Palatalization in the Russian Verb System: A Psycholinguistic Study*

Elena Kulinich, Phaedra Royle, and Daniel Valois

Abstract: This paper presents experimental data on the processing of loanwords and nonce words that focuses on morphophonological alternations in Russian. It addresses the issue of how stem allomorphy involving palatalization of the velar/palatal and dental/palatal types in the Russian verb system is processed in adults. The processing of morphophonological alternations is shown to be quite variable (and probably unproductive) and to depend, on the one hand, on the distribution of allomorphs within the verb paradigm, and on the other hand, on verb class productivity. It is hypothesized that these differences should be reflected in child language acquisition.

1. Introduction

Russian verbs are traditionally divided into two conjugation groups, 1st and 2nd, based on their nonpast inflectional pattern. Verbs from the first conjugation group pattern with a thematic *-e-* (or *-ë-* [o] when stressed) in the nonpast (e.g., *čitaj-e-š'* 'read$_{2SG}$', *čitaj-e-t* 'read$_{3SG}$', *čitaj-e-m* 'read$_{1PL}$'), and those from the second conjugation group with a thematic *-i-* vowel in the nonpast (e.g., *vid-i-š'* 'see$_{2SG}$', *vid-i-t* 'see$_{3SG}$', *vid-i-m* 'see$_{1PL}$'). Stem correlations involving morphophonological alternations or other differences (e.g., alternating suffixes: *ris-OV-* 'draw$_{PAST}$' vs. *ris-UJ-* 'draw$_{NONPAST}$'; *tolk-NU-* 'push$_{PAST}$' vs. *tolk-N-* 'push$_{NONPAST}$', etc.) define a variety of subclasses within these two main groups. These subclasses are heterogeneous and of variable membership. There are 24 verb subclasses in the Russian verb system according to Jakobson's (1948) and Townsend's (1975) classifications, 20 subclasses according to Švedova (1980), and 16 according to Zaliznjak (1977/2003).[1] Jakobson's and

* The authors would like to thank the associate editor and three anonymous *JSL* reviewers for useful comments and suggestions. All remaining errors are ours.

[1] These Russian verb classifications were recently compared by Slioussar (2003), who emphasizes her preference for Jakobson's as well as Townsend's classifications for psycholinguistic studies. We also use Jakobson's classification in this paper. For example,

Townsend's classifications are based on one longer stem from which other stems are derived by a final vowel/consonant deletion rule. In this tradition, verbs are classified according to the stem type (e.g., *-aj-*, *-i-*, *-a-*, etc.). Švedova's and Zaliznjak's classifications are based on stem relations and usually reflect correlations between past and nonpast forms. For example, *-aj-* verbs (e.g., *čitat'* 'to read') are defined as verbs with an *aj/a* "relation" in Švedova (1980) and as verbs ending in *-at'* 'inf.', *-aju* 'nonpast-1sg.', and *-ajet* 'nonpast-3sg.' in Zaliznjak (1977/2003).

Stem correlations sometimes involve palatalization, which applies to stems ending in velar or dental consonants (see Tables 1 and 2). However, not all stems of this kind are subject to this type of palatalization. The stem correlation of the most productive Russian verb class (Jakobson's *-aj-* class) does not involve morphophonological alternations that result in consonant mutations (e.g., *čita-l* 'read$_{M.PAST}$', *čitaj-u* 'read$_{1SG.NONPAST}$'). Thus, past stems ending in velar (/k/, /g/, /x/) or dental (/t/, /d/, /s/, /z/) consonants theoretically have two possibilities in the nonpast: the consonant either remains constant or undergoes palatalization (see Table 1).

Table 1. Past to nonpast stem correlations in Russian for *-at'* infinitives

Past (infinitive)			**Nonpast (1sg.)**	
k	*xmy*[k]*at'*	'to harrumph'	k	*xmy*[k]*aju*
	xny[k]*at'*	'to whine'	č	*xny*[č]*u*
x	*či*[x]*at'*	'to sneeze'	x	*či*[x]*aju*
	pa[x]*at'*	'to plow'	š	*pa*[š]*u*
s	*bro*[s]*at'*	'to throw'	s	*bro*[s]*aju*
	pi[s]*at'*	'to write'	š	*pi*[š]*u*
z	*sle*[z]*at'*	'to climb down'	z	*sle*[z]*aju*
	ska[z]*at'*	'to tell'	ž	*ska*[ž]*u*
t	*sva*[t]*at'*	'to match'	t	*sva*[t]*aju*
	prja[t]*at'*	'to hide'	č	*prja*[č]*u*

Looking at stem correlations in the direction from the nonpast to the past forms (Table 2), we observe that there are 2 or 3 potential outputs for stems ending in palatal in the nonpast. Past stems either have a palatal consonant (and hence no alternation, as in *mol*[č]*u—mol*[č]*at'* 'to be silent') or a nonpalatal consonant and show an alternation, as in *pla*[č]*u—pla*[k]*at'* 'to cry', or

the verb *čitat'* 'to read', will be described as an *-aj-* verb, *xodit'* 'to walk' as an *-i-* verb, and *plakat'* 'to cry' as an *-a-* verb.

prja[č]*u*—*prja*[t]*at'* 'to hide'. It is clear that palatalization patterns in the Russian verb system, illustrated in Tables 1 and 2, are not transparent.

Table 2. Nonpast to past stem correlations in Russian for *-at'* infinitives

Nonpast (1sg.)		**Past (infinitive)**		
č	*pla*[č]*u*	k	*pla*[k]*at'*	'to cry'
	mol[č]*u*	č	*mol*[č]*at'*	'to be silent'
	prja[č]*u*	t	*prja*[t]*at'*	'to hide'
š	*pa*[š]*u*	x	*pa*[x]*at'*	'to plow'
	dy[š]*u*	š	*dy*[š]*at'*	'to breathe'
ž	*ska*[ž]*u*	z	*ska*[z]*at'*	'to tell'
	der[ž]*u*	ž	*der*[ž]*at'*	'to hold'

There are two types of palatalization in Russian: the first involves an automatic phonological process of consonant modification, for example, /d/ becomes [d^j], /s/ becomes [s^j] before /j/ or front vowels. The second, sometimes called consonant mutation, which is no longer phonologically conditioned, has resulted in morphophonological alternations such as /d/ ~ /ž/, /s/ ~ /š/, etc. We focus on this second type of alternation and refer to it also as palatalization here. For convenience, the phonemes /š, ž, č/ are called palatals. When describing stems with these phonemes, we use the terms "palatalized stem."

