

Prethodno priopćenje

Rukopis primljen 19. 5. 2018.

Prihvaćen za tisak 20. 12. 2018.

<https://doi.org/10.22210/govor.2018.35.10>

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Synchronised and non-synchronised articulation of Polish nasals *ɲ* and *ɳ* in child and adult speech

Summary

Nasals are highly frequent sounds in the Polish language. It is believed that their articulation is mainly dependent on surrounding segments. The standard register of Polish language contains two different patterns of articulation of nasalised sounds, so called: synchronised and non-synchronised. This study attempts to show that surrounding consonants have different impact on the way of nasals articulation among adults and children. The acoustic methodology was applied in order to verify the hypothesis about differences in asynchronous articulation of nasals *ɲ*, *ɳ* in CVC and CV clusters in front of stops and affricatives; and synchronic articulation before fricatives among children and adults. Nasalised sounds were investigated on the basis of utterances of two children (3;9, 10;1) and compared with similar segments of adult speech excerpted from SpokesWeb CLARIN database.

Key words: language acquisition, acoustic phonetics, nasals *ɲ* and *ɳ*, Polish

1. INTRODUCTION

The perception of Polish spoken language from a side of non-Slavic languages speakers might often bring the sensation of highly palatalised and nasalised speech. Even though research on nasalisation could cause certain difficulties in finding acoustically relevant measurements of degree of nasalisation and nasals segmentation, the present paper approaches the phenomenon of the articulation of nasal segments from the perspective of acoustic phonetics and language development.

The first part of present study briefly introduces the acoustic characteristics of nasalisation and describes the position of nasals *ą*, *ę* in Polish vowel system. The following sections discuss the methodology of nasality measurements and introduce the conventions of audio data transcription, created for the need of presented research. Then, criteria for nasals acoustic classification are described in comparison with recorded voice samples. The final part contains the transcripts of recordings from which relevant clusters with nasals *ą* and *ę* were excerpted.

Nasalisation is one of the twelve phonological distinctive features in standard Polish language and applies to bilabial /m/, alveoral /n/, retroflex /ŋ/, palatal /ɲ/, glides: /r/, /l/ and investigated nasals *ą*, *ę* referring to /ɔ̃/¹, /ɛ̃/ or /ɔ̃N/, /ɛ̃N/. Different interpretations of nasals were presented in Polish phonetic literature (Bethin, 1987; Dłuska, 1981; Jassem, 1974; Laskowski, 2010; Zagórska-Brooks, 1968). Even though differences in terminology among researchers are still evident, the common consensus was reached and two general patterns of nasalisation in Polish were distinguished. Depending on the character of sounds following nasals – synchronised and non-synchronised (pol. *synchroniczna*, *niesynchroniczna*), sometimes also called biphonematic and monophonematic (pol. *bifonematyczna*, *monofonematyczna*), articulation types were defined. Investigated nasals in the Polish language are orthographically represented as *ą*² and *ę*, which might cause confusion, because in case of the first one, the cardinal /o/ not /a/ is nasalised. This orthographic tradition was established back in the 16th century where the pronunciation of *ą* was closer to /a/. Though the evolution in diachronic phonetics changed the character of nasalised *ą*, the outdated orthographic norm is still valid.

¹ In IPA convention, nasal symbol /ɔ̃/ differs from the one used in phonetic transcriptions of Slavic languages (AS: Alphabet Slavic), where /ǫ/ character is more common.

² The '̣' diacritic (Unicode: U+02DB, HTML: Ą and U+0104; Б for capitals) as an indicator of nasalisation is used in Polish, Old Church Slavonic and some Athabaskan languages. In Lithuanian though the same symbol indicates the length of sound.

As mentioned before, the differences in articulation of nasals are predominantly dependent on their surroundings. The adjacent sounds are not the only factor influencing synchronised and non-synchronised articulation and, as presented in this study, the age of a speaker can be a modifier of the articulation type. Two aforementioned patterns will be investigated from the perspective of different age of language users. Therefore, the articulation types of nasalised sounds uttered by children will be compared with similar adults' utterances excerpted from SpokesWeb CLARIN database (Peżik, 2015).

The purpose of this work required establishing new transcribing conventions. Unfortunately, Polish chapter of CHILDES database is not unified. Authors tend to follow various strategies in transcription of audio material and those datasets could not be taken as an example for this study. The transcription conventions applied here contain three obligatory paths: %pho – with information about phonetic layer according to IPA standards; %mor – containing the morphosyntactic relations and %eng – with Polish to English translation. Path %com – provides additional comments on the utterances or subjects' behaviour. Errors were tagged with asterisk and explained in following lines starting with: %err according to Tools for Analyzing Talk (MacWhinney, 2017, pp. 105–112). The intonation contour of utterances was tagged as well as primary and secondary stress. CLAN special characters were used to indicate laughing. The additional comments (see Appendix: line 193) were introduced for possible explanation of target phrases when an utterance was marked as mistaken. The lines with subjects' speech were written, with several exceptions, according to Polish orthographic norm – which makes the data searchable if specific phrase is of an interest to a researcher. The phonetic features with coarticulation diacritic were added in the %pho line. The accentual tagging allows to investigate the alternations of stress patterns in child speech, which might be interesting for some future research comparing the fixed place of paroxytonic accent in Polish orthoepic norm with accentual tendencies discovered among children. The phenomena of palatalization can be traced by following the '%com: palat' tag. Paralinguistic information without linguistically relevant articulation, but possibly important for conversation analysis, was described with '&t=' and '!=' (e.g. &t=laughs). The syllable prolongation was noted.

The information about morphosyntactic relations was introduced manually. Tags specify: part of speech, tense, aspect, voice, grammatical person, mood, and case. The Latin case abbreviations were used. Some additional lexical and stylistic information was mentioned with DEM and AUG indexes for diminutive and

augmentative forms respectively. When change of speech act occurs, the comment is given in '%add' row (e.g. line 16). Observations on the communicative intention were rarely noted (line 21) to prevent the subjectivity of transcriber's interpretation.

