

THE ACQUISITION OF PALATALIZATION IN RUSSIAN

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The paper treats the acquisition of palatalization for dental and labial stops in prevocalic environments in Russian using data from the 1927 longitudinal study of A.N. Gvozdev which describes the early stages of phonological acquisition by his son. The initial goal was a reanalysis of Gvozdev's data to provide a description of the phonemic as well as phonetic facts in the data. That is, not merely to describe the acquisition of individual sounds, but to describe the child's pre-adult phonological system(s).

To provide a general framework for the acquisition of palatalization by the child, Gvozdev's own explanations, as well as previous explanations in the early stages of phonological acquisition in Russian [7], as well as studies of palatalization in Slavic languages are examined.

Finally, it is shown that the facts and issues in the child's acquisition of palatalization can best be explained by showing which phonemic contrasts have been acquired and by relating the child's acquisition to specific phonetic properties and ambiguities, eg. formant frequencies of vowels, of the adult system.

INTRODUCTION

This paper treats the acquisition of palatalization for dental and labial stops in prevocalic environments in Russian. The data used is from the 1927 longitudinal study of A.N. Gvozdev [7], in which he describes the early stages of phonological acquisition by his son, Ženja.

I will argue that in order to best explain the facts and problems of the acquisition of palatalization, it is necessary to understand the child's pre-adult phonological system. That is, one must not only examine the phones in isolation, as Gvozdev did, but also the development of phonemic contrasts and syntagmatic constraints. Furthermore, the child's developing system must be examined within the context of the relevant facts, phonemic and phonetic, of the adult system.

Phonology of Russian

The Russian phonological system includes five vowel phonemes, the front vowels /i e/, the back vowels /a o u/, and a series of consonants which fall into classes according to place and manner of articulation. These consonants may utilize palatalization either contrastively or as an obligatory feature. This paper will examine the dental stops /t d n/ (and their palatalized counterparts /t' d' n'/) and the labial stops /p b m/

(and their palatalized counterparts /p' b' m'/). Palatalization functions distinctively for dental and labial stops in Russian before the phonemes /i a o u/ and in final position. Before the phoneme /e/ in native Russian words the phonemic distinction is neutralized. Only the palatalized variant of the consonant appears. There is therefore an asymmetry in the distribution of phonemic palatalization before different vowel phonemes in Russian.

The effect of palatalization on vowel phonemes in Russian is very strong. Even though there are only five vowel phonemes, it is traditional to distinguish at least two phones for each phoneme conditioned by the presence or absence of palatalization of the surrounding (especially preceding) consonants. [4] [15]

DATA

The source for the data in this paper is the diary of Gvozdev, a Russian philologist who observed his son from the age of one year and seven months until eight years of age. I will be concerned with data relevant only to the acquisition of dentals and labials in prevocalic position, for the time period one year seven months (1,7) to two years four months (2,4). Behaviour of the segments in final position was not considered because final segments are often treated in a special way or omitted in the early stages of acquisition. [9] The data will be presented in phonetic transcription.

At the stage 1,7-1,9, sequences where a non-palatalized labial should appear before a phonemic back vowel are produced correctly by the child [mas'a] ([máslə] 'butter'), [pat'] ([spat'] 'to sleep'). Where a palatalized labial should appear before the vowels /i/ and /e/, the child pronounces the sequences correctly [p'is'i] ([p'isʲ] 'write!'). For nonpalatalized labial before phonemically front /i/ (phone [i]), the child produces a palatalized labial and the front allophone ([m'is'ka] for [máškə] 'mouse' (dim.)) For palatalized labial before phonemic back vowel the child produces the palatalized labial and a front vowel [p'et'] for [p'æt'] /p'at'/ 'five'. Palatalized dentals before phonemic back vowels are produced correctly [t'ot'a] ([t'ótʲə] 'aunt!'). None of the sequences of nonpalatalized dental and phonemic back vowel are correct. The palatalized dental occurs instead [t'am] ([tam] 'there'). Palatalized dentals before /i/ or /e/ are correct: [d'i] ([id'i] 'go!'). Nonpalatalized dentals

which should occur before /i/ are mispronounced by the child. [T'i] sequences appear instead of [T°i] [bad'i] ([bad'i] 'water' gen. sg.).

