ/–/pʲ/	10
2	/pʲ/–/bʲ/	100	20	/r/–/lʲ/	7.5
3	/f/–/v/	90	21	/r/–/j/	10
4	/fʲ/–/vʲ/	85	22	/s/–/ʃ/	10
5	/l/–/v/	80	23	/s/–/ʃʲ/	20
6	/lʲ/–/vʲ/	75	24	/s/–/z/	30
7	/l/–/lʲ/	80	25	/s/–/ts/	62
8	/l/–/j/	51.5	26	/s/–/tʃ/	60
9	/m/–/mʲ/	80	27	/s/–/ʒ/	60
10	/nʲ/–/lʲ/	90	28	/z/–/ʒ/	10
11	/mʲ/–/sʲ/	90	29	/ʃ/–/ʒ/	10
12	/sʲ/–/bʲ/	90	30	/tʃ/–/ʃ/	11.5
13	/sʲ/–/zʲ/	90	31	/tʃ/–/ʃʲ/	27.5
14	/n/–/m/	80	32	/tʃ/–/tʲ/	27.5
15	/hʲ/–/kʲ/	75	33	/t/–/d/	100
16	/h/–/s/	75	34	/tʲ/–/dʲ/	100
17	/r/–/l/	75	35	/k/–/g/	90
18	/rʲ/–/lʲ/	11.5	36	/kʲ/–/gʲ/	90

The obtained results were grouped according to discriminability of the consonants opposed. Group 1 was comprised of phonemic oppositions with high discriminability (100–75%), Group 2 – medium discriminability (74–50%), and Group 3 – low discriminability (less than 50%).

19 out of 35 phonemic oppositions turned out in Group 1. 5 of them accounted for 100% (four pairs of hard and soft labial and dental stops: /p/–/b/, /pʲ/–/bʲ/, /t/–/d/, /tʲ/–/dʲ/ and a pair of soft labio-dental fricatives /f/–/vʲ/). 2 oppositions of hard and soft velar stops /k/–/g/ and /kʲ/–/gʲ/ were correctly performed by 90% of the subjects (10% account for voiceless substitutes /g/→/k/ in *golos* «voice» [kolas]) and /gʲ/→/kʲ/ in *gid* «guide» [kit]). Discriminability percent of soft pairs and hard pair was the same except for labio-dental ones. There was a 5% drop of discriminability in soft /fʲ/–/vʲ/ compared to hard /f/–/v/. Substitutes were noticed only for /f/: /h/ (*sofa* «sofa» [saha]), /p/ (*faza* «phase» [paza]), /s/ (*faza* «phase» [sasa] presenting a reduplication case).

The oppositions of soft /nʲ/–/lʲ/, /mʲ/–/sʲ/, /sʲ/–/bʲ/, /sʲ/–/zʲ/ accounted for 90% of correct pronunciation. Hard and soft /l/–/lʲ/, /m/–/mʲ/, as well as hard /n/–/m/ were characterized by 80% discriminability. Soft /lʲ/–/vʲ/, /hʲ/–/kʲ/ and hard /h/–/s/, /r/–/l/ accounted for 75% discriminability. Examples of palatalizing and substitutes are given in section 3.1.1. and 3.2.

Only three out of thirty five phonemic oppositions were assigned to Group 2: /s/–/ts/ (62%), /s/–/tʃ/ (60%) and /l/–/j/ (51.5%). Substitutes are described in section 3.2.

Twelve out of thirty five phonemic oppositions turned out in Group 3 with 30% for /s/–/z/, 27.5% for each of /tʃ/–/ʃ/ and /tʃ/–/tʲ/, 20% for /s/–/ʃ/, 11.5% for /tʃ/–/ʃ/. There was a 4% discriminability drop in /r/–/lʲ/ (7.5%) compared to /rʲ/–/lʲ/ (11.5 %). Oppositions /r/–/j/, /r/–/jʲ/, /rʲ/–/pʲ/ /s/–/ʃ/, /z/–/ʒ/, /ʃ/–/ʒ/, /tʃ/–/ʃ/ were characterized by 10% discriminability (substitutes are described in section 3.2). These results prove our first hypothesis about /r/, /rʲ/, /l/, /lʲ/, /ʃ/, /ʃʲ/, /ʒ/, /tʃ/ being the most difficult for 3-year-olds pronunciation. Low discriminability of /s/–/z/, however was unexpected.