In this paper, we examine palatalization in two different morphological contexts: (i) in past/nonpast stem allomorphy of a subgroup of Russian *-a-* verbs, and (ii) in a subgroup of *-i-* verbs where only the 1sg. nonpast has a palatalized stem allomorph (see examples in Tables 4 and 5 below). The palatalization possibilities are not the same in the two tested verb paradigms. The *-a-* verb palatalization pattern involves velars but the *-i-* stem verbs do not. In addition, *-a-* and *-i-* verbs contain alternations in labials such as /b/~/bl/, /p/~/pl/, /v/~/vl/, etc., under the same morphological conditions as dentals in each verb class. These are not tested in our study because we are interested in alternations with palatal consonants such as /š, ž, č/ which occur with velars and dentals (see Table 3).

Table 3. Morphophonological alternations in *-a-* and *-i-* stem verbs

	-a- verbs			*-a-* and *-i-* verbs								
Consonants (C)	Velars			Dentals				Labials				
Past stem C	/k/	/g/	/x/	/t/	/d/	/s/	/z/	/b/	/p/	/v/	/f/	/m/
Nonpast stem C	/č/	/ž/	/š/	/č/	/ž/	/š/	/ž/	/bl/	/pl/	/vl/	/fl/	/ml/

Because the morphophonological alternation results in alternating stem forms, specific questions related to their representation and processing arise: How many representations must be stored in the speaker's mental lexicon (i.e., is there only one underlying stem or are all surface forms represented)? If only the underlying stem is represented, how is it related to the surface forms?

There are different theoretical approaches to the interaction between morphology and phonology, the main ones being:

(i) Phonological alternations. Surface representations are derived from an underlying representation via the application of phonological rules. Only the underlying form is stored in the lexicon (e.g., Chomsky and Halle 1968).

(ii) Allomorphic variation. In line with the exemplar-based models (e.g., Bybee 1995, 2001), all allomorphs are stored in the lexicon (see also Anderson 1992).

(iii) Mixed approaches. Both rule-based and exemplar-based processing can apply (e.g., Marcus et al. 1992, Pinker 1999, Bertram, Schreuder, and Baayen 2000; see also Royle, Beritognolo, and Bergeron 2012).

As some morphophonological alternations can be predictable, it is often assumed that there is one underlying stem from which related forms are derived. For example, in Dutch, voice/voiceless alternation leads to singular-plural allomorphy when the noun stem is combined with the plural *-en* suffix, as in *bed* [bɛt] 'bed', *bedden* [bɛdən] 'beds' (see Zamuner, Kerkhoff, and Fikkert 2012). The voiced consonant is considered to be the underlying one, and a process of devoicing applies when this consonant occurs word-finally. However, palatalization in Russian has become less productive (or unproductive) as a result of historical change, and its degree of predictability depends on linguistic generalizations that speakers can make from their representations. Since several types of relationships can be established between morphologically related words, we predict that speakers should make different generalizations. In this work we study palatalization only in the inflectional verb paradigm, which shows at least two different patterns of palatalization.

(1) In all nonpast forms of some particular inflectional paradigms (*-a-* verbs; see Table 4).

(2) In only the 1sg. nonpast form of some other verb paradigms (*-i-* verbs; see Table 5).

Table 4. Palatalization throughout the nonpast subparadigm in *-a-* stem verbs: *plakat'* 'to cry'

Past		Nonpast	
masc. sg.	plak-al	1sg.	plač-u
fem. sg.	plak-ala	2sg.	plač-eš'
neut. sg.	plak-alo	3sg.	plač-et
pl.	plak-ali	1pl.	plač-em
		2pl.	plač-ete
		3pl.	plač-ut

Table 5. Palatalization only in the 1sg. of the nonpast subparadigm in *-i-* stem verbs: *xodit'* 'to walk'

Past		Nonpast	
masc. sg.	xod-il	1sg.	**xo[ž]-u** ←
fem. sg.	xod-ila	2sg.	xod-iš'
neut. sg.	xod-ilo	3sg.	xod-it
pl.	xod-ili	1pl.	xod-im
		2pl.	xod-ite
		3pl.	xod-jat

In Tables 4 and 5, the palatalized allomorph is linked to two different grammatical meanings: to the nonpast in general (for the verb *plakat'* 'to cry') and to the 1sg. nonpast (for the verb *xodit'* 'to walk'), respectively. Since these may represent different paradigm pressures with respect to the palatalized allomorph (see Hay and Baayen 2005 for the importance of relations between the whole and the parts in a paradigm), it is fair to ask whether the difference between these two allomorphy types could be reflected in verb production, with one type of allomorphy possibly being processed more efficiently than the other one. For example, according to Bernštejn (1974), the 1sg. palatalized forms of verbs like *xodit'* 'to walk' tend to be replaced by forms with consonant modification (e.g., *xodju* 'I walk') in some dialects of Russian, but these forms are protected from paradigm leveling by codification norms of standard Russian. This suggests that verbs of the type *plakat'* should be better mastered because of their consistent palatalization pattern, as compared to verbs like *xodit'* which only have one modified form in the paradigm.

However, this does not take into account verb-class productivity.[2] Verbs like *xodit'* are members of a productive *-i-* verb class, while those like *plakat'* are members of a nonproductive *-a-* verb class (e.g., Slioussar 2003). So although *xodit'* only has one modified allomorph, the strength of its verb-class paradigm might protect it from leveling, while verbs like *plakat'* might be more susceptible to analogical pressure from the productive *-aj-* verb class. If so, the question arises as to how novel and recently borrowed verbs will be integrated into these paradigms, and whether palatalization in particular will be robustly maintained.