In the month 1,10-1,11 nonpalatalized labials before back vowels are all produced correctly by the child [s'abaka] ([s'abákə] 'dog'). Examples of the palatalized labial before phonemic front vowel are produced correctly [kup'il'a] ([kup'i'la] 'she bought'). The child mispronounces the adult [P°i], producing [m'ija] for ([m'ila] 'washed' neut. sg.). The word requiring a palatalized labial before a phonemic back vowel alternates between front and back vowels [p'ec]-[p'ac'] ([p'et'] 'five'). Sequences of palatalized dentals before back vowel alternate palatalized and plain phones [s'en'a]-[s'ena] ([ž'n'a] 'ženja'). Most examples of non-palatalized dentals before /a o u/ are pronounced correctly [noga] ([mnógə] 'many'). Some forms alternate hard and soft dentals [paduka]-[pad'uka] ([padúškə] 'pillow'). Some have only the incorrect palatalized dental [d'und'uk] ([sundúk] 'box'). Palatalized dentals and front vowels are correct [n'is'ka] ([kn'iškə] 'book' dim. Adult [d'im] 'smoke' is produced as [d'im].

At the stage 1,11-2,0 sequences of plain labial and back vowel are produced correctly. Palatalized labials before /i e/ are also correct. Adult [P°i] are still incorrect [mam'i] ([mám'i] 'mama' gen. sg.). Adult [p'et'] 'five' occurs incorrectly as [p'ec']. Most of the palatalized dentals and back vowel sequences are now produced correctly [d'ot] ([id'ót] 'he/she goes'). Most sequences of plain dental and back vowel are correct. All cases of palatalized dental and /i e/ are correct. Adult [T°i] is either incorrect [t'i] ([t'i] 'you') or shows alternating forms [d'im]-[d'im] 'smoke'.

In the following months (2,0-2,4) the child's system of palatalization moves towards the adult system.

At the first pre-adult stage (1,7-1,9), for the labials, palatalization is distributed according to the following vowel: [P'] before /i e/ and [P°] before /a o u/. In contrast to this distribution, dental stops occur as [T'] before all vowels.

At the second stage (1,0-1,11) the labials show no change. [P'] appears before /i e/ and [P°] before /a o u/. The system for the dentals has changed and looks like the system for the labials. [T'] occurs automatically before /i e/. [T°] occurs before /a o u/ in most cases.

At the third pre-adult stage (1,11-2,0) there is no change for the labials: [P'] before /i e/ and [P°] before /a o u/. The system for the dentals has changed again. [T'] is still mandatory before /i e/. However, now [T'] may now occur before /a o u/ as well as [T°]. The child has begun to distribute palatalization according to adult phonemic constraints instead of according to vowel context. Furthermore, the appearance of alternation in [d'im]-[d'im] suggests that the dentals will soon adopt contrastive palatalization before /i/.

Gvozdev claims that by the end of the stage (1,7-1,9) both plain and sharp labials and sharp dentals have been acquired. The plain dentals are not acquired until 1,10.

The data at this stage shows that indeed, both hard and soft labial phones have appeared. However the labials appear in complementary distribution,

[P'] before /i e/ and [P°] before /a o u/. Therefore, it cannot be said that the phonemic contrast of palatalization has been acquired for the labials, or that the contrastive adult phonemes /P/ and /P°/ are truly present in the child's system.

The same situation obtains for the dentals in the period 1,9-1,10. Any hard dentals which are produced appear before /a o u/. Only soft dentals appear before /i e/.

The need to distinguish the two levels in acquisition (phonetic and phonemic) has been recognized in earlier works. Menn notes that there is a difference between "the ability to hit a phonetic target accurately and the more "cognitive" acquisition of the information that the two phones contrast phonologically." [14]

An interesting fact arising from the data is that the marked palatalized dental phones appear earlier than their unmarked plain counterparts. Gvozdev indicates only that the child may be missing a particular articulatory function and therefore cannot pronounce the plain phones.

Jakobson [11] offers a possible explanation. Part of his theory of language acquisition is the principle of maximal contrast. According to this theory, the first sound a child acquires is an "a" type vowel. A labial is the first consonant acquired because it provides for a maximum contrast with that vowel. Because a labial is a grave consonant, one of the next consonants to be acquired will be a dental, providing the opposition grave/acute. The fact that dentals appear first as [+palatalized] is not a problem, and indeed is crucial to this theory: "...the initial inclination of children to palatalize dentals can also be accounted for. Dentals are opposed to the labials by their distinct lightness and since palatalization...intensifies the lightness of the consonant, the palatalized dental sound offers the optimal degree of lightness." Jakobson indicates that the early appearance of palatalized dentals has been noted not only for Russian, but also in French, Polish, Estonian and Japanese. Further work in cross-linguistic phonology will verify the accuracy of Jakobson's hypotheses.

