Poznań Studies in Contemporary Linguistics 46(4), 2010, pp. 565–588

doi:10.2478/v10010-010-0028-0

CONSONANT CLUSTERS ACROSS MORPHEME BOUNDARIES: POLISH MORPHONOTACTIC INVENTORY AND ITS ACQUISITION

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ABSTRACT

Morphonotactics is a term introduced by Dressler and Dziubalska-Kołaczyk (2006) to refer to the interaction of phonotactics and morphotactics. This paper examines the acquisition of phonotactics and morphonotactics, i.e. consonant clusters occurring within morphemes and across morpheme boundaries. It is hypothesized that morphonotactic clusters will be better retained in production than lexical clusters as they carry significant morphological information. Additionally, the acquisition of consonant clusters will be investigated in terms of markedness. With respect to markedness, two hypotheses have been put forward. Firstly, less marked (preferred) sequences will emerge earlier. Secondly, preferred clusters will be retained in production better.

KEYWORDS: Phonotactics; morphonotactics; markedness; language acquisition.

1. Polish morphonotactics

The concept of *morphonotactics*, which has been proposed rather recently to cover the area of interaction of phonotactics and morphotactics (Dressler and Dziubalska-Kołaczyk 2006), refers to the first of the three parts of morphonology introduced by Trubetzkoy (1931: 161ff), i.e. the study of the phonological structure of morphemes. Dressler and Dziubalska-Kołaczyk (2006) focus on shapes of morpheme combinations, especially those whose phonotactic make-up differs from phonotactics of lexical roots. This section will be devoted to the description of Polish morphonotactics.

Polish belongs to a group of strongly inflecting languages and it has very rich inflectional and derivational morphology. As a result of the complex morphological make-up, in Polish one may expect the occurrence of numerous morphonotactic clusters among consonant clusters. Complex clusters are tolerated both in initial position (up to four consonants, e.g. *wzbraniać* /ˈvzbraɲatɕ/ ‘to forbid’), final position (up to five, e.g. *przestępstw* /ˈpʃɛstɛmpstf/ ‘crimes’-GEN.PL.), as well as word-medially (up to five elements, e.g. *bezwzględny* /bɛzˈvzglɛndnɨ/ ‘ruthless’).

The first inventory of consonant clusters in Polish was compiled by Bargiełówna (1950). The author enumerated all possible consonant combinations in the word initial, medial and final position. In her inventory, Bargiełówna included consonant combinations present in morphologically complex words, and she marked a morphological boundary (/) or a dead morphological boundary (·). The author also presented quantitative data which showed the number of clusters in Polish in all word positions. Table 1 presents a summary of the results compiled by Bargiełówna.[1]

Table 1. The number of clusters in Polish in all word positions.
(Adapted from Bargiełówna 1950: 22 ff.)

Cluster size	Number of initial clusters	Number of medial clusters	Number of final clusters
Doubles	231[2] 216[3] (+15)[4] 191[5] 59[6] 34[7]	534 479 (+55) 305 353 179	100 78 + (22)
Triples	165 160 (+5) 65 110 15	754 615 (+ 139) 97 518	26 16 (+ 10) 9 7
4-member member clusters (and more)	15 6 9	134 109 (+25) 11 98	12 2 11

The first group of clusters are doubles. Initial doubles comprise 231 cluster types, 216 native and 15 non-native ones. Among native clusters, 191 types occur within a morpheme whereas 59 clusters occur across morpheme boundaries (34 of these clusters may occur both within and across morphemes). As regards medial doubles, the total number of clusters amounts to 534 (479 native clusters and 55 non-native clusters). Among native clusters, 305 occur within a morpheme, 353 occur across morpheme boundaries, and 179 occur both within a morpheme and across morpheme boundaries.

[1] It is necessary to take note of the criteria according to which the inventory of clusters was established. Firstly, Bargiełówna recognised the existence of the following consonant phonemes: /b b' p p' m m' v v' f f' d t z s ʒ c n ł š ž ǯ č r l ś ź ʒ́ ć ń g g' k k' x j/ (the Slavic Phonetic Alphabet, used by Bargiełówna, will be replaced here by the International Phonetic Alphabet). Secondly, Bargiełówna chose word as a unit of analysis, investigating clusters in a word initial, medial and final position.

[2] The total number of cluster types.

[3] The number of native clusters.

[4] The number of non-native clusters.

[5] The number of clusters occurring morpheme-internally.

[6] The number of clusters occurring across morpheme boundaries.

[7] The number of clusters occurring both morpheme-internally and across morpheme boundaries.

Finally, Bargiełówna identified 100 double finals, 78 of which are native clusters and 22 are non-native. In the case of final doubles, almost all of them occur within a morpheme. Only isolated cases occur across morpheme boundaries, for example, /jɕ/ in *czyjś* 'somebody's' as well as several dubious cases such as /kw/ or /tw/.

The second group of clusters constitute triples. The number of realised initial triples is 165 (160 native and 5 non-native clusters). Among the native group, 65 clusters occur within a morpheme, whereas 110 occur across morpheme boundaries (15 cluster types are both mono- or bimorphemic). As regards medial triples, the total number of realised clusters is 754, 615 of which are native and 139 are non-native. Among the native clusters, bimorphemic clusters constitute the vast majority (518), whereas monomorphemic constitute less than one sixth (97). Finally, the number of realised final triples is 26 (16 native and 10 non-native). Native clusters are monomorphemic in 9 cases and bimorphemic in 7 cases.

Four-member initial clusters are realised by 15 different types, 6 of which occur within a morpheme, whereas 9 are bimorphemic in nature. As far as medial quadruples are concerned, there are 134 types of realised consonant clusters, 109 of which are native and 25 are non-native. Eleven native clusters occur within a morpheme whereas 98 occur across morpheme boundaries. The number of realised final clusters (all native) is 12. Eleven clusters occur across morpheme boundaries and only 2 clusters intramorphemically.

On the basis of the data presented above, the richness of Polish phonotactics and morphonotactics is evident. One can observe that as the number of elements in a cluster grows, the cluster is more likely to contain a morphological boundary. To illustrate this finding with an example, there are 59 initial doubles containing a morpheme boundary compared to 191 lexical clusters. However, already in the case of initial triples one can notice that there are almost twice as many morphonotactic clusters (110) as lexical ones (65). In the case of 4-member initials, a majority are morphological in nature. In the case of medials, the pattern is as follows: there are 305 lexical clusters and only 48 more morphonotactic double clusters (i.e. 353); in the case of medial triples, there are over five times more morphonotactic clusters than lexical ones (97 lexical vs. 518 morphonotactic ones). As for clusters of 4 (and more) members, 90% of clusters occur at a morpheme boundary. As far as finals are concerned, most of the morphonotactic clusters occur among clusters of 4 (and more) members, whereas doubles and triples are rather lexical in nature. The occurrence of such regularities and patterns in Polish indicates that complex clusters are indeed tolerated in a language, especially when they fulfil a morphological function.

According to Dressler and Dziubalska-Kołaczyk (2006), there are two sources of morphonotactic clusters: concatenative and non-concatenative ones. The former consists in adding affixes to the word root. The latter source generates clusters by means of such morphological operations as vowel~zero alternation, zero-Genitive-Plural formation or imperative formation.

The default mechanism leading to the creation of a morphonotactic cluster in Polish is affixation. Below, I present examples of inflectional and derivational affixes which, when added to a word root, may generate morphonotactic clusters. In Polish, most of the morphonotactic clusters come into being through derivation rather than inflection, since inflection is largely vocalic in nature. The selection of the morphemes was based (mainly) on Mizerski (2000).