2. CHARACTERISTICS OF NASAL SEGMENTS

The velum lowering during the articulation process and opening the velopharyngeal port causes the vocal tract extension and direction of an airstream towards nasal cavity. The movement of soft palate leads the airstream to oral and nasal cavities simultaneously. The nasalisation in Polish vowels, occurs more frequently in the second phase of articulation, in contrast to the French language, where the nasalisation is present already in the first segment of vowels (Rochet, 2015). The final segment of nasals *ɶ*, *ɷ* has similar spectral characteristics due to fixed volume of nose cavity resonator. Exceptions could be found among patients with changes in anatomy of nasal cavity occurred as a result of endonasal sinus surgery. Nasals are ordinarily voiced and can be phonetically distinguished as sonorants (cf. Kent & Kim, 2011, p. 367). Naturally, during nasals' articulation variations in formant values are visible due to the tongue position, which is: *ɶ* – mid-back and *ɷ* – mid-front. As a consequence of the movement of uvula and airstream division, the energy is led to the oral cavity and nasals intensity is slightly lowered compared with intensity of orals. The differences in articulation patterns of Polish nasals might raise the question of their classification. Therefore, *ɶ* and *ɷ* cannot be clearly classified as diphthongs, because the elements /*o*/, /*ũ*/; /*e*/, /*ĩ*/ consisting their non-synchronised articulation can be uttered independently, regardless of surroundings. This statement can be easily verified by measuring basic acoustic features of those elements separately and as a part of multisegmental entity. Nasals are typically more voiced than glides and less voiced than fricatives.

The question of nasalisation was raised in the field of language acquisition among the others by Olmsted (1966), Waterson (1971, pp. 195–200), and Macken and Ferguson (1981). The methodology of articulatory phonetics in the nasals investigation was applied by Kurowski and Blumstein (1987, pp. 1917–1927). Before the experimental methods were successfully applied in linguistics, fundamental theories on acquiring the smallest units of language system were stated by Roman Jakobson. The structuralistic approach – typical for the 'Prague Linguistic Circle' – is visible in his early works on language acquisition as well. Jakobson predicted that stops

are acquired before nasals, with fricatives next and liquids late (cf. Macken & Ferguson, 1981, p. 112). Nevertheless, stops, nasals and glides are among the first sound productions. The importance of nasals comprehension could be explained by the high frequency of nasals occurrence and supported by their language-specific discriminations (see Clark, 2016, pp. 69–72). Nasals are considerably frequent sounds in Polish, compared to English – where 18.45% of all consonants produced in initial, medial and final position contain nasal characteristics (Ardussi Mines, Hanson, & Shoup, 1978). Also, language-specific differences in a degree of nasality are noticeable.

Investigated nasals could be problematic for sign language users, because labiograms of both phases of *q*, *ɣ* articulation (regardless of synchronised or non-synchronised character) are very similar to /o/ and /e/ (Styczek, 2010, p. 99). Furthermore, deaf subjects significantly differ from non-clinical subjects in velopharyngeal openings during nasals articulation.

Nasalised sounds followed by a vowel, due to inevitable influence of coarticulation, considerably increase their degree of nasalisation (see Nasal assimilation in: Czaykowska-Higgins, 1992, p. 140). However, the degree of nasalisation of surrounding vowels was questioned by Bell-Berti (1993) and interesting conclusions on the anticipatory coarticulation were reached. The extended presence of nasality in orals caused by velopharyngeal dysfunctions (VPD) is defined as hyperrhinolalia. The method of measuring a degree of nasalance, called nasometry, allows to conduct relevant research even with young participants (Whitehill & Lee, 2008, p. 335). Nasometry provides a nasalance score, which is a ratio of nasal acoustic energy to the sum of nasal and oral acoustic energy multiplied by 100. In principle – the higher the nasalance score, the higher the degree of nasality. Other methods in nasality research, though dependent on signal intensity³ refer to: nasal pressure, vibration and flow. This investigation is based exclusively on the acoustic methodology, however, it could be easily supported with nasometric method. Interestingly, cinefluorographic methods allow to observe that the degree of nasality of English high vowels /i/, /u/ is greater than low vowels (cf. Chen, 1996, p. 17), which might not necessarily be the case in the Polish language.

Acoustic properties of nasals can be distinguished based on typical low intensity and dense pattern of resonances and anti-resonances (Kent & Kim, 2011, p. 398).

³ Possible solution to obtain relevant measures of nasality was proposed by Horii (1980). The index HONC (Horii Nasal-Oral Coupling Index) is the ratio of nasal accelerometric amplitude to voice amplitude.

Cross-linguistic spectral analysis of nasalised sounds pointed that F1 is clearly separated from the other formants. The appearance of a pole-zero pair above the first formant is also a vivid effect of nasalisation (Chen, 1996, p. 40). The general tendency of large formant bandwidths is noticeable. High density of formants combined with antiformants and flatter spectrum at low frequencies could be pointed as a general acoustic characteristic of sounds articulated via nasal cavity. The visual recognition of nasalisation on spectrograms should be driven by identifying the blank fields where very little of spectral energy was recorded. The careful following of formant transitions might be helpful in identifying nasality on the spectrographic picture.

3. MATERIAL

The recordings were made in a playtime situation with Tascam DR-05 handheld recorder. Microphones were set in omnidirectional mode. Applied sampling ratio was 44100 Hz. The audio-material was excerpted from two recording sessions which took place in subjects' home environment. Both participants were boys aged 3;9 and 10;1. Researcher's presence and so called Labov's effect had no influence on subjects' behaviour. Subjects' speech was natural and non-stimulated, therefore some overlapping interactions with their parents are noticeable (see Appendix lines: 119, 211, 223, 241, 256, 260, 265, 315, 330). Both children and their parents come from dialectically unmarked region of Poland. Parents of recorded children accomplished university education and a socio-economic status of the family could be estimated as middle-class. The adults' speech samples used for the comparison were downloaded from SpokesWeb – conversation data search database – the spoken part of Polish corpus created as a part of CLARIN-EU infrastructure (Peřik, 2015). The referential database of SpokesWeb was unfortunately low in metadata. Thus, the information about adults whose voice was analysed in comparison to child speech is highly limited. The policy of CLARIN consortium data protection requires that all files must not contain any personal information. The search options were limited to the speakers' sex, age and education level. Unfortunately, no information about dialectic affiliation or place of birth was enclosed in metadata.

3.1. Criteria for sample selection

Firstly, the non-stimulated natural speech of two children (boys aged 3;9 and 10;1) was recorded during their playtime. Secondly, the audio data underwent transcription and annotation process. Nasalised sounds were excerpted from the audio paths and after FFT transformation the spectral analysis of sounds was conducted by the means

of STx package (Balazs, Noll, Deutsch, & Laback, 2000) and Praat 6.0.36 (Boersma & Weenink, 2017) software.