It is difficult to predict which types of linguistic abstractions speakers can make from these and other verbs with respect to palatalization. Our intuition suggests rather specific (i.e., lexicalized) knowledge of verbs with palatalized/nonpalatalized stem allomorphs. However, it is possible for Russian speakers to make generalizations about palatalization patterns related to different morphological contexts. More specifically, because of phonological similarity of *-i-* verb stems ending in dentals (Daland, Sims, and Pierrehumbert 2007), the alternation pattern as in *xo*[d']-*il* 'walk$_{M.SG.PAST}$', *xo*[ž]-*u* 'walk$_{1SG.NONPAST}$' is predictable and expected to be extended to novel *-i-* verbs, or to be productive (in the sense of Berko 1958). In both *-a-* and *-i-* verbs the palatalization is not an automatic phonological process.

We assume that palatalization productivity depends on verb class productivity and on the morphophonological pattern involved in allomorphy within the verb paradigm. We also assume that for the palatalization of the *-a-* verbs type (e.g., *pla*[k]-*al* 'cry$_{M.SG.PAST}$', *pla*[č]-*u* 'cry$_{1SG.NONPAST}$') speakers should not systematically apply palatalization to nonce stems ending in dental or velar consonants because in standard Russian this palatalization applies to a limited class of *-a-* stem verbs, and they are in competition with the very productive *-aj-* verb class which does not exhibit stem allomorphy.

The main questions are: Do Russian speakers make use of information about the distribution of palatalized vs. nonpalatalized allomorphs within verb paradigms (e.g., is the palatalized allomorph present in only one or in many forms in the paradigm)? And if they do, do they take verb class productivity into account (e.g., is palatalization more productive in verbs within a more productive class)? Our hypotheses are: (i) If consistency within a verb paradigm is a more important factor than verb class productivity, then speakers will extend the palatalization pattern of the *plakat'* type to nonce or borrowed verbs more often than the palatalization pattern of the *xodit'* type. (ii) If it is verb-class productivity that plays the more important role, then the pala-

[2] Verb classes that serve as a conjugation model for new or borrowed verbs are taken to be productive. For example, many computer-related borrowings in Russian fall into *-i-* verb class: *apgrejdit'* 'to upgrade', *xoldit'* 'to hold', etc. See Table 6.

talization pattern of the *xodit'* type (*-i-* verbs) will be more easily generalized than that of the *plakat'* type (*-a-* verbs).

These hypotheses were tested using two palatalization experiments involving nonce and loanwords. In order to exclude effects of analogical pressure from the productive *-aj-* verbs, we also conducted a depalatalization task (from the palatalized nonpast form to the target nonpalatalized past). Here we expected that if speakers do make generalizations about the correspondence between dental or velar consonants and palatal consonants, they will alternate palatalized nonpast stems with nonpalatalized past stems. The next section provides experimental data from the three production tasks with adults. In the following sections the data are discussed in relation to our hypotheses and to the acquisition of morphophonology. We conclude in section 5.

2. Data

In this section we address two types of data that allow insight into the process of palatalization in Russian verb paradigms. First, we present results from two nonce-probe tasks on palatalization (of the type given in Table 3). As the two tasks test palatalization in two opposite directions, from nonpalatalized to palatalized and from palatalized to nonpalatalized allomorphs, we call them the palatalization task and the depalatalization task, respectively. Second, we compare these results with data on the integration of computer-related loanwords (*-i-* verbs), the paradigms of which also contain palatalized and nonpalatalized allomorphs. In the nonce-probe tasks we study past/nonpast stem correlations in verbs which would involve palatalization over the whole nonpast inflection paradigm. In case of loanwords, only one form in the nonpast paradigm (nonpast, 1sg.) undergoes palatalization, while the stem allomorph of the other forms is not palatalized (as in *-a-* verbs). We think that it is useful to compare the data for nonce words and loanwords because these two kinds of stimuli are often used to test productivity of phonological or morphological processes.

2.1. Nonce-Probe Task

The aim of the written nonce-probe task (inspired by Berko's [1958] *wug*-test) was to test speakers' intuitive knowledge of palatalization and more specifically to understand whether morphological alternations are related to specific lexical entries or whether they can be applied to novel or less well-known, words. In order to study this we created a list of 16 nonce verbs with stem-final consonants that could potentially alternate with a palatal. Nonce verbs were created mostly by adding the infinitive suffix *-(a)t'* to existing monosyllabic (or disyllabic) names.

2.1.1. Task 1: Production of Nonpast Forms for Nonce Verbs

In this task adult speaker behavior was tested with respect to the application of palatalization in the nonpast to nonce-verb stems ending in dental or velar consonants.

2.1.1.1. Participants

A group of 20 native speakers of Russian participated in a written production task. All participants were adults aged between 20 and 50 years (M = 39.85, SD = 13.42). All participants were from Moscow, and all were speakers of standard Russian.

2.1.1.2. Stimuli and Procedure

A list of 16 novel verbs (see Appendix) was created primarily by adding (C)*at'* to a real word. Some nonce verbs are not based on existing words but are similar to them (for example, the nonword *fykat'* is similar to *fukat'* 'to huff'). All resulting nonce words were disyllabic (*snek* 'snack' → *snekat'*, *muxa* 'fly' → *muxat'*, *dva* 'two' → *dvasat'*) with stems ending in a velar or dental consonant. Thus, we controlled items for syllabicity (only disyllabic, 5–6 segment items were used in our experiment) and final consonant type (7 velar and 9 dental). We did not control stimuli for their stress pattern because we do not believe that stress is a factor in palatalization alternations.

Nonce verbs were presented in the infinitive form (e.g., *snekat'*) to the participants, who were asked to produce corresponding 1sg. nonpast forms by filling out blanks on a page (i.e., *Snekat'. Ja* ___). Given the behavior of the Russian verb paradigms illustrated above, for the nonce verb *snekat'*, for instance, participants could be expected to produce either *snekaju* (without palatalization) or *sneču* (with palatalization). The experiment lasted 15–20 minutes.

2.1.1.3. Results

Speakers' responses were coded as having a palatalized vs. nonpalatalized stem-final consonant. For the analysis, the number of palatalizations and nonpalatalizations was calculated for each subject and each item. Palatalization rates were quite low (much lower than chance).