(1) Derivational prefixes (ending with a consonant)
Nouns: *przeciw-*, *kontr-*, *nad-*, *super-*, *hiper-*, *eks-*, *śród-*, *pod-*, *bez-*, *przed-*
Verbs: *nad-*, *ob-*, *od-*, *pod-*, *przed-*, *roz-*, *dez-*, *nad-*, *od-*, *pod-*, *współ-*
Consonantal prefixes of verbs: *w-*, *wz-*, *ws-*, *z-*, *s-*
Adjectives: *współ-*, *nad-*, *ponad-*, *hiper-*, *super-*, *bez-*, *przed-*, *post-*

(2) Derivational suffixes (beginning with a consonant)
Nouns: *(-da)*, *-nie*, *-cie*, *-ka*, *-ctwo*, *-stwo*, *-two*, *-cja*, *-zja*, *-ki*, *-ba*, *-twa*, *-ca*, *-ciel*, *-nik*, *-nica*, *-niczka*, *-czy*, *-niczy*, *-nia*, *-dło*, *-szczyzna*, *-szczak*, *-na*, *-czyk*, *-czuk*, *-sko*, *-sztyl*, *-cia*, *-cio*
Verbs: *-nąć*, *-nieć*
Adjectives: *-ny*, *-ki*, *-czy*, *-liwy*, *-ski*, *-ni*

(3) Inflectional morphemes (mostly suffixes beginning with a consonant)
Nouns: -*mi*
Verbs: -*ł*, -*śmy*, -*ście*, -*my*, -*cie*, -*wszy*
Adjectives: -*szy*, *naj*- (prefix)

Several observations can be derived from the abundant list of morphological affixes in Polish. Firstly, Polish possesses non-syllabic consonantal prefixes: {s-}, {z-}, {w-}, {w-s-}, {w-z-} (a subset of which is biconsonantal; {w-s-}, {w-z-} being variants of each other), which when attached to a consonant-initial word stem, may generate the whole range of morphologically complex clusters. Examples of such clusters are numerous: *s-chodzić* /sxɔʥiʨ/ 'to go down', *z-robić* /zrɔbiʨ/ 'to do'-PERF., *w-robić* /vrɔbiʨ/ 'to set sb up', *wz-braniać* (*się*) /vzbraɲaʨ/ 'to refrain', *wschodzić* /fsxɔʥiʨ/ 'to rise' etc.

The second observation is that Polish possesses two non-syllabic consonantal suffixes, namely the preterit {-ł} and the infinitival {-ć}. The former suffix may generate such clusters as /tw rw sw/ in *poszedł* 'he went', *umarł* 'he died', *niósł* 'he was carrying' etc.[8] The latter triggers such clusters as /ɕʨ jɕʨ ɲʨ/ in *nieść* 'to carry', *przyjść* 'to

[8] The cluster /tw/ in *poszedł* includes a devoiced plosive due to the process of obstruent final devoicing, though the pronunciation /dw/ is also possible when the cluster is immediately followed by a voiced segment, e.g. vowel, as in *poszedł i wrócił* 'he went and came back'.

come’, *zacząć* ‘to begin’.[9] Apart from initial and final non-syllabic consonantal affixes, Polish has an array of syllabic prefixes ending in a consonant which, when added to a stem beginning with a consonant, triggers the emergence of morphonotactic medial clusters, e.g. *mówić* ‘to say’ vs. *odmówić* ‘to refuse’. Similarly, numerous suffixes beginning with a consonant (when added to a consonant-final stem) lead to the creation of morphonotactic medials, for instance, *mysz* ‘mouse’ vs *mysz-ka* ‘mouse’-DIM.

However, according to Dressler and Dziubalska-Kołaczyk (2006), there are also non-concatenative sources of morphonotactic clusters. The first mechanism leading to the creation of new marked clusters is the process of vowel~zero alternation. This rule is related to the demise of yers (or jers) in Slavic languages, also in Polish (Walczak 1999; Długosz-Kurczabowa and Dubisz 2001; Gussmann 2007). Proto-Slavic developed a pair of vowels called yers out of a pair of Indo-European vowels, /i/ and /u/. The two vowels behaved in a similar fashion in all Slavic languages: they got lost in some positions and turned into non-high vowels in others. The result is the emergence of a pattern of vowels alternating with zero. Polish turned the non-lost yers into the vowel /ɛ/. The examples below illustrate the process of triggering con-concatenative morphonotactic clusters, all of which have a marked status.

(4)	*len* ‘linen’	*lnu* /lnu/ ‘linen’-GEN.SG.
(5)	*wesz* ‘louse’	*wszy* /fʃɨ/ ‘lice’
(6)	*pies* ‘dog’	*psa* /psa/ ‘dog’-GEN.SG.
(7)	*mech* ‘moss’	*mchu* /mxu/ ‘moss’-GEN.SG.

Another morphological operation which perhaps does not lead to the emergence of a “new” cluster but simply changes the position in the word, is a rule of zero-Genitive-Plural formation. To illustrate this process, let us consider the following examples.

(8)	*przestępstwo* ‘crime’-NOM.SG.	*przestępstw* /pʃɛstɛmpstf/ ‘crime’-GEN.PL.
(9)	*matactwo* ‘chicanery’-NOM.SG.	*matactw* /matatstf/ ‘chicanery’-GEN.PL.
(10)	*miejsce* ‘place’-NOM.SG.	*miejsc* /mjɛjsts/ ‘places’-GEN.PL.
(11)	*tratwa* ‘raft’-NOM.SG.	*tratw* /tratf/ ‘rafts’-GEN. PL.

The final clusters in the second column words appear in this particular position exclusively in genitive plural. Similarly, imperative formation may often lead to the creation of marked final clusters, e.g. the imperative of *mizdrzyć się* ‘to wheedle’ could be realised as *mizdrz się* with the final /stʃ/. However, morphology repairs this phonologically

[9] The cluster /ɲtɕ/ is derived from a nasalised vowel, graphically represented by <ą>, which in this particular context, that is before an affricate, is realised as the oral vowel /ɔ/ followed by a nasal consonant with the same place of articulation as the following affricate (in this case, the alveolo-palatal /tɕ/). The presence of a nasal is also visible in the imperfective verbal form *zaczynać*.

marked form by adding a suffix {-yj}, making the original cluster /zdʒ/ remain medial. Otherwise the aforementioned clusters are medials, and as such they are less marked than if they were finals.

2. Markedness

In phonotactics-related studies, markedness has always been understood as and measured by sonority.[10] A good initial cluster tends to increase in sonority, whereas a good final cluster decreases in sonority.[11] Thus, words such as *plump* or *quilt* are examples of preferred unmarked clusters. However, sonority turns out to be an insufficient explanation. First of all, it cannot account for all the occurrence of clusters even in such a sonority-abiding language as English. Second, evaluating consonant clusters exclusively by means of sonority results in treating many different clusters equally. To provide an example, an unmarked cluster type – plosive + semi-vowel – may be represented by /pw bw pj bj tw dw tj dj kw gw kj gj/. It is evident that each of these sequences has a different status in the English language. What is more, some of these sequences are not attested in English, e.g. /pw/ or /bw/.

In this paper, markedness is defined in terms of the Beats-and-Binding model of phonotactics (henceforth, B&B), introduced and revised by Dziubalska-Kołaczyk (2002, 2009). The revised version of B&B phonotactics takes into account not only the sonority of a sound (which comes down to the manner of articulation; henceforth, MOA), but also place of articulation (henceforth, POA) and voicing (henceforth, Lx), which notationally can be written as |MOA| + |POA| + |Lx|. The new model determines the status of a cluster by means of a phonotactic calculator which adds the values for POA, MOA and voice (Dziubalska-Kołaczyk 2008; Dziubalska-Kołaczyk and Krynicki 2007).[12] The result is a Net Auditory Distance (henceforth, NAD). The NAD principle can be applied to clusters in all word positions.

To illustrate cluster evaluation with an example, let us consider the NAD condition for initial doubles:

$$\mathbf{C_1C_2V} \qquad \text{NAD (C1,C2)} \geq \text{NAD (C2,V)}$$

Figure 1. The Net Auditory Distance condition for double initial clusters in the revised B&B model (Dziubalska-Kołaczyk 2009: 60).

[10] In the present paper, the terms *unmarked* and *preferred*, *marked* and *dispreferred* will be used interchangeably.

[11] For the discussion of sonority (its definition, values and problems), cf. Selkirk (1984), Ohala (1992).

[12] The phonotactic calculator devised by Dziubalska-Kołaczyk and Krynicki (2007) can be accessed from the following website: <http://ifa.amu.edu.pl/~dkasia/calculator/>.

The condition reads:

> In word-initial double clusters, the net auditory distance (NAD) between the two consonants should be greater than or equal to the net auditory distance between a vowel and a consonant neighbouring on it.

In other words, a greater perceptual distance between the two initial consonants in terms of the three criteria saves the cluster. As a result /pw/, /bw/, /pj/, /bj/, all equally preferred in the canonical understanding of markedness, are no longer clusters of equal quality. In fact, the two former clusters are less preferred than the latter two, as the place of articulation of the two member consonants in the former pair is too close to each other (both share the feature of labiality). Conversely, bilabial and palatal places of articulation are rather distant, which makes the clusters /pj/ and /bj/ gain a more preferred status.