Excerpted samples of nasalised utterances were admitted as synchronic ones if at least two out of five characteristics of nasality applied to the investigated segment: (1) Additional formant (approx. 300 Hz) with relatively high amplitude. Sometimes F1 – significantly reduced – could be combined with so called 'nasal formant'; (2) The higher values of F1 and F3⁴; (3) Increased F4; (4) Higher F3 values; (5) Additional formant in one or more of the following ranges: 0.7 kHz, 1.0–1.2 kHz, 1.8–2.25 kHz and 2.7–2.9 kHz. The segmentation should be done with a maximum frame of 45–50 ms after the vowel onset.⁵

The articulation pattern, or more precisely: anticipatory coarticulation effect, suggests that non-synchronised articulation of nasals *a*, *ɛ* indicating denasalization of initial segment should be noticeable in front of stops and affricates (e.g. pol. /p/, /b/, /t/, /d/, /tɕ/, /dz/, /tɕʃ/, /dzʃ/, /k/, /g/), whereas the synchronised articulation is expected when nasals are followed by fricatives (pol. /v/, /f/, /s/, /z/, /ɕ/, /ʒ/, /ʃ/, /z/, /x/). Two abovementioned assumptions will be verified and compared on the basis of two sets of recordings (children: index₁ and adults: index₂) within two groups with nasalised vowels in the final and medial position (CV, CVC).

4. RESULTS

Within distinguished categories the following clusters were retrieved: CV_{ch/a} -kɛ /kɛ̃/, -tɔ /tɔ̃/, -iɛ /jɛ̃/, -mɔ /mɔ̃/, -gɛ /gɛ̃/, -lɛ /lɛ̃/, -szɛ /ʃɛ̃/, -czɛ /tɕɛ̃/ (lines: 37, 120, 124, 135, 203, 334, 392, 397, 407); CVC_{ch/a} -czɔt- /tɕɔ̃t/, -iɛć- /jɛ̃tɕ/, -rɛk- /rɛ̃k/, -jɛd- /jɛ̃d/, -jɛk- /jɛ̃k/, -jɛci- /jɛ̃tɕ/ (lines: 31, 37, 101, 140, 144, 149, 236, 245, 249, 283, 367). The rest of samples came from untranscribed recordings from which following groups were selected: -paɕz- /pɔ̃tɕ/, -kɔt- /kɔ̃t/, -wɔs- /vɔ̃s/, -wɛz- /vɛ̃z/, -wɛch /vɛ̃x/, -wɔz- /vɔ̃z/, -mɛs- /mɛ̃s/, -wɛsz- /vɛ̃ʃ/, -tɛz- /tɛ̃z/, -mɔz- /mɔ̃z/.

In total 48 samples belonging to clusters: CV_{ch}, CV_a, CVC1_{ch}, CVC2_{ch}, CVC1_a, CVC2_a were measured. The groups with nasals in the final position (CV_{ch} CV_a) were investigated as independent units with long pause before the next segment or as a final part of a sentence, so the inter-lexical assimilations were not taken into consideration. The results of measurements are given in Table 1. Summarized results for each cluster are presented in Table 2. The second table shows the percentage of samples for which the relevant acoustic feature of initial segment nasality was found.

⁴ Higher than oral, cardinal equivalents – /o/, /ɛ/.

⁵ The changes are usually noticeable right after 20 ms.

Interestingly, non-synchronic articulation of investigated nasals had some common acoustic characteristics in adult and child speech. The non-synchronic realisation of Polish nasals was relatively often characterised by presence of F2 and F3 in the range between 2300 and 2600 Hz. Considerable differences were noticeable especially in the range of F2, the values of which are highly subject-dependent (as well as F4). The non-vocalic (always second) part of non-synchronised nasals was often accompanied by high amplitude additional formant in utterances of registered in both groups. The non-synchronic realisations had additional formant (around 300 Hz). Even though the nasalised segments are typically longer than oral ones, the tempo of child speech should not be compared with adults' utterances. The second segment of non-synchronised nasals often had two formants very close to each other or even combined.

In the CV_a cluster category, seven utterances were marked as synchronised; whereas among the same type of adults' utterances in group CV_{ch} five productions had clearly synchronised character. Nasals followed by stops or affricates were synchronised in five cases of adult speech but only in three cases in child speech. Third group, consisted of nasals followed by fricatives, was the most frequently synchronised among two groups of subjects. Child speech in CVC₂ was synchronised in five samples and adults' utterances were synchronised in seven cases. No acoustic characteristics of nasalization were found at four child utterances: /jẽ/ with nasal in final position; in CVC₁ group: /tʂõt/ with nasal in medial position followed by stop consonant; /jẽtɕ/ with nasal before affricate and, surprisingly, with nasal in medial position followed by fricative: /vẽz/. Within the set of adults' utterances, the only sample without nasalization features measured was /jẽk/ with nasal followed by stop consonant. Overall, the low degree of nasalization was found among nasals in final position /gẽ/ articulated by adults and /mõ/, /lẽ/ groups from child samples – all belonging to CV clusters. None of the mentioned utterances from set CVC₁: /jẽtɕ/, /rẽk/, /kõt/ reached the nasality threshold. Among nasals followed by fricatives (CVC₂), utterances /vẽz/, /mõz/ and /vẽx/ were not recognised as synchronous and the nasality degree result at /mõz/ was equal in child and adult pronunciation. The highest score on created nasality scale among children utterances was noted at /jẽd/ and /võs/ from CVC₁ and CVC₂ respectively.

The aim of this work was to compare the nasality degree of nasalised segments in child and adult speech, although the size of recorded data as well as a number of subjects seems too small to declare some general tendencies in Polish nasals articulations.