We used Pearson correlation matrix to observe common correctly performed patterns and common errors in 35 oppositions by the 20 subjects. The results indicate that only 2 subjects out of 20 demonstrated very close correlation (0,85), thus revealing similar tendencies in the amount of correctly realized oppositions and types of errors. 14 children demonstrated close correlation ($\geq 0,5$) forming the following 10 pairs (Ch1-Ch10, Ch2-Ch13, Ch2-Ch-19, Ch5-Ch-16, Ch6-Ch7, Ch8-Ch16, Ch10-Ch16, Ch11-Ch14, Ch14-Ch16). Other pairs demonstrated weak correlation (0,5-0,25) or no correlation what so ever ($< 0,25$). No group of the subjects with close correlation could be formed. Such results illustrate high across-speaker variability of the studied age group as far as the level of native language acquisition.

3.1.1. Palatalizing

As expected, palatalizing caused hard-for-soft phoneme substitutes with coronal consonants taking the lead.

Hard lateral approximant /l/ was replaced with its soft pair /lʲ/ by seven subjects word-initially and by one subject word-internally (e.g. *luk* «onion» [lʲuk], *telo* «body» [telʲæ]). Phoneme /l/ was also substituted with soft voiced labio-dental fricative /vʲ/ by two subjects: [vʲosk] for *losk* «polish» (the relevant feature of «sonorant» being lost).

Hard voiceless /f/ was replaced due to fronting and palatalizing with soft fricative /sʲ/ by three subjects word-initially (e.g. *shok* «shok» [sʲok]), by one subject word-internally (e.g. *koshka* «cat» [kosʲka]), and one – word-finally (e.g. *tush* «mascara» [tusʲ]).

Hard voiced /z/ underwent fronting and palatalizing as well – /zʲ/ was used by four subjects word-initially (e.g. *zhuk* «beetle» [zʲuk]) and by two subjects word-medially (e.g. *luzha* «puddle» [luzʲa]).

Hard /s/ was consistently substituted with its soft pair /sʲ/ by fifteen children out of twenty: *vosk* «wax» [losʲk], *suk* «bough» [sʲok] etc. Three subjects used this substitute in [sv]– cluster: [sʲet] or [tsʲet] for *svet* «light». The same tendency was noticed for hard voiced fricative /z/ with the same subjects: *roza* «rose» [rozʲæ], *koza* «goat» [kazʲæ], *zub* «tooth» [zʲup] etc.

Affricate /ts/ was palatalized to [tsʲ] by four subjects: [tsʲet] for *tsvet* «light». Unlike the above cases that lead to phoneme change, this one stays within allophonic variation pattern of /ts/ that has no soft pair in the Russian consonant system.

Among the forelinguals, /t/, /d/, /r/ had only single palatalization cases by one subject: *fit* «trick» [fitʲ], *vint* «screw» [vitʲ]; *gid* «guide» [gitʲ]; *rozha* «face, muzzle» [lʲoza].

As expected, palatalizing of labials was present, however, it turned out much less frequent than that of dentals. It involved single /m/ and /p/ in [plʲ]–cluster. /m/→/mʲ/ was observed in [mʲila] for *mylo* «soap» (three subjects), [mʲiska] for *myshka* «mouse» (seven subjects). As seen from the examples, the process was accompanied by vowel change /i/→/i/ caused by defective distribution of /i/ that is used only after hard consonants and as the Russian letter «И». [p]→[pʲ] was observed in *plechi* «shoulders» [pʲjetʲi], *pljus* «plus» [pʲus], *pljushch* «plus» [pʲuʃʲ] for two subjects. Another unexpected result was no palatalizing of velar consonants.

3.2. Single consonants and consonant clusters most difficult for pronunciation

3.2.1. Single consonants

There were certain single consonant phonemes particularly difficult for pronunciation. Post vocal trill and lateral approximant were among them. As expected, phoneme /r/ (hard trill) was most difficult to pronounce and therefore, most frequently replaced – by 16 subjects. Thus, eight subjects out of twenty substituted it with hard lateral /l/. Ex.: *rozhki* «pasta» [lozki]; *rak* «cancer» [lak] etc. Five subjects replaced /r/ with the palatal glide /j/: *rozhki* «pasta» [joʃki], *rak* «cancer» [jak], *ukor* «reproach» [ukoj]. Three children used [ʷ]-gliding instead of /r/: *rozhki* «pasta» [ʷofki], [ʷoʃki], *rak* «cancer» [ʷak]. Post-vocal /r/

could be substituted with [w]-glide as well. This tendency of gliding both word-initially and word-finally was noticed with three subjects (e.g. *ukor* «reproach» [uko^w], *roza* «rose» [woza]), and it might be considered common as it partly (only word-initially) corresponds with the same gliding tendency for the English language acquisition (see e.g. McLeod (2001 a, b), Dodd et al. (1995)).