Because of the distribution of responses, a nonparametric one-way chi-square analysis was run to compare the occurrence of both response types (palatalization vs. nonpalatalization), with the within-factor consonant type (dental vs. velar). Nonpalatalization occurred in the greater number of responses (n = 271), while palatalization occurred in the least number of re-

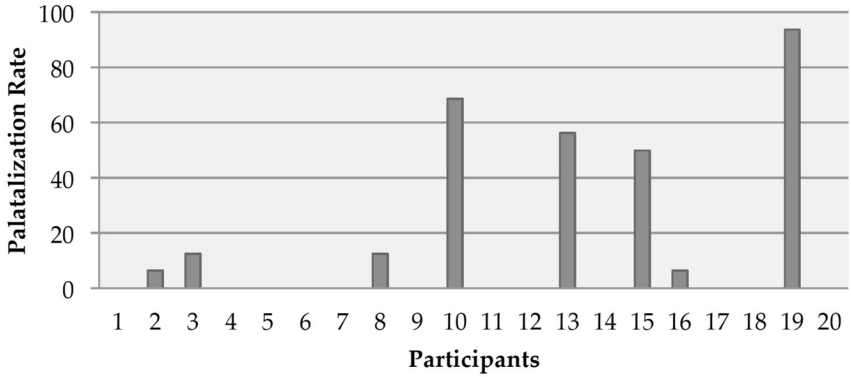

Figure 1. Percentage of palatalization by each participant in Task 1

sponses (n = 49): χ^2 (15, N = 320) = 154.01, p < .001. Consonant type had no effect on palatalization rates (χ^2 (15, N = 320) = 1.93, p = 0.17).

We observed variability in palatalization rates across participants. Palatalization was applied in 15.31% of responses on average (SD = 6.4), but participants divided in two groups: palatalizing and nonpalatalizing ones. Only eight of the twenty participants produced palatalized allomorphs in the 1sg. nonpast, and of these, only four applied it 50% of the time or more (see Figure 1 where palatalization rates are presented for each participant).

2.1.2. Task 2: Production of the Depalatalized Infinitive from 1sg. Nonpast of Nonce Verbs

The aim of this task was to test speakers' intuition on palatalization in the opposite direction: from the palatalized to the nonpalatalized allomorph. This is based on the observation that some Russian verb paradigms have only one palatalized stem (without allomorphy as in *molčat'* 'to be silent') within a paradigm, while others have palatalized/nonpalatalized allomorphs elsewhere in the paradigm. Thus, as in the Task 1, there is choice and possibly variability in applying palatalization.

2.1.2.1. Participants

A different group of 20 native speakers of Russian participated in a task similar to the first one. All participants were adults aged between 17 to 74 years old (M = 40.8, SD = 9.77) from Moscow who spoke standard Russian.

2.1.2.2. Stimuli and Procedure

Similar stimuli as in Task 1 were used in Task 2, but instead of producing the 1sg. nonpast from a given infinitive, the participants were asked to derive the infinitive from a given 1sg. nonpast form. The 1sg. nonpast form (e.g., *Ja sneču*) was presented to the participants, who were then asked to produce its corresponding infinitive form. The task lasted 15–20 minutes.

2.1.2.3. Results

Speakers' responses were coded as palatalized or nonpalatalized. As in Task 1 there was variability in the patterns observed. Depalatalization was applied in 28.7% (*SD* = 8.75) of all produced forms. As in Task 1, participants divided in two groups: half the speakers applied the alternation and only 6 of these did it more than 50% of the time, while 10 never depalatalized. (See Figure 2, where depalatalization rates are presented for each participant.) A one-way chi-square analysis was run to compare the two response types (depalatalization vs. no change). This revealed a statistically significant difference in the frequency of nonpalatalized versus palatalized stem production: χ^2 (15, N = 320) = 57.80, $p < .001$. Depalatalization occurred in the least number of responses (n = 92), while palatalized stems underwent no change in a greater number of responses (n = 228).

2.1.3. Discussion

Results from both experiments show that, as expected, (de)palatalization in Russian verbs is not fully productive. Nevertheless, the data suggest that these alternations may not be linked to specific lexical entries because they

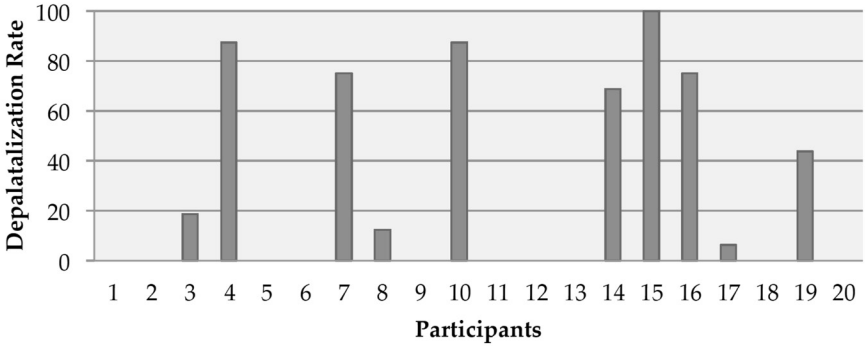

Figure 2. Percentage of depalatalization by each participant in Task 2

can occur with novel stems. However, if we observe the data more closely, we can see that of eight participants applying the alternation in Task 1, only four do it systematically, while the other four participants do it occasionally. In Task 2, six of ten participants are consistent in showing depalatalization more than 50% of the time, one does it less than 50% of the time, and three do it for fewer than 20% of produced forms. Even if not all participants applied the alternation (10 of 20 speakers did not do it at all) depalatalization appears to be productive at least for some speakers. This inconsistency in the results leads us to another possible explanation: (de)palatalization could be chosen by some participants as a response strategy. In view of the absence of these types of responses in a good number of participants, our results do not support the notion that palatalization is a productive pattern in Russian. The results also show that there is more variability in terms of depalatalization in Task 2 than there is with respect to palatalization in Task 1. We return to this result in section 3.