Table 1. Nasality in children and adults' speech – individual samples**Tablica 1.** Nazalnost u dječjem govoru i govoru odraslih – svi uzorci

Group / Grupa	Utterance / Izgovoreni segment	1		2		3		4		5		Nasality degree / Stupanj nazalnosti	
		CH	A	CH	A	CH	A	CH	A	CH	A	CH	A
CV	/kĕ̃/	+	+	-	+	+	+	-	+	-	-	0.4	0.8
	/tō̃/	+	+	-	+	-	-	+	+	-	-	0.4	0.6
	/jĕ̃/	-	+	+	-	-	+	-	-	-	+	0	0.6
	/mō̃/	-	-	-	+	+	+	+	-	-	+	0.2	0.4
	/gĕ̃/	+	-	+	-	-	-	-	-	-	+	0.4	0.2
	/lĕ̃/	-	+	+	-	-	+	-	-	-	-	0.2	0.4
	/šĕ̃/	+	+	-	+	-	-	-	-	+	-	0.4	0.4
	/tšĕ̃/	-	-	+	+	-	-	+	-	-	+	0.4	0.4
CVC ₁	/tšō̃t/	-	+	-	-	-	+	-	-	-	-	0	0.4
	/jĕ̃tē/	-	-	-	-	-	-	-	+	+	-	0.2	0.2
	/rĕ̃k/	-	-	-	+	-	-	-	-	+	+	0.2	0.4
	/jĕ̃d/	+	-	+	+	-	-	+	-	-	+	0.6	0.4
	/jĕ̃k/	-	-	-	-	-	-	+	-	+	-	0.4	0
	/jĕ̃tē/	-	+	-	-	-	+	-	-	-	-	0	0.4
	/pō̃tš/	+	+	-	-	+	+	-	-	-	-	0.4	0.4
/kō̃t/	-	-	-	+	-	-	-	-	+	-	0.2	0.2	
CVC ₂	/vō̃s/	+	+	-	+	+	-	vō̃s/	+	+	+	0.6	0.8
	/vĕ̃z/	-	-	-	-	-	+	-	-	-	+	0	0.4
	/mō̃z/	-	-	+	-	-	-	-	-	-	+	0.2	0.2
	/vō̃z/	+	+	+	-	-	+	-	-	-	+	0.4	0.6
	/mĕ̃s/	-	-	-	+	-	+	+	-	+	-	0.4	0.4
	/vĕ̃š/	-	+	-	-	+	-	-	+	+	+	0.4	0.6
	/tĕ̃z/	+	-	-	+	-	+	-	-	+	+	0.4	0.6
	/vĕ̃x/	-	+	-	-	-	+	-	+	+	+	0.2	0.8

Legend

Numbers 1–5 refer to acoustic characteristic mentioned above. Index CH – child utterance from recordings; index A – adults' utterances excerpted from SpokesWeb CLARIN database; group CV – consonant + nasal in final position; group CVC₁ – consonant + nasal + stop/affricative; group CVC₂ – consonant + nasal + fricative. Nasality degree index indicates if the utterance character was synchronised ≤ 0.4 or non-synchronised > 0.4 .

Legenda

Brojevi 1–5 odnose se na akustičke karakteristike nazalnosti. Oznaka CH odnosi se na dječji govor sa snimaka, a oznaka A na govor odraslih prikupljenih iz baze podataka SpokesWeb CLARIN; skupina CV označava konsonant + nazal u finalnoj poziciji; skupina CVC₁ odnosi se na konsonant + nazal + okluziv/afrikata; skupina CVC₂ odnosi na konsonant + nazal + frikativ. Indeks stupnja nazalnosti govori o pojavnosti sinkronizirane nazalnosti ≤ 0.4 ili nesinkronizirane > 0.4 .

Table 2. Nasality in children and adults' speech – segment clusters
Tablica 2. Nazalnost u dječjem govoru i govoru odraslih – skupine glasova

	1	2	3	4	5
CV _{ch}	0.5	0.5	0.25	0.75	0.13
CV _a	0.63	0.63	0.5	0.25	0.5
CVC1 _{ch}	0.25	0.13	0.13	0.25	0.5
CVC1 _a	0.38	0.38	0.38	0.13	0.25
CVC2 _{ch}	0.25	0.25	0.25	0.13	0.63
CVC2 _a	0.5	0.38	0.63	0.38	0.88

Legend

CV_{ch} – group: consonant + nasal in final position uttered by child; CV_a – group: consonant + nasal in final position uttered by adults; CVC1_{ch} – group: consonant + nasal + stop/affricative uttered by children; CVC1_a – group: consonant + nasal + stop/affricative uttered by adults; CVC2_{ch} – group: consonant + nasal + fricative uttered by children; CVC2_a – group: consonant + nasal + fricative uttered by adults. Numbers 1–5 refer to acoustic features mentioned above.

Legenda

CV_{ch} označava konsonant + nazal u finalnoj poziciji koje izgovara dijete; CV_a označava konsonant + nazal u finalnoj poziciji koje izgovara odrasla osoba; skupina CVC1_{ch} odnosi se na konsonant + nazal + okluziv/afrikata koje izgovara dijete; skupina CVC1_a odnosi se na konsonant + nazal + okluziv/afrikata koje izgovara odrasla osoba; skupina CVC2_{ch} označava konsonant + nazal + frikativ koje izgovara dijete; skupina CVC2_a označava konsonant + nazal + frikativ koje izgovara odrasla osoba. Brojevi 1–5 odnose se na akustičke karakteristike nazalnosti.

5. CONCLUSIONS

Polish nasal realisations – synchronised and non-synchronised are mostly dependent on the manner of articulation of adjacent segments. Interestingly, not only articulatory patterns influence the character of nasalization, but it appears that adults' speech, in a few cases among investigated clusters, significantly differed from child's utterances in terms of nasality of initial segment. However, in none of the samples all five characteristics of nasality were found. The highest nasality degree was noted among segments uttered by adults in /ṽs/ and /ṽx/ CVC₂ clusters and in final /k̃/ segment classified as CV_a. The highest nasality degree among utterances produced by children was noted, surprisingly, in CVC₁ group where theoretically non-synchronic nasals realisation could be expected. Nevertheless, the tendency of non-synchronic articulation of excerpted groups was present within the set CVC_{1ch} where five out of eight samples were pronounced in non-synchronised manner; compared to three samples from CVC_{1a} cluster. The most frequent acoustic feature among utterances from all groups was (5) – presence of additional formant in abovementioned ranges. Then, the additional so called 'nasal' formant was also observed in a large set of investigated samples. The presence of increased F3 value was less noticeable feature. It is worth to notice that F2 and F4 are the most subject-dependent vowels formants. To obtain results based on different measuring approaches the investigation of nasalisation should be supported with nasometric research. More representative group of participants is also preferable. Additional referential data about adult subjects derived from SpokesWeb CLARIN could be an asset in a future research.