In comparison to bare sonority, the NAD principle is a better explanatory tool, as it makes use of more phonetically grounded features of consonant description, and as a result it has a greater potential for distinguishing between clusters and predicting their behaviour in different areas of external evidence. Moreover, it functions without the notion of the syllable.

The NAD conditions for the remaining word positions are specified by the well-formedness conditions specified below. The condition for double final clusters states:

$$\mathbf{VC_1C_2} \qquad \text{NAD (V, C1)} \leq \text{NAD (C1,C2)}$$

Figure 2. The Net Auditory Distance condition for double final clusters in the revised B&B model.

The condition reads:

> In word-final double clusters the net auditory distance (NAD) between the two consonants should be greater than or equal to the sonority distance between a vowel and a consonant neighbouring on it.

The condition for double medial clusters states:

$$\mathbf{V_1C_1C_2V_2} \qquad \text{NAD (V1, C1)} \geq \text{NAD (C1,C2)} \leq \text{NAD (C2,V2)}$$

Figure 3. The Net Auditory Distance condition for double medial clusters in the revised B&B model.

The condition reads:

> For a word-medial double cluster, the NAD between the two consonants should be less than between each of the consonants and its respective neighbouring beat, and it may be equal to the NAD between the first consonant and the beat preceding it.

The more a cluster diverges from the preference, the more marked it gets. The revised model of Beats-and-Binding will be used for the analysis of produced and reduced clusters in the process of acquisition in Polish.

3. Developmental phonotactics

The behaviour of consonant clusters has always occupied a significant place in developmental studies. The research has focused on the order of emergence (Fikkert and Freitas 2004), the markedness of emerging clusters (Dziubalska-Kołaczyk 1999), reduction factors and patterns (Lleó and Prinz 1996; Menyuk 1968; Kirk and Demuth 2005), cluster modification strategies (Chervela 1981; Łukaszewicz 2007), as well as the frequency of occurrence of clusters in children's speech in comparison to adult-based data (Milewski 2005).

When investigating the process of language acquisition in Russian children, Gvozdev (1961, after Milewski 2005) reported that Russian children start to produce clusters at the age 1;8–1;10. Linguistic data show that the phonotactic system is acquired by the age 2;3–3;0 though this remains to be a moot point. Before the phonotactic system is acquired, children reduce clusters to single consonants. In fact, as regards the chronological emergence of syllable profiles, data from 12 Dutch children reveal that the development of syllable profiles proceeds from CV only, through CV and CVC, subsequently CV, CVC, V, VC, to all syllable types, including those with clusters (Levelt et al. 2000, after Bernhardt and Stemberger 2007: 578f). This progression is compatible with universal syllable structure markedness. Many English-speaking atypically developing children follow a similar pattern of syllable development, i.e. CV > CVC > CCV/CVCC.

Since CV is the most universal, unmarked and natural syllable structure, more complex syllable types may be difficult to acquire. There are several strategies applied by children to avoid the production of consonant clusters: reduction, epenthesis, prothesis, substitution, assimilation, and syncope.

Few developmental studies on phonotactic acquisition took into account the existence of morphological boundaries. Kirk and Demuth (2005), who investigated factors affection reduction of initial sC (/s/ + stop and /s/ + nasal) sequences and their mirror images, final Cs (stop + /s/, nasal + /z/ sequences) in children, found little evidence for the effect of morphology, as the subjects produced stop + /s/ clusters in mono- and bimorphemic words with equal accuracy.

Marshal and van der Lely (2006) investigated cluster reduction in G-SLI children (children suffering from grammatical specific language impairment). In their study, the authors used past tense verbs containing clusters which might as well occur in monomorphemic words (monomorphemically legal clusters) and past tense verb forms which occur only across morpheme boundaries (monomorphemically illegal clusters). The performance on both types of verbs was investigated in the population of G-SLI children as well as normally developing children. The results of the study revealed that G-SLI children performed better on monomorphemically legal clusters, whereas normally developing children's performance showed no effect of morphonotactics, i.e. monomorphemically legal and illegal clusters had similar reduction rates.

Other studies which dealt with the issue of phonotactic acquisition with special reference to morphological boundaries in a cluster were conducted by Kamandulytė (2006) in Lithuanian and Freiberger (2007) in German. The former author investigated longitudinal data of a Lithuanian girl between the age of 1;8–2;8 and found out that clusters, e.g. /st/, /sk/, /nt/ were produced correctly earlier when they occurred across morpheme boundaries than within morphemes. A parallel longitudinal study of the acquisition of German morphonotactics in first language acquisition was conducted by Freiberger (2007). The author found that morphonotactic clusters, despite their frequently marked character, posed no additional difficulty in acquisition (however, the study showed no positive evidence in favour of morphonotactic clusters).

The present longitudinal study aims at presenting the process of phonotactic and morphonotactic acquisition in the case of a Polish child.

4. The acquisition of Polish morphonotactics

4.1. Hypotheses

The acquisition of Polish consonant clusters will look at two parameters: lexical vs. morphonotactic status of the cluster and markedness. The two hypotheses originate from the model of acquisition in the framework of Natural Morphology and Natural Phonology, which are functional theories. The first hypothesis predicts that morphonotactic clusters stand a better chance of being articulated faithfully because they signal morphological information. In order to maintain the necessary morphological distinctions, the child should produce bimorphemic clusters more successfully than monomorphemic ones (thus the child will pay attention to what is functional and instantaneously useful). The second hypothesis predicts that phonologically dispreferred clusters will undergo reduction more frequently than preferred ones. Moreover, the preferred clusters will emerge earlier than dispreferred ones. These assumptions follow from language universals which predict that unmarked structures emerge before marked ones. Markedness will be determined in terms of the NAD principles, as presented in Section 2.

4.2. Data

In order to test the two hypotheses, data from the acquisition of Polish were used. They came from the recordings of a Polish normally-developing monolingual child, Zosia,[13] who was recorded by her parents between the ages 1;7 and 3;2. The data were transliterated in the CHAT format (MacWhinney 2000) and examined auditorily by the present author. For the investigation of morphonotactics, samples were chosen from the database as presented in Table 2.

Table 2. Audio materials used for the investigation of Polish morphonotactics.

Period	Age	Length of recording
Period 1	1;7–1;9	127 min
Period 2	1;11 & 2;1	86 min
Period 3	2;8–2;9	133 min
Period 4	3;1–3;2	126 min

Thus, the development of Polish morphonotactics was observed over the four periods.

4.3. Method

The method applied in the analysis was the following: all vocabulary items containing a consonant cluster of any length in any word position – initial, medial and final – were extracted from the recordings. All instances of words which might cast doubt on the correct interpretation of their meaning or pronunciation were excluded. The remaining items were divided into two groups:

(1) Words in which the target cluster was produced correctly (other changes such as inaccurate quality of a vowel or a change in the quality of a simplex consonant were ignored).

(2) Words in which the target cluster underwent reduction (one or more segments in a cluster were deleted).

[13] Zosia is a typically developing Polish child whose spontaneous production was recorded for the purposes of the international project on "The acquisition of pre- and protomorphology" organised by W.U. Dressler. The project was sponsored by the Österreichische Akademie der Wissenschaften and by the Hochschuljubiläumsfonds der Gemeinde Wien. Zosia's recordings, comprising the age between 1;7 and 3;2, were recorded and transliterated by her mother. The data served as part of the Poznań contribution to the project (Dziubalska-Kołaczyk 1997).

Finally, all words were categorised according to their position in the word (initial, medial and final), as well as according to the main criterion of the study, namely the lexical or morphonotactic status of the target cluster.

4.4. Results and discussion

The data are presented in Tables 3, 4, 5, and 7. The tables present consonant clusters in the word initial, medial and final positions, and are further subdivided into intact and reduced, lexical (L) and morphonotactic forms (M). Each cluster denotes a given type, whereas a superscript number placed next to the cluster denotes tokens, i.e. the number of word occurrences featuring a given cluster.[14]

Clusters which occurred in proper names, onomatopoeic expressions or interjections rather than common words were labelled $CC(C)(C)^{PN}$ (proper name), $CC(C)(C)^{ONO}$ (onomatopoeic expression), and $CC(C)(C)^{I}$ (interjection) respectively. For the same reason, in order to make allowances for the fact that not all words have the same status in language, being extragrammatical words or proper nouns, some clusters appear in a given table slot twice.