Further Discussion of Dentals and Labials

There is a paradox in the acquisition of palatalization in the early stages. Although nondistinctive variation arises first in the labials, the distinctive opposition occurs first in the dentals. Interestingly, these facts correlate well with the facts of adult Russian and other Slavic languages in which palatalization occurs more for dentals.

In adult Russian, dentals show the use of distinctive palatalization more than labials. Data from Avanesov shows that in final position, soft labials are becoming hard while dentals are not [4], showing that in final position dentals show more contrast.

As mentioned above, all dentals and labials are palatalized before /e/ in native Russian words. The situation in foreign borrowings is different. Before /e/ in these lexemes a consonant may appear as [-pal.]. However, as noted by Holden [8], the tendency to appear as [-pal.] is not equally utilized by all consonants. Labials assimilate (return to their neutralized state) before /e/, while the dentals maintain the distinctive contrast. Thus Holden suggests that, "...the opposition of

palatalization vs. nonpalatalization is most weakly developed for velars, more developed for the labials, and most developed for the dentals."

Vowel Context and Asymmetry

Earlier we showed that in the child's pre-adult systems the application of palatalization works differently in the environment of different vowels ([+pal] before /i e/, [+pal] before /a o u/).

If we examine adult Russian, such an asymmetry is not clear. Back vowels allow distinctive palatalization, but before the two front vowels palatalization works differently.

There are facts about other Slavic languages that do show the asymmetry. For example in contemporary standard Bulgarian distinctive palatalization is found only before back vowels. [3]

Another example of this asymmetrical application of palatalization before the two types of vowels can be found in the history of Slavic, in the dispalatalization of Ukrainian. The development, as noted by Jakobson [10], was that all palatalized consonants were dispalatalized before the front vowels, while they retained their palatalization before /a o u/. Since hard consonants also existed before /a o u/, it became the environment which allowed more distinctive palatalization.

EXPLANATIONS FOR PALATALIZATION PATTERNS

Factors affecting acquisition noted in the literature include articulatory constraints, phonological processes, avoidance, asymmetries in the adult system and others. This section will explore two kinds of explanations for the child's acquisition of palatalization: ambiguities in the adult acoustic signal and contextual constraints which cause assimilation or allow contrast. This phonetic model seems to most accurately explain the acquisition of palatalization in this child.

Ambiguities in the Russian Vowels

In a model of sound change proposed by Andersen, ambiguities in the utterances of adults open the way to possible reanalysis by a new generation of speakers. In a system with two features, "the language learner, who has to interpret its acoustic manifestations [must] make a number of decisions... how many phonological oppositions are involved... which of the constituents is superordinate and which subordinate." [1]. Andersen notes that the child may make different choices than the adult, choices made plausible by ambiguities in what he hears.

As stated by Ladefoged, "vowels can be described as points on a continuum in a way that is not true for consonants..." [12]. A continuum that needs to be divided into meaningful units is inherently ambiguous. The question, then, is what kind of division of the continuum the child is going to make. In this case, can Zenja's division of the vowels into the groups /i e/ vs. /a o u/ be given a phonetic explanation?

Fant (1970) provides the basis for an articulatory classification which permits the separation of vowels into the two groups [i e] and [a o u]. Fant shows that the distance of the maximum constriction from the front of the vocal tract is one of the most important dimensions for the vowels. The distance may be seen in Table I (from [5]).

Table I: Distance of the Main Constriction from the Front End of the Vocal Tract (in cent.)

[i]	[e]	[ɛ]	[u]	[o]	[a]
4	4	7.5	11	12	13

It is clear from Table I that /i e/ can be grouped together, apart from the rest of the vowels.

Fant also utilizes the front to back cavity volume ratio which he shows separate [u o a] from the other vowels. [5]

Palatalization consists of a constriction in the palatal region, precisely where the vowels /i e/ have their maximum constriction.