To conclude, this research has shown that non-synchronised as well as synchronised articulation manners can occur in different surroundings in child speech and in adults' utterances. Apart from adjacent segments, the age of language user has a significant influence on the character of nasalisation of Polish *q*, *ɛ* nasals.

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APPENDIX / PRILOG

- 1 @Begin
 2 @Languages: pol
 3 @Participants: WUJ Adult, MAM Mother, JED Child, BAR Target_Child
 4 @ID: pol|change_corpus_later|WUJ||male||White,MC|Adult|higher||
 5 @ID: pol|change_corpus_later|MAM||female||White,MC|Mother|higher||
 6 @ID: pol|change_corpus_later|JED|10;7.|male|||Child|||
 7 @ID: pol|change_corpus_later|BAR|3;9.|male|||Target_Child|||
 8 @Media: 1, audio
 9 @Location: Wrocław, Poland
 10 @Situation: Jędrzej i Bartus are playing together
 11 @Interaction Type: family
 12 @Recording Quality: good
 13 @Transcription: detailed
 14 @Transcriber: Jacek
 15 @Date: 27-OCT-2017
 16 %add: Bartus to Jędrzej
 17 *BAR: pokāżać ci↑ ?
 18 %pho: pokazatɛ tɛ
 19 %mor: VER|pokaz-ać PRO|ci
 20 %eng: do you want me to show you?
 21 %act: wants attention
 22 *JED: co ?
 23 %mor: PRO|co
 24 %eng: what ?
 25 *BAR: ??yyy?? (1.7) → nājpierw tšęba [* p]
 26 %err: trzeba
 27 %com: palat
 28 %pho: najpʲerf tšęba
 29 %mor: POST|naj-pierw V|trzeba
 30 %eng: first you should
 31 *BAR: na te piecātki [* p] m [* 0v] tu
 32 %err: c/cz, verb omission
 33 %sit: is instructing how to make a stamp

- 34 %pho: na te piecōtki
 35 %mor: PRO|na PRO|te N:NOM:PL|pieczātk-i
 36 %eng: on this stamps
 37 *BAR: zrōbić jēdnā pieczātkę
 38 %pho: pʲet̪ōtkɛ̃
 39 %mor: V|zrobi-ć DET:NUM|jednā N:ACC|pieczātk-ę
 40 %eng: make one stamp
 41 *BAR: u jeśće [* p]
 42 %err: ś/sz ć/cz
 43 %com: palat
 44 %pho: u ject̪ɛ̃
 45 %mor: PTL|jeszcze
 46 %eng: else
 47 *BAR: o włāśnie ↑tāk to miāło być
 48 %pho: o wɫaɕɲe ↑tak to miāɫo bʲit̪ɛ̃
 49 %mor: PRT|włāśnie tak DET|to V:PAST|miało V:INVbyć
 50 %eng: it was supposed to be like this
 51 *JED: &= laughing
 52 *BAR: o to hop siup
 53 %pho: o to xop ɕup
 54 %com: rythmed phrase
 55 *BAR: ↑&=laughing
 56 *BAR: ciu
 57 %pho: t̪ɕu
 58 *BAR: @x hop siup pierwsy [* p] raz
 59 %err: metathesis ś/sz
 60 %pho: xop ɕup pʲerfsʲi ras
 61 %mor: NUM:ORD|piērwszy raz
 62 %com: palat ryhmed phrase
 63 %eng: first time
 64 *BAR: uwaga↑ →uwaga uwaga bo jedzie rozwaga
 65 %pho: uvaga↑ →uvaga uvaga bo jedz̪ɛ̃ rosvaga
 66 %mor: CO|uwaga CONJ|bo V:PRES:3SING|jedzie N:NOM|rozwag-a
 67 %eng: watch out the thought is coming

- 68 %com: rythming wordplay with 'łamaga' and 'rozwaga': clumsy and thought
- 69 *BAR: ☺fi↑
- 70 %pho: wi↑
- 71 %com: happiness interjection
- 72 *JED: ☺☹ &ɤ=laughing
- 73 *BAR: mama mama mama
- 74 %pho: mama [x 3]
- 75 %mor: N:NOM:SING|mam-a
- 76 %eng: mom [x 3]
- 77 *BAR: ☹·&ɤ=laughing↑
- 78 *JED: uwaga
- 79 %pho: uvaga
- 80 %mor: N:NOM:SING|uwag-a
- 81 %eng: attention (watch out)
- 82 *BAR: uwāga
- 83 %pho: uvaga
- 84 %mor: N:NOM:SING|uwag-a
- 85 %eng: attention (watch out)
- 86 *BAR: uwāga uwāga bo jedzie rolwāga [* n]
- 87 %pho: uvaga uvaga bo jedźe rolvaga
- 88 %mor: N:NOM:SING|uwag-a [x 2] CONJ|bo VERB: 3SING|jedzie
N:NOM:SING|rolwag-a
- 89 %com: wordplay and rythming
- 90 %eng: watch out watch out because the [neologism] is coming
- 91 *BAR: lee ju↑hu☺
- 92 %pho: we juxu
- 93 %com: interjections and laughing
- 94 *JED: hmm☹
- 95 %pho: xm
- 96 %com: breathy voice
- 97 *BAR: &ɤ=lauhgting
- 98 *BAR: hop siup
- 99 %pho: xop ɛup
- 100 %com: rythmed wordplay

- 101 *BAR: tely [* p] pienc [* p]
 102 %err: cz/t r/l e/ę [cztery pięć]
 103 %pho: tely piɛntɛ̃
 104 %mor: NUM|czter-y NUM|pięć
 105 %eng: four five
 106 *BAR: szēs [* p] siēdem ōsiem
 107 %err: metathesis ś/śc
 108 %pho: ʂɛɛ ɛedem oɛem
 109 %mor: NUM|sześć NUM|siedem NUM|osiem
 110 %eng: six seven eight
 111 *BAR: pien [*] dziesięć
 112 %com: unclassified error utterance close to cardinal numerical '5' without
 113 affricative consonant
 114 %pho: piɛn dʒɛɛtɛ̃
 115 %mor: @x NUM|dziesi-ęć
 116 %eng: @x ten
 117 *JED: &=coughs
 118 *JED: &=lauhgting
 119 *MAM: mhm
 120 *BAR: proszę nagrānie
 121 %pho: proɛɛ̃ nagraɲe
 122 %mor: IMP|prosz-ę N:ACC:SING|nagrani-e
 123 %eng: give me the recording
 124 *BAR: proszę↑
 125 %pho: proɛɛ̃
 126 %mor: IMP|prosz-ę
 127 %eng: please
 128 *JED: &=laughing
 129 *BAR: ee
 130 %com: &=inhaling
 131 *JED: przepraszam
 132 %pho: pɕɛpraɕam
 133 %mor: V:1:SING|przeprasza-m
 134 %eng: I am sorry
 135 *BAR: przēcież jā się