/l/ and /li/ were substituted by many subjects. Five children consistently used glide [j] instead of both approximants in different word positions: *telo* «body» [tejæ], *ukol* «injection» [ukoj], *losk* «polish» [josk] etc. Four subjects always replaced /l/ with hard fricative labio-dental /v/ word initially: *lozhki* «spoons» [voski], *lak* «lacquer» [vak], *losk* «polish» [vasj]. Post-vocal hard approximant /l/ as well as post-vocal hard trill /r/ mentioned above could be substituted with [ʊ]-vowel e.g. *ukol* «injection» [ukou]. This tendency of word-internal and word-final vocalizing was noticed with the same three subjects who vocalized /r/.

Single /r/, /l/ and /li/ were deleted, however, their deletion was less frequent than their substitution with other phonemes. The most frequent was /r/ and /li/ deletion – 28 instances with 9 subjects and 36 instances with 10 subjects correspondingly. Hard /l/ deletion was less frequent with only 8 instances and six subjects involved. Deletion occurred in all word positions but more often word-medially. There were a few occasion of /vʹ/, /v/, /k/ deletion (3, 2, and 2 subjects correspondingly). Other single consonants were not deleted.

Another group that presented considerable difficulty comprised palatal hard and soft fricatives and affricate /ʃ/, /ʒ/, /ʒ/ /tʃ/. They consistently underwent fronting. Soft voiceless doubly-articulated fricative /ʃ/ was among most frequently replaced mainly by /sʲ/: word-initially – [sʲolka] for *shchjelka* «slot» (eleven subjects), word-medially – [pisʲætʲ] for *pishchatj* «cheep» (ten subjects), word-finally – [plasʲ] for *plashch* «raincoat» (eight subjects). /ʃ/ was replaced with [tsʲ] only by one subject: [tsʲolka] for *shchjelka* «slot».

Hard doubly-articulated /ʃ/ was among most frequently replaced as well. Thus, eleven children replaced it with hard fricative dental /s/: word-initially (*shok* «shok» [sok], *sova* «owl» [ʃava]) and word-finally (*tush* «mascara» [tus], *dush* «shower» [dus]). /ʃ/ was also replaced with soft fricative /sʲ/ by three subjects word-initially (e.g. *shok* «shok» [sʲok], *shalj* «shaw» [sʲæl]). Two subjects pronounced fricative labial /f/ word-final instead of /ʃ/: *tush* «mascara» [tuf], *dush* «shower» [duf].

Hard doubly-articulated voiced /ʒ/ was substituted with different phonemes. Mainly it was fronting. Fronting «/z/ type» occurred word-initially in *zhuk* «beetle» [zuk], *zhir* «fat» [zʲil] across ten subjects. Fronting «/zʲ/ type» was produced by four subjects word-initially (e.g. *zhuk* «beetle» [zʲuk], *zhir* «fat» [zʲil], *zharitj* «fry» [zʲæitj]) and by two subjects word-medially (e.g. *luzha* «puddle» [luzʲa], *rozha* «face» [jozʲæ]). Four children consistently produced fronting «/s/ type» both word-initially and word-finally: *zhuk* «beetle» [suk], *nozha* «knife» [nos].

Palatal soft affricate /tʃ/ was consistently substituted with coronal palatalized allophone [tsʲ] of hard affricate /ts/ (that has no soft pair) by nine

subjects word-initially (e.g. *chaika* «seagull» [tsʲaika], *chjelka* «bang» [tsʲelka]), by nine subjects word-medially (e.g. *tochka* «dot» [totsʲka], *dochka* «daughter» [dotsʲka]; *kochka* «bump» [kotsʲka]), and by thirteen subjects word-finally (e.g. *noch* «night» [nosʲ], *mech* «sword» [metsʲ], *plach* «cry» [platsʲ]). /tʃ/ was replaced with /sʲ/ by two subjects: [nosʲ] for *noch* «night», [sʲaika] for *chaika* «seagull».