Speakers also sometimes make errors while applying palatalization. It seems that they have information about the presence of an alternation but use this information in an innovative way, for instance, by producing contaminated forms such as *mo*[šč]*u* from *mo*[s]*at'*.[3] In Russian, /s/ alternates with /š/ but never with /šč/. In addition, the example *sme*[č]*u* from *sme*[x]*at'* illustrates a case where /x/ alternates with /č/. In Russian, however, /x/ alternates with /š/ but never with /č/. Finally, examples such as *sne*[š]*u* from *sne*[k]*at'* or *mo*[k]*at'* from *mo*[š]*u* illustrate cases where /k/ alternates with /š/, which also does not normally occur in Russian.

2.2. Integration of New Computer Borrowings

In this section, we address the second type of allomorphy found in *-i-* verbs, where the final dental of the stem undergoes palatalization in the 1sg. nonpast as in, for example, the verb *xo*[d']*it'* 'to walk' – *xo*[ž]*u* 'walk$_{1SG.NONPAST}$'. For this study computer-related loanwords were used. Palatalization was tested in a similar written production task.

2.2.1. Task 3

In this task adult speaker behavior was tested with respect to the application of palatalization to loanwords ending in dentals.

[3] For statistical analysis these forms were coded as palatalized.

2.2.2. Participants

Twenty-three native Russian speakers (average age 21 years, *SD* = 3.6) participated in a production task involving computer-related loanwords verbs. All speakers were university students from Moscow and spoke standard Russian.

2.2.3. Stimuli and Procedure

The stimuli consisted of a list of verbs recently borrowed from English and used in computer-related contexts (Table 6). All of them were 2nd conjugation *-i-* verbs, and their stem-final dental could potentially alternate with a corresponding palatal in the 1sg. nonpast.

Participants were asked to derive the 1sg. nonpast from infinitives with stems ending in a dental consonant by filling in a blank in a written task. For example:

(3) *Ja (apgrejdit')* _____ *moj compjuter.*
'I (to upgrade) _____ my computer.'

Table 6. Russian computer-related *-i-* verb class loanwords used for Task 3

Verb in Russian	Origin
flud-i-t'	'to flood'
čat-i-t'-sja	'to chat'
konekt-i-t'-sja	'to connect'
otrout-i-t'	'to route'
frend-i-t'	'to make friends'
apgrejd-i-t'	'to upgrade'
xold-i-t'	'to hold'
fiks-i-t'	'to fix'
gejt-i-t'	'to gate'

2.2.4. Results

Speakers' responses were coded as palatalized or nonpalatalized. The alternation was applied in 51.66% (*SD* = 30.3) of the produced forms. Results show strong variability between items and between subjects, as evidenced by the large standard deviation. A nonparametric one-way chi-square analysis on frequencies for response types (palatalization vs. nonpalatalization) did not reveal a statistically significant difference between these two response pat-

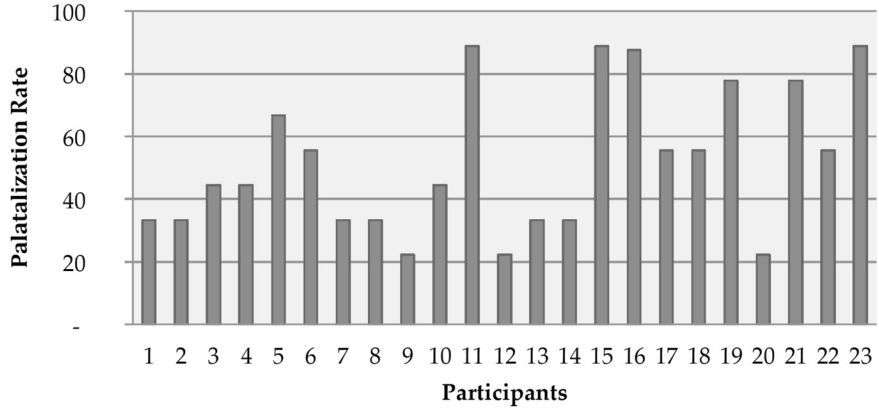

Figure 3. Percentage of palatalization on borrowings by each participant in Task 3

terns: χ^2 (22, N = 207) = .237, p = .627. Nonpalatalization occurred in almost the same number of responses (n = 107, 51.7%) as palatalization (n = 100, 48.3%). Thus, the data appear to show that Russian speakers do not agree on the form for the 1sg. nonpast of these verbs and produce forms either with or without palatalized alternation (see Figure 3 where palatalization rates are presented for each participant).

2.3. Comparison of Task 1 and Task 2

To determine whether there is a difference in applying morphophonological alternations in present-from-past derivation versus past-from-present derivation, an unpaired *t*-test was conducted between results of Task 1 and 2. A statistically significant difference was found (p < .001), with Task 1 showing less palatalization (15.31%, *SD* = 6.44) and Task 2 showing more depalatalization (28.99%, *SD* = 8.75). This shows that speakers have a stronger tendency to derive nonpalatalized stem allomorphs from palatalized ones than the reverse. In addition, as can be seen in Figure 4 (on page 350), this was the case for almost every individual nonce verb, except for the verbs *bru*[k]*at' ~ bru*[č]*u* (#6), *sme*[x]*at' ~ sme*[š]*u* (#8), and *šre*[k]*at' ~ šre*[č]*u* (#14).