Notation of the type *xy* > *x* illustrates the profile of a change (cluster *xy* underwent the reduction where element *y* was deleted whereas element *x* was retained). The arrangement of clusters in Tables 3, 4, 5 and 7 is made according to sonority (or the manner of articulation) from the least sonorous to the most sonorous (plosives–affricates–fricatives–nasals–liquids–semivowels). Sounds which are usually assigned the same sonority value are arranged from front to back (for instance, plosives are arranged in the order /p t k/).

Since the second purpose of the study is the analysis of consonant clusters in terms of markedness, preferred clusters have been underlined in the tables, whereas dispreferred ones have been left un-underlined. Triples (marked grey) have not been evaluated in terms of markedness. Since triples occur relatively scarcely, the percentages presented in Tables 6 and 8 concern doubles only.

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[14] Pronunciation of palatalised labial consonants in words such as *miasto*, *wiosna*, *biuro*, *pies*, *wierny* is twofold: synchronous and asynchronous (Zajda 1977). In synchronous pronunciation, the positioning of the tongue towards the soft palate occurs simultaneously with labial articulation, which is transcribed as /m’astɔ/ *miasto*, /v’ɔsna/ *wiosna*, /b’uro/ *biuro*, /p’ɛs/ *pies*, /v’ɛrnɨ/ *wierny*. In the case of asynchronous pronunciation, the movement of the central part of the tongue is retarded in relation to labial articulation and the softness is rendered as /mjastɔ/, /vjɔsna/, /bjurɔ/, /pjɛs/, /vjɛrnɨ/. The asynchronous pronunciation is heard among speakers from older generations but is very rare. The synchronous realisation, on the other hand, is the most frequent and the most widespread (Madejowa 1993). Both types of pronunciation are considered to be the norm. Since there is variation among speakers as to the pronunciation variant and both forms are equally acceptable, palatalised labial consonants will not be treated as clusters, that is candidates for reduction. In Zosia’s pronunciation, both synchronous and asynchronous pronunciations surface.

Table 3 presents clusters attempted by Zosia in the earliest period of investigation, that is at the age of 1;7–1;9.

Table 3. Cluster reduction in Zosia: Period 1.

Initials			
	Intact	L	–
		M	–
	Reduced	L	pt > p^{2}, kr > k^{5}, tʃ > tɕ^{5}, sp > p^{1}
		M	–
Medials			
	Intact	L	pt^{3} ^{w}t^{2}
		M	pk^{1} tk^{1} (kt$^{ONO\ 1}$) wk^{2} jk^{1}
	Reduced	L	dɲ > b^{1}, mb > b^{2}, wt > t^{7}
		M	tk > k^{1}, (kt^{ONO} > t^{3} k^{1}), ptɕ > b^{1}, wk > k^{2}
Finals			
	Intact	L	–
		M	–
	Reduced	L	ɕtɕ > ɕ^{1}
		M	–

Table 4 presents further productions of Zosia analysed in a slightly later period, at the age of 1;11 and 2;1.

Table 4. Cluster reduction in Zosia: Period 2.

Initials			
	Intact	L	–
		M	–
	Reduced	L	pt > p^{1}, gdʑ > dʑ^{1}, tʃ > tɕ^{2}, dr > d^{6}, dw > d^{1}, gw > g^{7}, xts > tɕ^{4} ts^{7}, ɕp > p^{4}, vw > j^{1}, mr > m^{1}, ml > m^{1}, spʃ > p^{2}
		M	–
Medials			
	Intact	L	pt^{1} nt^{2} nd^{7} ɲdʑ^{1}
		M	tk^{4} fk^{6} mk^{6}
	Reduced	L	ɕtɕ > ɕ^{1}, nt > t^{11}, nd > d^{1}
		M	(mb^{ONO} > b^{1}), mpk > pk^{1}, rtk > fk^{1}
Finals			
	Intact	L	–
		M	–
	Reduced	L	tr > t^{1}, st > ɕ^{19} s^{4}, ɕtɕ > ɕ^{1}
		M	–

Table 5 includes clusters which were attempted by Zosia at the age of 2;8–2;9 whereas Table 6 presents cluster reduction rates.

Table 5. Cluster reduction in Zosia: Period 3.

Initials			
Intact	L		gʥ^{1} pʃ^{33} bʒ^{1} dv^{5} pɕ$^{ONO\ 1}$ kʃ^{2} kʃ$^{PN\ 1}$ gʒ^{2} gʒ$^{PN\ 2}$ kɕ^{9} bl^{1} dl^{1} kl^{5} pw^{3} gw^{3} ʧt^{4} sp^{4} st^{12} sk^{3} ʃp^{1} ɕp^{6} xʦ^{5} xʨ^{2} fʃ^{2} vw$^{PN\ 1}$ sw^{4} xw^{4} mn^{3} mɲ^{7} dv^{j1} spʃ^{1} skl^{2} ʃkl^{1} zdj^{2} ɕpj^{2}
	M		sp^{2} zb^{3} sk^{1} zg^{1} sx^{2} zn^{1} zj^{3}
Reduced	L		pt > p^{1} t^{3}, kt > t^{3}, pʃ > ʨ^{1} p^{1}, tf > f^{1}, tʃ > ʧ^{8}, dʒ > ʤ^{1}, pl > p^{1}, tr > t^{6}, dr > d^{7}, dl > j^{8} l^{9} 0^{1} n^{30}, kr > k^{5}, dw > d^{1}, gʥ > ʥ^{6}, ʥv > ʥ^{3}, fʃ > ʃ^{8} ɕ^{5} x^{1}, vʑ > ʑ^{1}, sp > p^{1}, xʦ > ʦ^{2}, xʨ > ʨ^{1}, ɕf > ɕ^{1}, xf > x^{1}, sm > s^{2}, ɕɲ > ɕ^{5}, xl > x^{1}, vw^{PN} > v^{6,} gvj > gj^{1}, stʃ > ʧʃ^{1}, str > st^{3}, zdr > zd^{1}, zdj > ʑd^{1} zd^{1},ɕfj > ɕ^{5}
	M		zn > z^{1}, zr > z^{6} ʑ^{1}, vw > w^{2}, zj > ʑ^{2} fst > st^{1}
Medials			
Intact	L		pk^{2} tk^{1} kt^{5} ps^{2} pɕ$^{ONO\ 1}$ gʒ^{2} gɲ$^{PN\ 1}$ pr^{1} br^{1} pl$^{I\ 1}$ kl^{8} pw^{2} tsk^{1} ʧn^{1} tsj^{1} vd^{1} st^{26} sk^{2} zd^{2} ʑɲ^{1} ʃt^{1} ʃʧ^{21} ɕʨ^{2} ʑʥ^{2} ɕm^{3} ʒn^{1} sw^{2} nt^{1} nd^{9} ŋg$^{PN\ 5}$ nts^{1} ɲʨ^{7} ɲʥ^{7} lk^{2} rn^{1} lj$^{PN\ 2}$ wt^{2} jʥ^{4} wn^{2} ŋgv^{1} mpj^{3} wvj^{1}
	M		pk^{6} tk^{8} tk$^{PN\ 1}$ pʧ^{1} pʨ^{13} pʦ^{2} bn^{1} dn^{4} kn^{1} tɲ^{1} dɲ^{1} gɲ^{1} dw^{2} gw^{2} ʧk^{43} ʧn^{1} ʨm^{1} fk^{4} ʃk^{15} sk^{3} sts^{1} ʃn^{1} ʒn^{1} ʃl^{2} ʃw^{3} nt^{1} mk^{3} ŋk^{20} ŋk$^{PN\ 7}$ ɲʧ$^{PN\ 3}$ mn^{3} lk^{4} lk$^{PN\ 2}$ ln^{2} lɲ^{1} wk^{10} jk^{2} jʨ$^{PN\ 1}$ jn^{1} stk^{1} zbj^{1} ŋgn^{1} nʧk^{1} rpk^{1} lkj^{1} wtk^{1}
Reduced	L		tf > v^{1} t^{1}, tʃ > ʧ^{2}, dm > d^{1}, dr > d^{1}, bw > b^{2}, tsj > t^{1}, st > t^{1}, fʧ > ʨ^{2} ʧ^{3}, ʃʧ > ʧ^{1}, ʒʤ > ʤ^{1}, ɕt > t^{2}, sm > s^{1}, nd > d^{3}, ŋk > k^{1}, ɲʧ > ʧ^{1}, ɲʥ > ʥ^{5}, lb > b^{2}, lk > k^{10}, rg^{PN} > g^{1} , rv > n^{3}, lm > j^{1}, rn > n^{1}, wt > t^{2} ɕpj > sp^{1}
	M		tp > p^{1}, dn > d^{1} n^{3}, dɲ > ɲ^{1}, ʧk > k^{1}, ʧn > ʧ^{1}, zm > s^{1}, ʃl > ɕ^{2} ʃ^{1} ɕʨʨ >ɕʨ^{1}, dvr > w^{2}, stk > sk^{1}, stk^{j} > sk^{j1}, mpk > mk^{1}, mkn > kn^{1}, jpj > pj^{1}
Finals			
Intact	L		st^{29} ʃʧ^{3} ɕʨ^{3} nt^{1} ŋk^{1} nts^{4} ɲʨ^{1} lk^{1} wf^{1} wn^{2}
	M		ɲʨ^{1}, ɕʨ^{5} jɕʨ^{2}
Reduced	L		st > s^{48} ɕ^{4} ç^{2}, ɕʨ > ɕ^{1}, sw > s^{2}, nts > ʦ^{1}, ɲʨ > ʨ^{1}, rf > f^{1}
	M		tw > t^{2}, ɕʨ > ɕ^{5}