Other phonemes were substituted considerably less.

3.2.2. Consonant clusters

Another difficulty for our subjects was consonant clusters. Fourteen clusters were involved in the current experiment: [tr], [dr], [sv], [tʃk], [tsv], [rk], [plʲ], [pl], [lk], [ʃk], [nt], [jk]. Among them, word-initial consonant clusters [tr], [dr] [pl] [sv] were reduced to a single consonant in *trava* «grass» [tava], *drova* «firewood» [dava], *plach* «cry» [patʃ], *svet* «light» [sʲet]. Word-final [nt] was reduced to hard stop /t/ in *fint* «trick» [fit] and *vint* «screw» [vit] by six subjects. Three subjects reduced it to /n/ and the other three substituted it with soft stop /tʲ/: *fint* «trick» [fin], [fitʲ], *vint* «screw» [vin], [vitʲ].

No elements were omitted in the remaining clusters, however, the target cluster elements were consistently substituted with other phonemes: [plʲ]→[pʲj] in *plechi* «shoulders» [pʲjetʲi], [tsv]→[sʲj] in *tsvet* «color» [sʲjet], [sv]→[sʲj] in *svet* «light» [sʲjet], [ʃk]→[sk] in *loshki* «spoons» [loski].

Word-medial cluster [ʃk] had four substitutes: [ʃk]→[sk], in *rozunki* «pasta» [loski], [vaski], [roski] (ten subjects), [ʃk]→[fk] in [lofki], [jofki] (two subjects). Word-medial [tʃk] was substituted with [tsʲk] in *tochka* «dot» [totsʲka], *dochka* «daughter» [dotsʲka] (seven subjects), [tʃk]→[tsʲk] in *kochka* «bump» [kotsʲka] (two subjects), and [tʃk] →[sʲk] *kochka* «bump» [kosʲka] (two subjects).

Word-medial [rk] was substituted with [ʊk] in *marka* «stamp» [maʊka] by three subjects, [lk] in *marka* «stamp» [malka] by ten subjects, [jk] in *marka* «stamp» [majka] by two subjects (however, [jk] itself was pronounced correctly by all subjects in *maika* «shirt» [maika], *gaika* «nut» [gaika]). Word-medial [lk] was reduced to /k/ in *galka* «jackdaw» [gaka] by two subjects.

4. Conclusions and outlook

The results, obtained during the present acoustic study, enabled to range the Russian consonants according to the difficulty of their performance by Russian three-year-olds. As expected, hard and soft trills /r/, /rʲ/ together with hard and soft lateral glides /l/, /lʲ/, proved the most difficult. They were followed by palatal sibilants – fricative /ʃ/, /ʃʲ/, /z/, and affricate /tʃ/ on difficulty rank scale. Interestingly enough, another affricate /ts/ did not present much difficulty to 3-year-olds.

Another finding was that more than a half of phoneme oppositions involved in the present study (19 of 35) were discriminated well by our subjects (100% to 75% of correct performance of the pronunciation task) while almost a third part of them had low discriminability – 30% and less. There was high across-speaker variability in the studied age group as far as the level of native

language acquisition. Unlike e.g. with English 3-year-olds, there were no articulatory errors for velar consonants with Russian ones.

As expected, substitutes of hard consonants for soft consonants occurred quite often. Among forelingual consonants, /l/, /ʃ/, /ʒ/ and /ts/ underwent across-speaker palatalization, which is, according to the previous data, obviously, a reflection of a universal tendency. Across-speaker palatalizing of labials is language-specific reflecting the difficulty in acquiring Russian consonants opposition of «hard-soft». Other instances of palatalization were idiosyncratic.

Another common cross-linguistic pattern of child production is cluster reduction. Among 14 clusters involved in this study, 4 word-initial ones (/tr/, /dr/, /pl/, /sv/) lost their second member in 5–8 subjects. From 1 word-final cluster /nt/, some children deleted the first member while others omitted the second one. No elements were deleted from the remaining 9 clusters, however, in 7 of them, the target cluster elements could be substituted with other phonemes following the substitute patterns noticed for single consonants.

An unexpected result was that 3-year-olds did not use metathesis.

Our future work will focus on further study of the same group of subjects every half a year during the following two-year period to see L1 acquisition progressing.

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