Experimental Evidence for Lexical Conservatism in Russian:
Defective Verbs Revisited[*]

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Some Russian verbs famously have a paradigm gap in the first person singular non-past form (henceforth 1p.sg. for brevity). A well-known example of such a *defective* verb is the verb *pobedit'* 'win,' for which speakers entertain several possibilities (pobežu? pobed'u? pobežd'u?), but ultimately are not satisfied with any of them. In general, defective words are characterized by lower than expected frequency of the "gapped" wordforms and low confidence in the production of such forms (Sims, 2006). Several researchers propose that paradigm gaps in Russian verbs have a diachronic explanation, but are synchronically arbitrary and must be learned on a verb-by-verb basis (Graudina et. al. 1976, Daland et. al. 2007, Baerman 2008). In contrast, Albright (2009) and Pertsova (in press) connect defective verbs in Russian to aspects of synchronic grammar, the morpho-phonological alternations of stem-final consonants that are expected to occur in the 1p.sg. (see section 1 for details). Such an a-priori plausible connection has been previously rejected on the grounds

that the alternations in question are exceptionless (for all but one consonant), and that many high- and low-frequency verbs undergo these alternations without any problems. In other words, these alternations should be productive. However, Pertsova (in press) identifies a crucial generalization that addresses the objection above: using evidence from lexical statistics and from web searches she argues that all stems with the problematic alternations (including novel borrowings) are susceptible to gaps *except when the expected alternation appears in at least one other derivationally related form*. In this paper, we confirm the claim above in two production experiments which elicited 1p.sg. forms of both defective and non-defective Russian verbs. We also test whether the relationship between defectiveness and the frequency of expected alternations in related derivatives is gradient, and find that it is categorical instead. That is, there is no significant difference between verbs that have just a few vs. many attested relatives with alternations or verbs for which such relatives are frequent vs. infrequent. Existence of a single relative with an alternation is usually sufficient to protect a verb from being defective.

1 Alternations in 1p.sg. Non-Past Forms

Two types of verbs of second conjugation in Russian (i.e., verbs with the theme-vowel *-i*) have alternations in 1p.sg. non-past form. These alternations used to be conditioned by the glide [j] at the beginning of the 1p.sg. suffix. However, this glide is no longer realized on the surface rendering the 1p.sg. alternations opaque. The first group of verbs with alternations are verbs with a dental stem-final obstruent /d/, /t/, /s/, /z/ (*dental verbs*). The obstruent mutates to a post-alveolar or palatal fricative of the same voicing, whose identity is not entirely predictable. These alternations are summarized in Table 1.

Another group of verbs with alternations in 1p.sg. are verbs whose stem ends in a labial consonant /m/, /f/, /v/, /b/, /p/ (*labial stems*). These verbs undergo insertion of [lʲ] between the stem and the suffix *-u* (e.g., *lov-it'* –

lov-[lʲ-u] "to catch"). Interestingly, all defective verbs are dental and not labial.[1] Possible reasons for this asymmetry are mentioned in section 5.

Table 1: Examples of verbs with dental alternations

Alternation	infinitive	1p.sg.	gloss
d → ž	r'ad-it'	r'a**ž**-u	'dress up'
z → ž	vonz-it'	von**ž**-u	'stab'
s → š	kos-it'	ko**š**-u	'scythe'
st → čš	vyrast-it'	vyra**čš**-u	'cultivate'
t → čš	sokrat-it'	sokra**čš**-u	'reduce'
t → č	port-it'	por**č**-u	'spoil'

Below are some examples of both defective and non-defective dental verbs of similarly low lemma frequency (defective status of these verbs is unlikely to be memorized, since they are rarely encountered). Throughout this paper lemma frequency is based on the frequency dictionary of Lyashevskaya and Sharov (2009), and is measured in instances per million (ipm).   The defective status of a verb was determined using the list of defective verbs compiled by Sims (2006)[2]. It is worth noting, however, that defectiveness is a gradient notion, and that there is no universal agreement among the speakers about which verbs are defective.