Looking at the acoustic shape of Russian vowels, we see the following formant values (from [5]):

Table II: Formant Frequencies

	i	e	ɛ	u	o	a
F1	240	440	300	700	535	300
F2	2250	1800	1480	1080	780	625

Here again, a division of vowels into the two groups /i e/ and /a o u/ is possible according to the height of the second formant.

A high second formant is the most important cue for palatalization. Vowels with a high second formant might well be expected to function in a special way with respect to palatalization.

The child's pattern of palatalization for the labial stops in all three stages is thus easily explained. He palatalized before /i e/, vowels that sound like and are articulated like palatal sounds, and does not palatalize before other vowels.

Dentals have a high second formant transition similar to the high second formant trajectory produced by palatalization, and that is easily confused with palatalization. For example, Andersen [2] has suggested that this kind of confusion has led speakers of certain Czech dialects to re-interpret palatalized labials as dentals. The child might, in a similar way, re-interpret all dentals, which have a high second formant characteristic of palatalization, as palatalized.

In the first stage, the child palatalizes all dentals. This is consistent with the high second formant transition of the dentals, and seems particularly likely re-interpretation given that he is hearing a language in which palatalized dentals occur. It seems that the palatalization of some dentals is overgeneralized to include all of them.

At the second stage the dentals have changed their distribution of palatalization. Before front vowels, both the consonant and the vowel have a front tongue constriction and a high second formant, forming a gesture and an acoustic shape similar to palatalization. In the environment before front vowels, the distinction between palatalized and nonpalatalized dentals is quite subtle acoustically.

Dentals before back vowels now appear as non-palatalized. The child has thus begun producing

dentals in two different ways, but does not use palatalization distinctively. The acoustic and articulatory characteristics of the following vowel, rather than the acoustic and articulatory characteristics of the consonant, now come to determine whether dentals are palatalized or not. The pattern for the dentals at the second stage is therefore the same as that for the labials.

In the third stage, there is no change for the labials or dentals before front vowels. Dentals before back vowels now may occur as palatalized or nonpalatalized. Palatalization causes a high second formant, while back vowels have a low second formant. Palatalization will therefore cause a steep downward glide of the second formant. In the absence of palatalization this very steep glide will not occur. Therefore, the distinction between palatalization and nonpalatalization should be highly audible before back vowels. It thus seems logical for the child to develop the contrast first for dentals before back vowels. The fact that back vowels allow more phonemic palatalization, and that dentals utilize phonemic palatalization to a greater degree than labials, is true also of adult Russian and other Slavic languages. The adult asymmetries and the child's acquisition patterns are both subject to the same phonetic constraints. (For further discussion of parallels in child and adult systems see [6].)

To return to our original question, given that the vowels are potentially ambiguous, what would lead Ženja Gvozdev to divide the vowel continuum into the groups front/back. Fant's analysis, utilizing maximum constriction and second formant height, shows that the Russian vowels really can be divided naturally into these groups. Therefore, it is not surprising that the child does so.

The substitutions made by the child become clear within Fant's framework. The child hears the adult sequence [Cɹ] and produces [C'i]. As indicated in tables I and II above, [ɹ] can be grouped with [i e] on the basis of both articulatory and acoustic factors (the point of maximum constriction and the height of the second formant). Furthermore, [ɹ] is an allophone of /i/ in the adult language. This apparently leads the child to reinterpret [ɹ] as [i].

The problem with palatalized labials before back vowels is more complex. As pointed out in literature on child language, children often deal with difficult combinations by avoiding them. [13] Ženja produces only one example of /P'/ before the back vowels [p'ec'] ([adult [p'ɛt'] from /p'at'/]). He maintains the correct palatalization but fronts the vowel. Although Fant does not include [ɛ] in his tables, he does say that "the centralization of /u/ /o/ /a/ phonemes in positions between two sharp [+pal] consonants resulting in the allophones [ü] [ö] and [æ] is manifested by a higher F2." [5]. Since a raised F2 is a cue for front vowels and palatalization, it is not surprising that the child reinterprets the combination of a palatalized labial and the front allophone of a back vowel as palatalization plus a front vowel.

CONCLUSION

This paper has presented the facts of acquisition of palatalization for dental and labial stops in prevocalic environment for one Russian child. It showed that the general facts of acquisition can best be explained not only by showing which phones have been acquired, but by showing which phonemic contrasts and syntagmatic constraints are relevant to the child's system. The child's development of palatalization has been shown to be related to the articulatory and acoustic properties of the adult system.

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