Table 6. Cluster reduction in Zosia: Period 3.

		Lexical				Morphonotactic			
		Produced		Reduced		Produced		Reduced	
Total initials	Types	27		25[a]		7		4[a]	
	%	52		48[a]		64		36[a]	
	Tokens	128		131[a]		13		12[a]	
	%	49		51[a]		52		48[a]	
P/D initials		P	D	P	D	P	D	P	D
	Types	18	9	15[c]	10[c]	1	6	3[d]	1[d]
	%	55	47	45[c]	53[c]	25	86	75[d]	14[d]
	Tokens	29	99	82[d]	49[d]	3	10	11[d]	1[d]
	%	26	67	74[d]	33[d]	21	91	79[d]	9[d]
Total medials	Types	39		23[a]		36		7[a]	
	%	63		37[a]		84		16[a]	
	Tokens	137		50[a]		179		12[a]	
	%	73		27[a]		94		6[a]	
P/D medials		P	D	P	D	P	D	P	D
	Types	21	18	10[c]	13[c]	13	23	2[c]	5[c]
	%	68	58	32[c]	42[c]	87	82	13[c]	18[c]
	Tokens	95	42	23[c]	27[c]	103	76	2[c]	10[c]
	%	81	61	19[c]	39[c]	98	92	2[c]	12[c]
Total finals	Types	10		6[b]		2		2[b]	
	%	62.5		37.5[b]		50		50[b]	
	Tokens	46		60[a]		6		7[a]	
	%	43		57[a]		46		54[a]	
P/D finals		P	D	P	D	P	D	P	D
	Types	7	3	4[c]	2[c]	1	1	1[e]	1[e]
	%	64	60	36[c]	40[c]	50	50	50[e]	50[e]
	Tokens	11	35	5[c]	55[c]	1	5	2[d]	5[d]
	%	69	39	31[c]	61[c]	33	50	67[d]	50[d]
		Without *jest*							
Total finals	types	9		5		–		–	
	%	64		36					
	tokens	17		6		–		–	
	%	74		26					
P/D finals		P	D	P	D				
	types	7	2	4[d]	1[d]	–	–	–	–
	%	64	67	36[d]	33[d]				
	tokens	11	6	5[d]	1[d]	–	–	–	–
	%	69	86	31[d]	14[d]				

Legend: ([a]) confirmation of hypothesis one: morphonotactic clusters reduced less frequently than lexical ones; ([b]) disconfirmation of hypothesis one: morphonotactic clusters reduced more frequently than lexical ones; ([c]) confirmation of hypothesis two: dispreferred clusters reduced more frequently than preferred ones; ([d]) disconfirmation of hypothesis two: dispreferred clusters reduced less frequently than preferred ones; ([e]) inconclusive results (hypothesis one and two); P = preferred; D = dispreferred.

The data from the last period of acquisition are presented in Table 7 and cover the age of 3;1–3;2. Cluster reduction rates are presented in Table 8.

Table 7. Cluster reduction in Zosia: Period 4.

Initials			
Intact	L		kt^{1} gdʑ^{4} pʃ^{27} bʒ^{2} tf^{2} dv^{3} tʃ^{4} kʃ^{1} kʃ^{2} kɕ^{3} pr^{2} pl^{2} tr^{2} dr^{1} kr^{1} kl^{3} pw^{7} gw^{2} ʧt^{2} sp^{8} st^{6} sk^{3} ɕp^{2} xts^{8} fʧ^{1} ʃʧ^{1} fʃ^{6} sf^{2} sm^{2} zn^{6} vw^{3} xw^{3} zw^{10} mn^{3} mɲ^{7} dvj^{1} dvj^{2} skl^{6}
	M		sp^{4} zb^{2} zd^{2} fs^{1} fʃ^{1} fx^{2} sx^{1} zm^{1} zn^{6} vw^{1} zw^{1} zj^{1} skw^{1} zm^{j1}
Reduced	L		pt > t^{1}, kt > t^{3}, gdʑ > dʑ^{17}, pʃ > p^{1} ʃ^{1}, tʃ > ʧ^{2}, tr > t^{1}, dr > d^{1}, dl > n^{13}, kr > k^{15}, dw > d^{1}, sp > p^{1}, fʃ > ʃ^{8}, ɕf > ɕ^{7}, ʃʧ > f^{1}, xts > ts^{2} , xtɕ > tɕ^{1}, ɕɲ > ɕ^{1}, ɕl > ɕ^{2}, vr > l^{1}, vw > v^{1}, vw^{PN} > v^{2}, mɲ > ɲ^{2} kfj > kj^{2}
	M		ɕtɕ > tɕ^{1}, zr > z^{11} r^{1}
Medials			
Intact	L		pk^{7} tk^{1} ptɕ^{6} ps^{1} bʒ^{13} tʃ^{3} bn^{1} dɲ^{1} br^{2} pl^{4} tl^{2} gl^{4} pw^{2} kw^{8} ʣv^{1} tsj^{1} vd^{3} st^{23} sk^{5} ʃk^{2} ɕt^{4} ɕt$^{ONO\ 4}$ ʃʧ^{33} ɕtɕ^{3} ʑdʑ^{1} sm^{1} ʒn^{1} ɕm^{3} ɕɲ^{1} ʃl^{1} nt^{6} nd^{24} ŋk^{3} nts^{1} nʧ^{1} ɲtɕ^{4} ɲdʑ^{73} nn^{1} lk^{2} ln^{1} jd^{6} jdʑ^{2} jʒ^{4} wn^{1} tkj
	M		pk^{5} tk^{16} db^{1} gb^{1} ptɕ^{6} bn^{1} tn^{1} dn^{2} tɲ^{2} dɲ^{2} dl^{1} dw^{1} tsk^{3} ʧk^{32} tɕtɕ^{6} dʑm^{1} sk^{6} ʃk^{20} fk^{2} fts^{1} ʃtɕ^{1} sts^{1} ss^{1} vʒ^{1} vɲ^{2} zm^{1} zj^{1} mb^{1} mt^{2} mk^{1} nk^{2} ŋk^{8} mts^{1} ɲtɕ^{1} mɲ^{2} rk^{1} lk^{2} ltɕ^{1} wk^{2} jk^{5} jk$^{PN\ 1}$ jtɕ^{5} dvr^{1} stk^{9} mpk^{1} mkɲ^{1} ŋgn^{1}
Reduced	L		tʃ > ʧ^{3}, tr > t^{1}, fʧ > ʧ^{2}, mb > b^{1}, nd > d^{2}, ɲdʑ > dʑ^{1}, ɲ^{1}, lk > k^{10}, rd > d^{1}, rx > x^{1}, wd > d^{1}, jd > d^{4}, jdʑ > dʑ^{1}, jm > m^{1}
	M		dn > n^{1}, ɕtɕ > ɕ^{1}, ŋk > g^{1}, jl > l^{1} stk^{j} > tk^{j1}, mkn > kn^{1}, mkɲ > kɲ^{1}, ɲtɕtɕ > tɕtɕ^{1}, jpj > pj^{2} p^{j1}
Finals			
Intact	L		ɕtɕ^{2} st^{16} ʃʧ^{1} ɲtɕ^{1} wn^{1}
	M		ɕtɕ^{6} ɲtɕ^{2} jtɕ^{2}
Reduced	L		kt > k^{3}, st > s^{64} z^{1} ɕ^{2}, rf > f^{3}
	M		tw > t^{1}, ɕtɕ > ɕ^{5} jɕtɕ > jɕ^{1}