- 136 %pho: pʂetɕeɕ ja ɕɛ̃
 137 %mor: CONJ|przecież PRO|ja PRO:REFL|się
 138 %eng: but I
 139 *JED: &ɕ=caugh
 140 *BAR: poślizgnąłem tato
 141 %pho: poelizgɲɔwem tato
 142 %mor: V:PAST:1:SING|po-ślizgną-łem N:VOC:SING|tat-o
 143 %eng: I have slipped myself dad
 144 *BAR: tato poślizgnąłem się tato
 145 %pho: tato poelizgɲɔwem ɕɛ̃ tato
 146 %mor: N:VOC:SING|tat-o V:PAST:1:SING|po-ślizgną-łem
 PRO:REFL|się
 147 N:VOC:SING|tat-o
 148 %eng: dad I slipped myself dad
 149 *BAR: poślizgnąłem się
 150 %pho: poelizgɲɔwem ɕɛ̃
 151 %mor: V:PAST:1:SING|po-ślizgną-łem PART:REFL|się
 152 %eng: I slipped myself
 153 *BAR: to się poślizgnąłem
 154 %pho: to ɕɛ̃ poelizgɲɔwem
 155 %mor: PRO|to PART:REFL|się V:PAST:1:SING|po-ślizgną-łem
 156 %eng: this I slipped myself
 157 *WUJ: no to się nię ślizgaj
 158 %add: Uncle - adult to Bartus - direct_child
 159 %pho: no to ɕɛ̃ ɲe ɕlizgaj
 160 %mor: CONJ|no PRO|to PART:REFL|się V:AUX:NEG|nie
 V:IMP:2:SING|ślizgaj
 161 %eng: so do not slip
 162 *JED: cīcho
 163 %pho: tɕɕxo
 164 %mor: V:IMP|cicho
 165 %eng: [be] quiet
 166 *BAR: nię↑ nie mam pīcho [* p:m]
 167 %err: metathesis p/tɕ
 168 %com: picho/cicho initial segment changed

- 169 %pho: jɛ↑ jɛ mam pʰxo
 170 %mor: AUX:NEG|nie AUX:NEG|nie AUX|mam @x
 171 *JED: &ɥ=breathing
 172 *BAR: tyl- [* 0] tak↑ głośno
 173 %err: syllable omission -ko
 174 %pho: tɨl tak gwoɛno
 175 %mor: @x PRO|tak ADV|głośno
 176 %eng: but that loudly
 177 *BAR: &ɥ=hisses
 178 *BAR: &ɥ=laughing
 179 *BAR: ja piɛrsy [* p] jaʰ↑ piɛrsy [* p]
 180 %err: omission_w metathesis_s/ʃ [x 2]
 181 %pho: ja piɛrsi ja piɛrsi
 182 %mor: PRO:1:SING|ja NUM:ORD:1:SING:MASC|pierwsz-y [x 2]
 183 %eng: me first [x 2]
 184 *JED: @xxx whisper
 185 *BAR: uwāga uwāga↑
 186 %pho: uvaga uvaga
 187 %mor: N:NOM:SING|uwag-a [x 2]
 188 %eng: attention (watch out)
 189 *BAR: @xxx &ɥ=squeals
 190 *JED: &ɥ=caugh
 191 *BAR: @xxx tie [* p: m] kōcham
 192 %err: methatesis tʰ/tɕ
 193 %com: target_strasznie
 194 %pho: tʰɛ koxam
 195 %mor: PRO:REFL:2:SING|cię V:PRES:1:SING|kocham
 196 %eng: I love you
 197 *JED: &ɥ=giggling
 198 *BAR: us [* n: uk]
 199 %com: neologism
 200 *BAR: @xxx
 201 %com: sounds like English
 202 *BAR: &ɥ=screaming
 203 *BAR: @xxx ↑ tu na chwile

- 204 %pho: tu na xfilẽ
 205 %mor: DET|tu PART|na chwilę
 206 %eng: here for a moment
 207 *JED: o niē
 208 %pho: o ɲe
 209 %mor: PART|o nie
 210 %eng: oh no
 211 *MAM: ja nie mogę
 212 %pho: ja ɲe mogẽ
 213 %mor: PRO:1:SING|ja NEG|nie V:PRES:1:SING|mog-ę
 214 %eng: I cannot
 215 *BAR: &ɕ=shouting
 216 *JED: &ɕ=giggling
 217 *BAR: zobacz
 218 %pho: zobatɕ
 219 %mor: V:IMP:2:SING|zobacz
 220 %eng: look
 221 *BAR: @xxx
 222 %com: unclear
 223 *MAM: przēstań skākać
 224 %pho: pżestaj̃ skakate
 225 %mor: V:IMP:2:SING|przestań V:INF|skaka-ć
 226 %eng: stop jumping
 227 *BAR: trzȳmaj kierōwi [* m] bō się nie poprāwi
 228 %com: singing
 229 %err: omission
 230 %pho: tɕimaj kierõvi bo ɕẽ ɲe popravi
 231 %mor: V:IMP:1:SING|trzymaj target_N:ACC:SING|kierow- CONJ|bo
 232 PART:REFL|się NEG|nie V:FUT:3:SING|popraw-i
 233 %eng: hold the target_wheel* because it will not get better
 234 *BAR: &ɕ=screaming
 235 *JED: &ɕ=laughing
 236 *BAR: ja miałem zdjęcie na mōje przygōdy
 237 %pho: ja m'awem sdjēt̩e na moje pɕigodi
-