2.4. Comparison of Task 1 and Task 3

In both of these tasks the direction of change was from the nonpalatal to the palatal stem, but the test was either on allomorphy of type 1 (past/nonpast) with nonce verbs or allomorphy of type 2 (1sg. nonpast/other forms) with loanwords. To determine whether there was a difference in applying palatal-

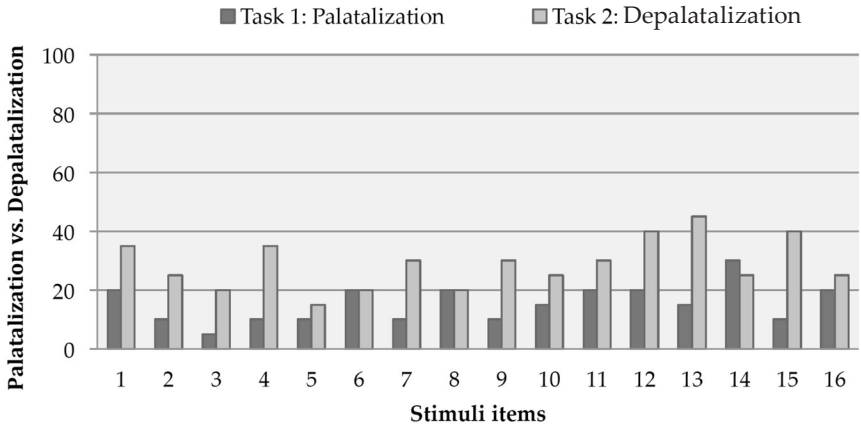

Figure 4. Percentage of palatalization in Task 1 vs. depalatalization in Task 2 for each verb

ization in both of these conditions, an unpaired *t*-test was conducted. Because of the different number of items in each task, an F-Test for homogeneity of variance was first done ($p < .001$). An unpaired *t*-test assuming nonhomogeneity of variance showed statistically significant differences between the two types of allomorphy ($p < .001$) with Task 1 involving nonce verbs, showing significantly less palatalization ($M = 15.31\%$, $SD = 6.44$) than Task 3, in which loanwords were used ($M = 51.66\%$, $SD = 30.3$).

3. Discussion

In section 2, we proposed that the same morphophonological alternation that leads to palatalized/nonpalatalized stem allomorphy is realized differently in different morphological conditions. We hypothesized that speakers can make different generalizations about palatalization that depend on the distribution of allomorphs within the verb paradigm and on verb class productivity. Specifically, we hypothesized that two factors may influence the processing of palatalization: (i) consistency of palatalization within a verb paradigm (in this case the palatalization that applies in *-a-* class verbs with past/nonpast allomorph distribution throughout the paradigm should be more productive) or (ii) verb class productivity (in this case allomorphy in *-i-* class verbs, where only the 1sg. nonpast stem allomorph is palatalized, should be productive). Finally, we expected that (iii) for the first type of allomorphy, there would be a difference in applying (de)palatalization in different directions: (i) from the nonpalatalized past to the palatalized nonpast stem, and (ii) from the palatalized nonpast to the nonpalatalized past stem. Depalatalization was expected to apply more often than palatalization. We hypothesized that this difference

could be related to analogical pressure from the most productive *-aj-* verb class, where there is no consonant alternation. In the palatalization task we expected this pressure to influence the application of palatalization, while the influence of *-aj-* verbs was excluded in depalatalization tasks.

Our results appear to have borne out our hypotheses. At first glance, both nonce verbs and loanwords show somewhat similar results: palatalization can be extended to both types of verbs. However, there is also an important difference between these two types of verbs. Participants of the two nonce-probe tasks divide almost completely into two groups: those who do not apply (de)palatalization processes and those who do. In addition, speakers who apply (de)palatalization do it either consistently (more than 50% of time) or occasionally (less than 20% of time). These results suggest that some speakers have chosen palatalization as a response strategy rather than extending this alternation productively to nonce words. Furthermore, on average only 15% of forms were palatalized. This is clearly not evidence for a productive morpho-phonological process.

There is even greater individual variability across subjects and across items in the task with loanwords. The comparison of Tasks 1 and 3 indicates that palatalization is more plausible in the condition where only the form of the 1sg. nonpast is palatalized in *-i-* verbs than when palatalization applies to all nonpast forms of *-a-*. This result was expected because *-i-* verbs are a productive verb class in Russian. However, even under this condition only 51.66% of forms are palatalized on average. We thus observe that palatalization is not as consistent as would be expected, even in ideal conditions for its realization. In our opinion, this either suggests that loanwords are not fully integrated and that the percentage of palatalization reflects instability of the integration process, or that pressure is exerted from the rest of the verb paradigm where all forms except the 1sg. are nonpalatalized.

The comparison of Tasks 1 and 2 shows that speakers depalatalize more often (28.99% of time) than they palatalize (15.31%), i.e., they prefer to apply the alternation deriving a nonpalatal allomorph from a palatal one over deriving a palatal allomorph from a nonpalatal one. We explain this result rather simply: in Task 2 there is no influence from the productive *-aj-* verb class on the output.

As discussed by Pierrehumbert (2006: 84–85) in her study on velar softening in English (as in *electri*[k]-*electri*[s]*ity*), understanding the productivity of an alternation "provides a crucial line of evidence about [speakers'] cognitive abstractions." Thus, if an alternation fails to extend to nonattested forms, it suggests that speakers do not form any abstract generalization for this specific rule. If the alternation is "aggressively and reliably" extended, it means that a generalization has been formed. In addition, "if the situation lies somewhere in the middle, then the exact pattern of productivity can yield insights about the exact character of the abstraction that is formed." In Russian, it seems that

palatalization represents an alternation that is neither completely unproductive nor reliably productive. Furthermore, the same alternation seems to have different degrees of productivity depending on several factors, such as the nature of allomorph distribution within a given paradigm, verb class productivity, or verb class interactions. Among these factors it seems that verb class productivity has more influence than allomorph distribution. The *plakat'* type of allomorphy (*-a-* verb class) is not productive, as these verbs constitute a limited class, and thus do not generalize to novel (nonce) verbs (e.g., *snekat' ~ snekaju*, not *sneču*) despite the fact that forms within the nonpast paradigm all exhibit the palatalized allomorph. These verbs are apparently subject to word-specific (and stem-specific) learning, and thus, palatalization is not readily extended to novel or nonce verbs. However, the second type of allomorphy observed in *-i-* verbs (e.g., *xodit'* 'to walk') is quite productive and therefore results in transfer to borrowings such as *apgrejdit'* 'to upgrade'. The reason for this is the more systematic application of palatalization in these verb paradigms: stems ending in dental consonants often palatalize in the 1sg. nonpast. The difference in applying (de)palatalization in different directions—from the nonpalatalized past to the nonpast stem, and from the palatalized nonpast to the past stem—can be explained by the presence (in palatalization Task 1) or absence (in depalatalization Task 2) of the productive *-aj-* verb class influence.