Table 8. Cluster reduction in Zosia: Period 4.[15]

		Lexical				Morphonotactic			
		Produced		Reduced		Produced		Reduced	
Total initials	Types	34		21[a]		12		2[a]	
	%	62		38[a]		86		14[a]	
	Tokens	142		85[a]		23		13[a]	
	%	63		37[a]		64		36[a]	
P/D initials		P	D	P	D	P	D	P	D
	Types	13	21	10[d]	11[d]	4	8	1[d]	1[d]
	%	57	67	43[d]	33[d]	80	89	20[d]	11[d]
	Tokens	45	97	40[d]	45[d]	4	19	12[d]	1[d]
	%	53	68	47[d]	32[d]	25	95	75[d]	5[d]
Total medials	Types	43		13[a]		41		4[a]	
	%	77		23[a]		91		9[a]	
	Tokens	271		30[a]		153		4[a]	
	%	90		10[a]		97		3[a]	
P/D medials		P	D	P	D	P	D	P	D
	Types	21	22	5[c]	8[c]	17	24	1[c]	3[c]
	%	81	73	19[c]	27[c]	94	88	6[c]	12[c]
	Tokens	212	59	10[c]	20[c]	104	49	1[c]	3[c]
	%	95	75	5[c]	25[c]	99	94	1[c]	6[c]
Total finals	Types	5		3[b]		3		2[b]	
	%	62.5		37.5[b]		60		40[b]	
	Tokens	21		73[a]		10		6[a]	
	%	22		78[a]		62.5		37.5[a]	
P/D finals		P	D	P	D	P	D	P	D
	Types	2	3	1[c]	2[c]	2	1	1[c]	1[c]
	%	67	60	33[c]	40[c]	67	50	33[c]	50[c]
	Tokens	2	19	3[c]	70[c]	4	6	1[c]	5[c]
	%	40	21	60[c]	79[c]	80	55	20[c]	45[c]
		without *jest*							
Total finals	Types	4		2		–		–	
	%	67		33					
	Tokens	5		6		–		–	
	%	46		54					
P/D finals		P	D	P	D				
	Types	2	2	1[e]	1[e]	–	–	–	–
	%	67	67	33[e]	33[e]				
	Tokens	2	4	3[d]	3[d]	–	–	–	–
	%	40	57	60[d]	43[d]				

Legend: See Table 6.

[15] It must be clarified that the results of the study were not subjected to statistical testing. Thus the presented results should be treated with caution. The pilot character of the study meant that it aimed at observing tendencies which must be further investigated on a more representative sample.

In the two earliest periods of investigation, Zosia produced relatively few items containing clusters, which is partially dictated by the shape of her lexicon.[16] All initial and final clusters are reduced. The first clusters to emerge in Zosia's productions are medials. The majority of produced medials, however, are morphonotactic clusters. The key morphological operation triggering morphonotactic clusters is the formation of diminutives, e.g. *kółko* 'circle', *główka* 'head'-DIM. (which are most probably rote-learned). One should remark that although some medial clusters start to emerge, they are far from stable in the sense that they often get reduced. Other potential morphonotactic clusters are missing as at this stage Zosia's morphology lacks rules that might lead to the creation of morphonotactic clusters. Due to the small amount of data in these periods, I will refrain from calculating cluster reduction rates, especially because certain groups of clusters, e.g. morphonotactic initials or finals are not attempted at this stage at all.

As far as the emergence of unmarked/marked clusters in the two earliest periods of Zosia's acquisition is concerned, one can make an observation about medials: the majority of the produced medials have a preferred status. In the lexical group, 75% (i.e. 12 out of 16 tokens) of all the correctly produced medial tokens were preferred. In the morphonotactic group 59% (i.e.13 out of 22 tokens) of all the correctly produced medial tokens were preferred. One might conclude that although the first medial clusters to emerge in Zosia's speech include both preferred and dispreferred clusters, the preferred ones constitute the majority.

Periods 3 and 4 differ from the previous two in two respects. Firstly, one can observe a clear vocabulary spurt and, by the same token, a cluster spurt. Secondly, morphonotactic clusters in all word positions are attempted, which means that significant morphological distinctions and numerous morphological affixes have been acquired. Table 6 and 8 present the reduction rates of clusters in all word positions, also with reference to their markedness. The reduction rates were calculated by dividing the number of reduced clusters (in a given word position) by the number of all targeted clusters (in a given word position).

I will now analyse the results of the study with reference to the first criterion of analysis, namely the lexical/morphonotactic status of the cluster. As regards initials, morphonotactic clusters are reduced less frequently than lexical ones by 12 % (period

[16] Zosia's early lexical repertoire contains word forms peculiar to herself, some of them are quite distant from the target form. Not infrequently, one word form is used to express several meanings: *pupi* is used to refer to *pies* 'dog', *piłka* 'ball', *piłeczki* 'ball-DIM.'; *papi* is used to refer to *parasol* 'umbrella', *piesek* 'dog-DIM.', *piłeczka* 'ball-DIM.', *piłka* 'ball', *ptak* 'bird', *czapeczka* 'cap-DIM.'. The opposite phenomenon may also be observed: one meaning may be realised through different forms: *pies*(*ek*) 'dog'-DIM. is realised as *pupi*, *pipi*, *pasi*, *pasiete*, *pata*; *piłeczka* 'ball'-DIM. is pronounced as *pipi*, *pupi*, *papi*. The above examples are quite distant renditions of the target words in which the feature of labiality is usually preserved but the syllable structure, vowels and consonants are distorted. Since the above Zosia-specific forms undergo many more processes than consonant cluster reduction, they will be exempt from the analysis and they will not be counted as instances of cluster reduction. Secondly, the author will also exempt from analysis words which are truncated or unfinished, e.g. *uś* for *usiąść* or *aci* for *otworzyć* 'to open' (Zosia's phonological and morphological development has also been studied by Dziubalska-Kołaczyk 1997).

3) and 24% (period 4) in the case of cluster types and by 3% (period 3) and 1% (period 4) in the case of cluster tokens. Although the results for cluster types seem to confirm the initial predictions, almost equal reduction rates for cluster tokens come as a surprise, and are incompatible with the original assumptions. In order to explain why the reduction rates for initial tokens are not lower than expected, one must consider the words reduced. A very frequent morphonotactic reduction is that of /zr/ as in *zrobić* 'to do', which contains an alveolar trill /r/.[17] An auxiliary study of Zosia's production of singleton consonants has shown that she faces severe difficulties with producing /r/, even in a CVCV sequence. This articulatory obstacle forces her to substitute or reduce this consonant also in clusters. What is remarkable, however, is that Zosia retains the morphological marker /z/ which expresses the perfective aspect. As a result, morphological information is retained. A similar observation can be made about the reduction of /zj/, whose reduction has a different motivation: /z/ is followed by a palatal approximant /j/ and in Zosia's production the fricative gets palatalised. As a result, instead of a sequence of a hard consonant followed by a palatal glide, we obtain an alveolo-palatal fricative /ʑ/. Thus despite a relatively high reduction rate of morphonotactic initials, morphological information is easily decodeable in most cases. If one excludes from the analysis all the initial clusters containing the troublesome /r/, the results immediately change in favour of our hypothesis: then the reduction rates of the lexical cluster tokens amount to 47% (period 3) and 33% (period 4), and the reduction rates of morphonotactic cluster tokens amount to 28% (period 3) and 4% (period 4). (Separate calculations of the reduction rates for all initials excluding C + /r/ sequences are provided in Appendix A.)[18]

As far as medials are concerned, the reduction rates for morphonotactic clusters are 21% lower than for lexical ones, both in the case of cluster types and tokens produced in period 3. As regards medial clusters in period 4, morphonotactic clusters are reduced less frequently than lexical ones by 14% in the case of types and 7% in the case of tokens. Such a reduction pattern fully confirms the original assumption about a better preservation of morphonotactic clusters.

As far as finals are concerned, one can observe that in the case of cluster types, the data work against the hypothesis: morphonotactic cluster types are reduced more frequently than lexical ones by 12.5% in period 3 and by 2.5% in period 4. In the case of

[17] For a detailed discussion of articulatory divergences in the production of /r/ by children cf. Łobacz (1996) and references therein.