- 238 %mor: PRO:PER:1:SING|ja V:PAST:1:SING|miał-em
N:ACC:SING|zdjęci-e PART|na
- 239 PRO:POS:1:SING|moje N:NOM:SING|przygod-y
- 240 %eng: I had a photo on my adventures
- 241 *MAM: Jēzu niē skacz
- 242 %pho: Jezu ꞑe skatꞑ
- 243 %mor: N:VOC:Jezu PART:NEG|nie V:IMP:1:SING|skacz
- 244 %eng: Jesus do not jump
- 245 *BAR: @xxx zdjęcie do naszēgo
- 246 %pho: zdjētēe do našego
- 247 %mor: N:NOM:SING|zdjęci-e PREP|do
PRO:POS:GEN:SING:2:PLUR|nasz-ego
- 248 %eng: photo to our
- 249 *BAR: pilnika piēknēgo
- 250 %pho: pīłꞑka piēknego
- 251 %mor: N:GEN:SING|pilnik-a ADJ:GEN:SING|piēkn-ego
- 252 *BAR: koniec
- 253 %pho: koꞑec
- 254 %mor: N:NOM:SING|konie-c
- 255 %eng: the end
- 256 *MAM: przēstań skakać
- 257 %pho: pzēstaꞑ skakate
- 258 %mor: V:IMP:2:SING|przestań V:INF|skaka-ć
- 259 %eng: stop jumping
- 260 *MAM: rozūmiesz co do ciēbie mōwię
- 261 %pho: rozumjēs co do tēbie muvie
- 262 %mor: V:PRES:2:SING|rozumie-sz PART|co do
PRO:PER:REF:1:SING|ciebie
- 263 V:PRES:1:SING|mōwi-ę
- 264 %eng: do you understand what I am talking to you
- 265 *MAM: niē skacz
- 266 %pho: ꞑe skatꞑ
- 267 %mor: PART:NEG|nie V:IMP:1:SING|skacz
- 268 %eng: do not jump
- 269 *MAM: niē skacz bo mniē do szātu doprowādzisz zārąz

- 270 %pho: ɲɛ skatɕ bo mɲe do ɕawu doprowadziɕ zaraz
 271 %mor: PART:NEG|nie V:IMP:2:SING|skacz CONJ|bo
 PRO:PER:REF:1:SING|mnie
 272 PART|do N:GEN:SING|szał-u V:2:SING|do-prowadzi-sz ADV|zaraz
 273 %eng: do not jump it drives me crazy
 274 *BAR: &ɕ=screaming
 275 *BAR: m̄ama
 276 %pho: mama
 277 %mor: N:NOM:SING|mam-a
 278 %eng: mom
 279 *BAR: @xxx b̄adź c̄icho bo
 280 %pho: b̄ɔdʑ t̄ɛxo bo
 281 %mor: V:IMP:2:SING|b̄adź ADV|c̄icho CONJ|bo
 282 %eng: be quiet because
 283 *BAR: bo J̄ędrus̄ nagr̄ywa filmiki
 284 %pho: bo J̄ędrus̄ nagr̄ɪva filmiki
 285 %mor: CONJ|bo N:NOM:SING:DEM|J̄ędrus̄ V:PRES:3:SING|nagrywa
 286 N:ACC:PLUR:DEM|filmik-i
 287 %eng: be quiet because Jedrus is recording films
 288 *BAR: &ɕ=shouting
 289 *MAM: @xxx
 290 *BAR: &ɕ=singing
 291 *BAR: &ɕ=singing ↑
 292 *JED: m̄ama
 293 %com: whispering
 294 %pho: mama
 295 %mor: N:NOM:SING|mam-a
 296 %eng: mom
 297 *BAR: &ɕ=singing
 298 *JED: m̄ama
 299 %com: whispering
 300 %pho: mama
 301 %mor: N:NOM:SING|mam-a
 302 %eng: mom
 303 *BAR: mani [* n]

- 304 %com: neologism
 305 %pho: ma:ɲi
 306 *BAR: &ɕ=shouting
 307 *BAR: a:oa [* n]
 308 %pho: āaoa
 309 *BAR: ch̄yba @xxx
 310 %pho: xiba
 311 %mor: PART|chyba
 312 %eng: perhaps
 313 *BAR: &ɕ=shouting
 314 *BAR: &ɕ=singing
 315 *MAM: niē skacz
 316 %pho: ɲiē skatɕ
 317 %mor: PART:NEG|nie V:IMP:1:SING|skacz
 318 %eng: do not jump
 319 *BAR: &ɕ=singing
 320 *BAR: dłączēgo nie ma głōśni [* 0]
 321 %com: omission_głōśni-0
 322 %pho: dlatɕego ɲiē ma gwoɕɲi
 323 %mor: AUX:WH|dlaczego PART:NEG|nie V:3:SING|ma target_N:GEN
 324 %eng: why there is no [* 0]
 325 *BAR: dłączēgo niē ma głōsnych [* p]
 326 %err: s/ś
 327 %pho: dlatɕego ɲiē ma gwosɲix
 328 %mor: AUX:WH|dlaczego PART:NEG|nie V:3:SING|ma
 ADJ:GEN:PLUR|głōsny-ch
 329 %eng: why there is no loud
 330 *MAM: bo mōwisz
 331 %pho: bo muviɕ
 332 %mor: CONJ|bo V:PRES:2:SING|mōwi-sz
 333 %eng: because you are speaking
 334 *BAR: nie mōwię
 335 %pho: ɲiē muvie
 336 %mor: PART:NEG|nie V:PRES:1:SING|mōwi-ę
 337 %eng: I am not speaking

- 338 *BAR: ja przēcież niē mówīłem
 339 %pho: ja pʂetēeʂ ɲiē muviwem
 340 %mor: PRO:PER:1:SING|ja PART|przecież PART:NEG|nie
 V:PAST:1:SING|mówił-em
 341 %eng: but I was not speaking
 342 *JED: &ɣ=giggling
 343 *BAR: māma @xxx g̃fōs
 344 %pho: mama gwos
 345 %mor: N:NOM:SING|mam-a N:NOM:SING|g̃fōs
 346 %eng: mom sound
 347 *JED: &ɣ=whispering @xxx
 348 *BAR: tu jēst szlāban niē można przejęchać
 349 %pho: tu jes ʂlaban ɲiē można pʂejexat̃
 350 %mor: PRO|tu V:3:SING|jest N:NOM:SING|szlaban PART:NEG|nie
 V:INF|można
 351 V:INF|prze-jech-ać
 352 %eng: here is the bar cannot go
 353 *BAR: cō mam zrōbić
 354 %pho: co mam zrobite
 355 %mor: AUX:WH|co V:PRES:1:SING|mam V:INF|zrobi-ć
 356 %eng: what should I do
 357 *BAR: uwaga intaka [* n]
 358 %com: rhyming
 359 %pho: uvaga intaka
 360 %mor: N:NOM:SING|uwag-a
 361 %eng: watch out
 362 *BAR: &ɣ=yells
 363 *BAR: o niē ch̃yba
 364 %pho: o ɲiē x̃iba
 365 %mor: PART:NEG|o nie PART|chyba
 366 %eng: oh no perhaps
 367 *BAR: kręłka nie ma taka para [* n]
 368 %com: neologisms, unclear
 369 %pho: kr̃ka ɲiē ma taka para
 370 *BAR: mi (...) mi mi mi mi