3.1. Possible Limitations to Our Study

Since our stimuli consisted in newly borrowed or nonce verbs, we did not take into account lexical neighborhood effects and frequency, which are undoubtedly important factors influencing lexical access and productivity. This issue needs to be addressed in further studies. However, even if the similarity of nonverbs to existing words of Russian in our study could influence results, we do not observe such effects in speaker behavior. For instance, speakers who apply palatalization seem to apply it to more than 50% of nonce verbs, while most participants do not palatalize at all. These results are in line with other evidence that morphophonological alternation productivity depends on type frequency and does not seem to depend on token frequency: "alternations found in extremely few types… are not productive no matter how frequently the irregular forms may be used" (Pierrehumbert 2006: 87). The palatalization pattern, the productivity of which we test with nonce verbs, is not related to high type frequency verbs (as the *-a-* verb class is unproductive), and thus the palatalization pattern is not reliably extended to nonce words. On the contrary, the palatalization pattern tested with borrowings falling into the *-i-* verb class appears to have been influenced by type frequency. Even if we observe item variability, the results suggest that speakers make a generalization about the alternation pattern involved.

Moreover, the productivity of some alternations may depend on word stress (as was shown for the vowel/zero alternation originating from the short vowel *jer* in Gouskova and Becker's 2013 study), but in the case of palatalization the morphophonological alternation was originally motivated by factors other than stress (i.e., a following front vowel or /j/). Thus, we would not expect to observe any strong effect of stress pattern on palatalization productivity in tested verbs. We cannot, however, completely exclude this factor as being irrelevant because it is possible that some Russian verb classes are associated with a particular stress pattern, and we admit that if these verb classes are productive, stress placement can play a role in prompting some morphophonological processes. According to Zaliznjak (1985), there is no correlation between verb classes and stress patterns, but a recent study by Slioussar (2003) suggests that each verb class in Russian has a particular stress pattern combination. For example, *-aj-* verbs have stress on the stem in past and nonpast forms, while *-i-* verbs have three combinations almost equally distributed among verbs of this class: (i) stress on the stem in past and nonpast forms, (ii) stress on the stem in past forms and on the inflection in nonpast forms, and (iii) stress on the stem in past forms and either on the stem or the inflection in nonpast forms. As for *-a-* verbs, they are equally distributed between two stress pattern types, either with stress always on the stem as in *-aj-* verbs (e.g., *pláka-t'* 'to cry', *pláč-u* 'cry$_{1SG.NONPAST}$' or with stress that changes position in the nonpast forms (e.g., *vjazá-t'* 'to bind', *vjaž-ú* 'bind$_{1SG.NONPAST}$', *vjáž-eš'* 'bind$_{2SG.NONPAST}$' From this, it is not clear how stress could influence palatalization pattern productivity, but this question should be addressed in future studies.

4. Implications for Child Language Acquisition

According to data from Russian child language, the acquisition of stem allomorphic variation is preceded by a period of verb overregularization (Cejtlin 2009). In early stages of language acquisition (3–4 year old) children seem to avoid allomorphy in two ways. Importantly, in both cases, there is a tendency to maintain paradigm uniformity. The processes involve either (i) levelling by analogy with other forms in the paradigm, or (ii) applying the so-called "*j*-correlation" model (Cejtlin 2009), which consists of inserting /j/[4] in the intervocalic position at the stem/inflection boundary, as in the most productive Russian verb class (e.g., *čita-l* 'read$_{M.PAST}$', *čitaj-u* 'read$_{1SG.NONPAST}$'). The former is illustrated by child productions such as *mo*[ž]*ut* instead of *mo*[g]*ut* 'be able$_{3PL.NONPAST}$' based on *mo*[ž]-*et* 'be able$_{3SG.NONPAST}$' or *xo*[č]*ut* instead of *xo*[t']*at* 'want$_{3PL.NONPAST}$' based on *xo*[č]-*et* 'want$_{3SG.NONPAST}$'. Alternations of the type presented in *-i-* verbs (e.g., *xod-it'* 'to walk' - *xo*[ž]-*u* 'walk$_{1SG.NONPAST}$')

[4] In their study on Russian verbal morphology, Gor and Chernigovskaya (2001) call this pattern "*j*-deletion."

are also eliminated by analogy of the 1sg. nonpast form to other forms in the paradigm: children produce *xo*[d']-*u* instead of *xo*[ž]-*u* in the 1sg. nonpast. The latter, the *j*-correlation model, applies to *-a-* stem verbs. For example, children will not palatalize consonants in verbs that should be palatalized (*pla*[k]*aj-u* instead of *pla*[č]-*u* 'cry$_{1SG.NONPAST}$' or *sprja*[t]*aj-us'* instead of *sprja*[č]-*us'* 'hide$_{1SG.NONPAST}$'). This process is transparent and does not involve any consonant alternations. It seems to be the preferred pattern used by children in early stages of language acquisition (3–4 years). Thus, the two types of allomorphy discussed in this paper tend to be eliminated in Russian child language through these two processes of overregularization.

In order to gain a better understanding of the acquisition of stem allomorphy involving palatalization, it is crucial to know how palatalization is processed by adult speakers of Russian. Acquiring these alternations appears to be a challenging task for children because they are faced with confusing data in the input. This suggests that word-specific learning should take place for these forms in the initial stages of Russian acquisition. If so, palatalization errors are expected to occur in the form of overregularization of one of the stems.

5. Conclusion

To conclude, the same morphophonological alternation, i.e., palatalization, that results in verb-stem allomorphy in Russian has apparently different representations and is differently processed in the adult language depending on the lexical status of the verb and its verb conjugation class. Palatalization seems to be less productive (or even unproductive) in a subgroup of verbs with past/nonpast stem allomorphy (corresponding to *-a-* verbs), while it is more prevalent but not completely productive in the 1sg. nonpast of a subgroup of 2nd conjugation *-i-* stem verbs. Among the factors that influence the productivity patterns discussed in this paper are allomorph distribution within a verb paradigm, verb class productivity, and verb class interactions within the whole Russian verb system. It seems that the influence of verb class on palatalization is greater than the pattern of allomorph relations in a verb paradigm. As was mentioned, both types of allomorphy are subject to overregularization in child language. The study of how different stem-allomorphy types involving palatalization are acquired in Russian is ongoing.