[18] This footnote has been added in reply to a reviewer's comment on the markedness of individual segments. One could propose a difficulty/markedness hierarchy of singletons, as obviously certain consonants are more challenging for children in the process of first language acquisition than others. Moreover, one could also raise the question of potential difficulty of certain consonant–vowel transitions, e.g. approximants /w/ and /j/ are not problematic as such, however, in combinations with /u/ and /i/ respectively, they are clearly disfavoured. These examples show that the revised Beats-and-Binding model of phonotactics has a great potential which requires further development and testing.

cluster tokens, the situation is reversed, it is the lexical clusters which are reduced more frequently than morphonotactic ones by 3% in period 3 and 40.5% in period 4.

As for the nature of reduction of final clusters, the high reduction rate of lexical finals can be ascribed to the extremely frequently reduced final cluster /st/ in the word *jest* 'is'. This type of reduction is also present in the speech of adults and is thus phonostylistic in nature. If one excludes the word *jest* from the analysis, in period 3 lexical clusters are better preserved than morphonotactic clusters both type-wise (by 14%) and token-wise (by 28%). Upon excluding *jest* in period 4, lexical clusters undergo reduction more frequently 16.5% (token-wise).

As regards morphonotactic reductions, the reduction of morphonotactic /ɕtɕ/, as in *iść* 'to go', as well as /tw/ in *przyszedł* 'he came' also occurs in the speech of adult speakers. What is remarkable from the point of view of our analysis is that neither of these reductions lead to the loss of morphological information. The first example, *iść* /iɕtɕ/, is an infinitive. However, the reduction of the infinitival ending {-ć} does not lead to confusion, as this form is distinct enough from other forms in the inflectional paradigm, e.g. the present tense *idę* 'I go' or past tense *szłam* 'I was going'. A reduced word of this kind is perfectly decodeable by the listener. Similarly, the deletion of the final past tense suffix {-ł} in *przyszedł* does not lead to the loss of morphological information, as *przyszedł* 'he went' is distinct enough, phonologically and morphologically, from present tense *przychodzi* 'he is coming' or any other inflected form in the paradigm for that matter.

As far as the second object of this study is concerned, namely the markedness of clusters, the results are the following: as far as lexical clusters in period 3 are concerned, dispreferred clusters are reduced more frequently than preferred ones in all word positions, both type-wise and token-wise, with the exception of initial cluster tokens; in the morphonotactic group, the hypothesis is corroborated only in the case of medials, whereas in the case of initials and finals the prediction does not hold, i.e. it is the preferred clusters that undergo reduction more frequently. In period 4, the prediction holds for lexical and morphonotactic medial and final cluster types and tokens, but not for initials.

The following explanation should account for this inconsistency. Recall that a preferred cluster should have a rather great distance between the two consonants in the initial and final position, and as small a difference as possible in the medial position. A great distance between initial and final CC can be obtained through combining such two consonants as obstruent + approximant/trill. It is obstruent + approximant/trill sequences which are preferred, as they are good for perception. However, many of Zosia's initial reductions include sequences with approximants/trills. Firstly, many of the preferred reduced sequences contain the articulatorily difficult /r/, which makes C + /r/ difficult to produce; secondly many of the preferred reduced clusters consist of a obstruent followed by /w/, which in turn is followed by /u/ as in the word *Włóczykij* /vwutʃɨcij/ 'proper name'. The /w/ to /u/ transition is strongly dispreferred due to the feature of labiality which is shared by the semivowel and the neighbouring vowel. Thus, although

Table 9. Cluster reduction in Zosia: All periods.

<table>
<tr><th></th><th></th><th colspan="6">Produced</th><th></th><th colspan="7">Reduced</th><th colspan="2" rowspan="3">CRR
%</th></tr>
<tr><th></th><th></th><th colspan="6">Period</th><th></th><th colspan="7">Period</th></tr>
<tr><th></th><th>CC</th><th>I</th><th>II</th><th colspan="2">III</th><th colspan="2">IV</th><th>CC</th><th>I</th><th colspan="2">II</th><th colspan="2">III</th><th colspan="2">IV</th></tr>
<tr><td rowspan="6">Initials</td><td>sp^{18}</td><td></td><td></td><td>4</td><td>2</td><td>8</td><td>4</td><td>sp^{3}</td><td>1</td><td colspan="2"></td><td colspan="2">1</td><td colspan="2">1</td><td>20</td><td>0</td></tr>
<tr><td>sk^{5}</td><td></td><td>1</td><td>3</td><td>1</td><td colspan="2"></td><td></td><td></td><td colspan="2"></td><td colspan="2"></td><td colspan="2"></td><td>0</td><td>0</td></tr>
<tr><td>fʃ^{9}</td><td></td><td></td><td colspan="2">2</td><td>6</td><td>1</td><td>fʃ^{22}</td><td></td><td colspan="2"></td><td colspan="2">14</td><td colspan="2">8</td><td>73</td><td>0</td></tr>
<tr><td>zn^{12}</td><td></td><td></td><td colspan="2"></td><td>6</td><td>6</td><td>zn^{1}</td><td></td><td colspan="2"></td><td colspan="2">1</td><td colspan="2"></td><td>0</td><td>14</td></tr>
<tr><td>vw^{5}</td><td></td><td></td><td colspan="2">1</td><td>3</td><td>1</td><td>vw^{12}</td><td></td><td colspan="2">1</td><td>6</td><td>2</td><td colspan="2">3</td><td>71</td><td>67</td></tr>
<tr><td>zw^{11}</td><td></td><td></td><td colspan="2"></td><td>10</td><td>1</td><td></td><td></td><td colspan="2"></td><td colspan="2"></td><td colspan="2"></td><td>0</td><td>0</td></tr>
<tr><td rowspan="19">Medials</td><td>pk^{21}</td><td>1</td><td></td><td>2</td><td>6</td><td>7</td><td>5</td><td></td><td></td><td colspan="2"></td><td colspan="2"></td><td colspan="2"></td><td>0</td><td>0</td></tr>
<tr><td>tk^{31}</td><td>1</td><td>4</td><td colspan="2">9</td><td>1</td><td>16</td><td>tk^{1}</td><td>1</td><td colspan="2"></td><td colspan="2"></td><td colspan="2"></td><td>0</td><td>3</td></tr>
<tr><td>kt^{5}</td><td>1</td><td></td><td colspan="2">5</td><td colspan="2"></td><td>kt^{4}</td><td>4</td><td colspan="2"></td><td colspan="2"></td><td colspan="2"></td><td>0</td><td>80</td></tr>
<tr><td>ptɕ^{25}</td><td></td><td></td><td colspan="2">13</td><td>6</td><td>6</td><td>ptɕ^{1}</td><td>1</td><td colspan="2"></td><td colspan="2"></td><td colspan="2"></td><td>0</td><td>5</td></tr>
<tr><td>bn^{3}</td><td></td><td></td><td colspan="2">1</td><td>1</td><td>1</td><td></td><td></td><td colspan="2"></td><td colspan="2"></td><td colspan="2"></td><td>0</td><td>0</td></tr>
<tr><td>dɲ^{4}</td><td></td><td></td><td colspan="2">1</td><td>1</td><td>2</td><td>dɲ^{2}</td><td>1</td><td colspan="2"></td><td colspan="2">1</td><td colspan="2"></td><td>50</td><td>25</td></tr>
<tr><td>gɲ^{1}</td><td></td><td></td><td>1</td><td>1</td><td colspan="2"></td><td></td><td></td><td colspan="2"></td><td colspan="2"></td><td colspan="2"></td><td>0</td><td>0</td></tr>
<tr><td>tsk^{4}</td><td></td><td></td><td colspan="2">1</td><td colspan="2">3</td><td></td><td></td><td colspan="2"></td><td colspan="2"></td><td colspan="2"></td><td>0</td><td>0</td></tr>
<tr><td>sk^{16}</td><td></td><td></td><td>2</td><td>3</td><td>5</td><td>6</td><td></td><td></td><td colspan="2"></td><td colspan="2"></td><td colspan="2"></td><td>0</td><td>0</td></tr>
<tr><td>ʃk^{31}</td><td></td><td></td><td colspan="2">15</td><td>2</td><td>20</td><td></td><td></td><td colspan="2"></td><td colspan="2"></td><td colspan="2"></td><td>0</td><td>0</td></tr>
<tr><td>ʒn^{3}</td><td></td><td></td><td>1</td><td>1</td><td colspan="2">1</td><td></td><td></td><td colspan="2"></td><td colspan="2"></td><td colspan="2"></td><td>0</td><td>0</td></tr>
<tr><td>ʃl^{3}</td><td></td><td></td><td colspan="2">2</td><td colspan="2">1</td><td>ʃl^{3}</td><td></td><td colspan="2"></td><td colspan="2">3</td><td colspan="2"></td><td>0</td><td>60</td></tr>
<tr><td>mb^{1}</td><td></td><td></td><td colspan="2"></td><td colspan="2">1</td><td>mb^{4}</td><td>2</td><td colspan="2">1</td><td colspan="2"></td><td colspan="2">1</td><td>100</td><td>50</td></tr>
<tr><td>nt^{9}</td><td></td><td>2</td><td>1</td><td>1</td><td colspan="2">6</td><td>nt^{11}</td><td></td><td colspan="2">11</td><td colspan="2"></td><td colspan="2"></td><td>55</td><td>0</td></tr>
<tr><td>ŋk^{38}</td><td></td><td></td><td colspan="2">27</td><td>3</td><td>8</td><td>ŋk^{2}</td><td></td><td colspan="2"></td><td colspan="2">1</td><td colspan="2">1</td><td>25</td><td>3</td></tr>
<tr><td>ɲtʃ^{4}</td><td></td><td>1</td><td colspan="2">3</td><td colspan="2"></td><td>ɲtʃ^{1}</td><td></td><td colspan="2"></td><td colspan="2">1</td><td colspan="2"></td><td>50</td><td>0</td></tr>
<tr><td>ɲtɕ^{11}</td><td></td><td></td><td colspan="2">7</td><td>3</td><td>1</td><td></td><td></td><td colspan="2"></td><td colspan="2"></td><td colspan="2"></td><td>0</td><td>0</td></tr>
<tr><td>lk^{12}</td><td></td><td></td><td>2</td><td>6</td><td>2</td><td>2</td><td>lk^{19}</td><td></td><td colspan="2"></td><td colspan="2">10</td><td colspan="2">9</td><td>83</td><td>0</td></tr>
<tr><td>ln^{3}</td><td></td><td></td><td colspan="2">2</td><td colspan="2">1</td><td></td><td></td><td colspan="2"></td><td colspan="2"></td><td colspan="2"></td><td>0</td><td>0</td></tr>
<tr><td rowspan="2">Finals</td><td>ɕtɕ^{16}</td><td></td><td></td><td>3</td><td>5</td><td>2</td><td>6</td><td>ɕtɕ^{13}</td><td>1</td><td>1</td><td>0</td><td>1</td><td>5</td><td>0</td><td>5</td><td>35.5</td><td>48</td></tr>
<tr><td>ɲtɕ^{5}</td><td></td><td></td><td>1</td><td>1</td><td>1</td><td>2</td><td>ɲtɕ^{1}</td><td></td><td colspan="2"></td><td colspan="2">1</td><td colspan="2"></td><td>33</td><td>0</td></tr>
</table>