- 371 %com: vocalizes: mi [x 5]
 372 *BAR: mi mim mi mim mi mim
 373 %com: pitch shifting: rise-fall-rise
 374 *BAR: t̄a:k
 375 %pho: tak
 376 %mor: AUX:AFF|tak
 377 %eng: yes
 378 *BAR: &ɛ=mumbles
 379 *BAR: oō ja upād̄lem na podłōgę
 380 %pho: o:o ja upadwem na podwoģe
 381 %mor: INT|oo PRO:PER:1:SING|ja V:PAST:1:SING|upadł-em ADV|na
 382 N:ACC:SING|podłog-ę
 383 %eng: oh I fell on the floor
 384 *BAR: ale zīmno mi
 385 %pho: ale zimno mi
 386 %mor: CONJ|ale ADV|zimno PRO:PER:REF|mi
 387 %eng: but I am cold
 388 *BAR: t̄ak to mi j̄est zīmno
 389 %pho: tak to mi jes zimno
 390 %mor: AUX:AFF|tak PRO:DEM|to PRO:PER:REF|mi
 V:PRES:3:SING|jest ADV|zimno
 391 %eng: this way I am cold
 392 *BAR: chōdź na chwīłę
 393 %pho: xotɛ na xfile
 394 %mor: V:IMP:2:SING|chodź PART|na ADJ|chwīłę
 395 %eng: come here for a moment
 396 *JED: &ɛ=whispering @xxx
 397 *BAR: &ɛ=singing
 398 *BAR: &ɛ=yells
 399 *BAR: ħii jūhu
 400 %com: wordplay
 401 *BAR: dłączęgo dziś nie ma głōsu
 402 %pho: dlatęģego dze n̄ie ma gwosu
 403 %mor: AUX:WH|dłaczego ADV|dziś AUX:NEG|nie V:PRES:3:SING|ma
 404 N:GEN:SING|głos-u

405 %eng: why today there is no sound
406 *BAR: &=screaming
407 *BAR: ja właśnie skaczę
408 %pho: ja vwaɛɲie skatʂɛ̃
409 %mor: PRO:PER:1:SING|ja PART|właśnie V:PRES:1:SING|skacz-ę
410 %eng: I am just jumping
411 @End

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Sveučilište u Aarhusu, Danska

Sinkroniziran i nesinkroniziran izgovor poljskih nazala *ɶ* i *ɛ* u govoru djece i odraslih

Sažetak

Nazali *ɶ* i *ɛ* u poljskom jeziku artikuliraju se na dva načina – sinkronijski i asinkronijski, a nazalnost je jedno od dvanaest distinktivnih obilježja poljskih fonema. Smatra se da način artikulacije nazaliziranih segmenata uglavnom ovisi o njihovu okruženju. U ovome je članku pažnja usmjerena na usvajanje jezika te je pretpostavljeno da se način artikulacije *ɶ* i *ɛ* značajnije razlikuje kod djece i odraslih govornika.

Spontani govor dvoje djece snimljen je i transkribiran uz pomoć programa CLAN. U radu su primijenjena vlastita pravila transkripcije u koju su uključeni podaci o fonetskoj realizaciji u standardu IPA s primarnim i sekundarnim naglaskom, morfosintaktičkom strukturom rečenice, posebnim komentarima o koartikulaciji ili pogreškama te niz paralingvističkih podataka o izgovoru. Krajnji redovi namijenjeni su engleskom prijevodu. Govor odraslih govornika poljskog jezika preuzet je iz korpusa SpokesWeb CLARIN.

Polazi se od pretpostavke da je asinkronična artikulacija nazala tipična za *ɶ* i *ɛ*, koji se nalaze ispred afrikativnih suglasnika, ali da je sinkronički način artikulacije ispred frikativa, jer su izmjereni segmenti nazalizirani u sredini slogovne jezgre konsonant-vokal-konsonant (CVC). Dodatno su istraženi nazali u krajnjem položaju konsonant-vokal (CV). Sinkronizacija segmenata bila je označena ako su se na spektru pojavile barem dvije od pet navedenih karakteristika: (1) dodatni formant (oko 300 Hz) s relativno visokom amplitudom – ponekad redukcijom F1, sažimanje prvog maksimuma s takozvanim nazalnim formantom; (2) povećane vrijednosti F1 i F3; (3) veći F4 u odnosu na nenazalni segment; (4) veće vrijednosti F3 te (5) prisutan dodatni maksimum u okviru 0,7 kHz, 1,0–1,2 kHz, 1,8–2,25 kHz i 2,7–2,9 kHz. Na osnovu tih kriterija napravljena je skala nazalnosti.

Spektrogramska analiza materijala pokazala je sličnosti u nazalima u govoru djece i odraslih, kao što su F2 i F3 u dometu 2 300 i 2 600 Hz, iako neka obilježja nazalnosti nisu bila zabilježena niti u jednom dječjem izgovoru grupe CVC /v̥ɛz/. Najveći stupanj nazalnosti dječjeg izgovora bio je zabilježen u grupama CVC /j̥ɛd/ i /v̥ɔs/. Detaljni prikaz nazalnosti u okviru 24 konsonantske skupine s nosnim segmentom sadrži Tablica 1. U budućim

istraživanjima pojavnosti nosne artikulacije poželjno je ponoviti postupak na većem broju ispitanika da bi se mogao donijeti zaključak o općenitim tendencijama nazalne artikulacije segmenata *ŋ* i *ɲ*.

Ključne riječi: usvajanje jezika, akustička fonetika, nazali *ŋ* i *ɲ*, poljski