References

Anderson, Stephen R. (1992) *A-morphous morphology*. Cambridge: Cambridge University Press.

Berko, Jean. (1958) "The child's learning of English morphology". *Word* 14: 150–77.

Bernštejn, Samuil B. (1974) *Očerk sravnitel'noj grammatiki slavjanskix jazykov: Čeredovanija. Imennye osnovy*. Moscow: Nauka.

Bertram, Raymond, Robert Schreuder, and R. Harald Baayen. (2000) "The balance of storage and computation in morphological processing: The role of word formation type, affixal homonymy, and productivity". *Journal of experimental psychology: Learning, memory, and cognition* 26(2): 489–511.

Bybee, Joan. (1995) "Regular morphology and the lexicon". *Language and cognitive processes* 10(5): 425–55.

————. (2001) *Phonology and language use*. Cambridge: Cambridge University Press.

Cejtlin, Stella N. (2009) *Očerki po slovoobrazovaniju i formoobrazovaniju v detskoj reči*. Moscow: Znak.

Chomsky, Noam and Morris Halle. (1968) *The sound pattern of English*. New York: Harper and Row.

Daland, Robert, Andrea D. Sims, and Janet Pierrehumbert. (2007) "Much ado about nothing: A social network model of Russian paradigmatic gaps". *Proceedings of the 45th Annual Meeting of the Association of Computational Linguistics*. Prague: Association of Computational Linguistics, 936–43.

Hay, Jennifer B. and R. Harald Baayen. (2005) "Shifting paradigms: Gradient structure in morphology". *TRENDS in cognitive sciences* 9(7): 342–48.

Gor, Kira and Tatiana Chernigovskaya. (2001) "Rules in the processing of Russian verbal morphology". Gerhild Zybatow, Uwe Junghanns, Grit Melhorn, and Luka Szucsich, eds. *Current issues in formal Slavic linguistics*. Frankfurt am Main: Peter Lang, 528–35.

Gouskova, Maria and Michael Becker. (2013) "Nonce words show that Russian *yer* alternations are governed by the grammar". *Natural language and linguistic theory* 31: 735–65.

Jakobson, Roman. (1948) "Russian conjugation". *Word* 4: 155–67.

Marcus, Gary F., Steven Pinker, Michael Ullman, Michelle Hollander, T. John Rosen, Fei Xu, and Harald Clahsen. (1992) *Overregularization in language acquisition*. Chicago: University of Chicago Press. [*Monographs of the Society for Research in Child Development*, 57(4).]

Pinker, Steven. (1999) *Words and rules*. New York: Basic Books.

Pierrehumbert, Janet B. (2006) "The statistical basis of an unnatural alternation". Louis Goldstein, D. H. Whalen, and Catherine T. Best, eds. *Laboratory phonology 8: Varieties of phonological competence*. Berlin: Mouton de Gruyter, 81–107.

Royle, Phaedra, Gustavo Beritognolo, and Eve Bergeron. (2012) "Regularity, subregularity, and irregularity in French acquisition". J. van der Auwera, Thomas Stolz, Hitomi Otsuka, Aina Urdze, and , Johan van der Auwera, eds. *Irregularity in morphology (and beyond)*. Berlin: Akademie Verlag, 227–50. [*Studia typologia*, 11.]

Slioussar, Natalia. (2003) *Psixolingvističeskoe issledovanie struktury mental'nogo leksikona na materiale russkix glagolov*. M.A. thesis, Saint Petersburg State University.

Švedova, Natalia Ju., ed. (1980) *Russkaja grammatika*. Moscow: Nauka.

Townsend, Charles E. (1975) *Russian word formation*. Cambridge, MA: Slavica.

Zaliznjak, Andrej A. (1977/2003) *Grammatičeskij slovar' russkogo jazyka*. Moscow: Russkie slovari.

————. (1985) *Ot praslavianskoj akcentuacii k russkoj*. Moscow: Nauka.

Zamuner, Tania S., Annemarie Kerkhoff, and Paula Fikkert. (2012) "Phonotactics and morphophonology in early child language: Evidence from Dutch". *Applied psycholinguistics* 33: 481–99.

Received: November 2014
Revised: September 2015

Elena Kulinich and Daniel Valois
Département de linguistique et de traduction
Université de Montréal
Pavillon Lionel-Groulx
C. P. 6128, succursale Centre-ville
Montréal, QC H3C 3J7
Canada
ekulinich@yahoo.com
daniel.valois@umontreal.ca

Elena Kulinich, Phaedra Royle, and Daniel Valois
Centre for Research on Brain, Language and Music
McGill University, Faculty of Medicine
Rabinovitch House, 3640 de la Montagne
Montreal, QC H3G 2A8
Canada

Phaedra Royle
Université de Montréal
Faculté de médecine
École d'orthophonie et d'audiologie
C.P. 6128, succursale Centre-ville
Montréal, QC H3C 3J7
Canada
phaedra.royle@umontreal.ca

Daniel Valois
Institut des Sciences Cognitives (Cognitive Sciences Institute)
Université du Québec à Montréal
P.O. Box 8888, Downtown Station
Montreal, QC H3C 3P8
Canada

Appendix

A. List of Novel Stimuli Items for the Palatalization Task (Task 1)

1. fykat′
2. botat′
3. muxat′
4. fuzat′
5. bukat′
6. brysat′
7. smexat′
8. fetat′
9. mosat′
10. snekat′
11. bryzat′
12. trizat′
13. šrekat′
14. xrutat′
15. loxat′
16. dvasat′

B. List of Novel Stimuli Items for the Depalatalization Task (Task 2)

1. fyču
2. fužu
3. bryšu
4. sneču
5. lošu
6. xruču
7. dvašu
8. boču
9. trižu
10. šreču
11. bruču
12. mošu
13. feču
14. bryžu
15. mušu
16. paču