the cluster obstruent + /w/ is classified as a good one, the longer string, i.e. the cluster + the following vowel, make it difficult for the child (and as a matter of fact for an adult too) to pronounce.

On the other hand, good medials are those clusters which have the smallest possible distance between CC; the consonants in turn should be maximally distant from the neighbouring vowels. What follows from this condition is that the best clusters are those consisting of two obstruents. Since medial obstruents + approximants/trill sequences are dispreferred, and Zosia faces difficulty producing clusters with approximants/trills, it is dispreferred clusters which get reduced more frequently.

Finally, let us turn our attention to the behaviour of clusters which occurred in the data both morpheme-internally and across morpheme boundaries. Table 9 presents all lexical and morphonotactically-driven clusters which occurred in the four acquisition periods in both contexts. The Roman numerals refer to the period of acquisition, and the shaded fields show values for morphonotactic clusters.

As regards initials, the clusters /sp fʃ vw/ occurred both within and across morpheme boundaries: lexical /sp/ was reduced in 20% of the cases, whereas morphonotactic /sp/ was always retained in production; lexical /fʃ/, which occurred in such words as *wszyscy* ‘everybody’ or *wszystko* ‘everything’, was reduced 22 times out of 30 targets, whereas morphonotactic /fʃ/ was retained (though it occurred only once); /vw/ was reduced several times both in the lexical and in the morphonotactic case, but the reduction rate for the latter was slightly lower (67% compared to 71% for the lexical cluster). Only one initial cluster in the data set behaved in the opposite manner: morphonotactic /zn/ was reduced once out of 7 targets, whereas lexical /zn/ was produced correctly in the six targeted cases.

As far as medials are concerned, in period 3 and 4 lexical cluster /lk/ in *tylko* ‘only’ was reduced in 83 % of the cases, whereas morphonotactic /lk/ in, e.g. *lalko* ‘doll-VOC.’ was always produced correctly. The reduction of /lk/ in *tylko* also happens to occur in adult language. According to Madelska (2005), *tylko* is pronounced as /tɨlkɔ/ in 79.2% and as /tɨkɔ/ in 11.7% of the cases.

Several other medial clusters were reduced more frequently as lexical clusters: /mb nt ŋk ɲtʃ lk/. On the other hand, clusters which had higher reduction rates when morphonotactic included /tk/, /ptɕ/ and /ʃl/. Some clusters remained intact both in lexical and morphonotactic contexts, e.g. /pk bn gɲ ɲtɕ tsk sk ʃk ʒn ln/.

As regards similar observations in final clusters, the only clusters common to the lexical and morphonotactic category were /ɲtɕ/ and /ɕtɕ/. The former had a higher reduction rate as a lexical one (33%), whereas as a morphonotactic cluster it was always retained. The latter cluster was reduced regardless of its mono- or bimorphemic status (the reduction rates for the morphonotactic /ɕtɕ/ were actually higher than for the lexical one).

4.6. Summary

The aim of this paper was to give an insight into Polish morphonotactics and present its acquisition by a Polish child. The two major questions to be answered were: Do morphonotactic clusters undergo reduction less frequently than lexical ones due to their morphological function? Do marked/dispreferred clusters undergo reduction more frequently than unmarked/preferred ones? The results at least partially corroborated these hypotheses. The points where the results diverged from the original assumptions revealed that the cluster reduction rates may be also affected by other intervening factors, such as articulatory difficulty of member consonants in a cluster, unfavourable consonant–vowel transitions leading to consonant deletion, phonostylistic tendencies also observed in the adult language, as well as the reduction of the consonant of the stem accompanied by the retention of the suffix.

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APPENDIX

The cluster reduction rates on the exclusion of C + /r/ clusters in period 3 and 4.

Period 3
Initials without C + /r/

		Lexical				Morphonotactic			
		Produced		Reduced		Produced		Reduced	
Total initials	Types	27		22[a]		7		3[a]	
	%	55		45[a]		70		30[a]	
	Tokens	128		113[a]		13		5[a]	
	%	53		47[a]		72		28[a]	
P/D initials		P	D	P	D	P	D	P	D
	Types	18	9	12[b]	10[b]	1	6	2[c]	1[c]
	%	60	47	40[b]	53[b]	33	86	67[c]	14[c]
	Tokens	29	99	64[c]	49[c]	3	10	4[c]	1[c]
	%	31	67	69[c]	33[c]	43	91	57[c]	9[c]

Period 4
Initials without C + /r/

		Lexical				Morphonotactic			
		Produced		Reduced		Produced		Reduced	
Total initials	Types	30		17[a]		12		1[a]	
	%	64		36[a]		92		8[a]	
	Tokens	136		67[a]		22		1[a]	
	%	67		33[a]		96		4[a]	
P/D initials		P	D	P	D	P	D	P	D
	types	9	21	6[c]	11[c]	4	8	0[b]	1[b]
	%	60	67	40[c]	33[c]	100	89	0[b]	11[b]
	tokens	39	97	22[c]	45[c]	4	19	0[b]	1[b]
	%	46	68	54[c]	32[c]	100	95	0[b]	5[b]

Legend: ([a]) confirmation of hypothesis one: morphonotactic clusters reduced less frequently than lexical ones; ([b]) confirmation of hypothesis two: dispreferred clusters reduced more frequently than preferred ones; ([c]) disconfirmation of hypothesis two: dispreferred clusters reduced less frequently than preferred ones. P = preferred; D = dispreferred.