Note that the alternations in Table 1 are consistent or regular except for stems ending in *-t*, which have two possible alternants highlighted in grey. All dental alternations are relatively well-attested in the Russian lexicon (Pertsova, in press) and so should be productive. However, as the data in Table 2 illustrate, speakers hesitate to apply these alternations to some (typically infrequent) dental stems. The natural question to ask is: what separates defective dental verbs from the non-defective ones? We consider one possible answer to this question in the next section.

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[1] The only exception is the labial verb *zatmit'* "to eclipse" which is also defective. Defectiveness of this verb is hypothesized to be connected to the illicitness of the cluster [tml'] (see Moskvin, 2015), which does not occur in any other stem.
[2]   This list was compiled using a "systematic search of the online version of Ozhegov (1972) [dictionary] and a less thorough search of 8 other major Russian grammars and dictionaries" (Sims 2006).

Table 2: Examples of defective and regular (non-defective) verbs

	infinitive	1p.sg.	lemma freq.	gloss
regular	kvas-it'	kvaš-u	0.8 ipm	'ferment'
	gorod-it'	gorož-u	2.2 ipm	'enclose'
	skopyt-it'-sja	skopyč-u-s'	0 ipm	'keel over'
	opaskud-it'	opaskuž-u	0 ipm	'debase''
defective	koles-it'	koles'/š-u ??	1.8 ipm	'wheel'
	grez-it'	grez'/ž-u ??	2.6 ipm	'daydream'
	želt-it'	želt'/č-u ??	0 ipm	'to yellow'
	erund-it'	erund'/ž-u ??	0 ipm	'speak nonsense'

2   The Hypothesis

While 1p.sg. forms of frequent lexemes (or systematic absence of such forms) can be lexicalized, the same is not true of low-frequency verbs, so their defectiveness must be predictable. Such verbs can be divided into two groups: those that have the 1p.sg. alternation in other related derivatives and those that do not. Following Pertsova (in press), we hypothesize that

(1) it is the second group of verbs (those whose stems never show the same alternation as the 1p.sg. form) that are defective.

For many verbs (e.g., *vstret-it'* 'meet$_{PRV}$') the 1p.sg. alternations also occur throughout the past passive participle[3] paradigm (*vstreč-enn-yj* 'one who was met'), the secondary imperfective paradigm (*vstreč-at'* 'meet$_{IMPF}$'), and occasionally in related nominal or adjectival forms (*vstreč-a* 'meeting'). However, some verbs do not have such related forms for semantic or accidental reasons (e.g., intransitive imperfective verbs like *erund-it'* 'to speak nonsense' do not have past passive participles or secondary imperfective forms). Pertsova (ibid.) confirmed

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[3] For some verbs whose stem ends in –*d'*, past passive participles (PPP) have a different alternation (d ~ žd) than the one that occurs in the 1p.sg. (e.g., ro**d**it' INF – ro**ž**u 1SG – ro**žd**ennyj PPP 'give birth'). These verbs are typically relatively frequent verbs of Old Church Slavonic origin, some of which are defective.

that practically all verbs marked as defective in dictionaries lack alternations in other related forms. However, some low frequency verbs not marked as defective also have this property. Such verbs, it turns out, behave similarly to defective verbs. In particular, the data from the web shows that speakers tend to disagree with each other about the 1p.sg. form of such verbs and often fail to apply the prescriptively mandatory alternation, while they almost never do that with verbs that have the expected alternations in related derivatives. The same pattern of high variability in 1p.sg. forms (or low interspeaker agreement) holds in novel borrowings with dental but not labial stems (Sliossar and Kholodilova 2013, Pertsova ibid.).

Since the data from the web is noisy and since it cannot be easily used to estimate speakers' lack of confidence in their productions (a prominent hallmark of defectiveness), the experiments presented here will further test the hypothesis in (1).

3   Experiment 1

Previous experimental work on defectiveness (Albright 2003, Sims 2006) showed that when people are asked to produce problematic forms of defective lexemes, the responses they give are highly variable and receive lower confidence ratings or take longer to complete compared to non-defective lexemes. Sims (2006) also showed that low confidence is not simply a result of variation – in other areas of grammar variation is not accompanied by low confidence. In the experiments described here, we take variation in production of 1p.sg. forms coupled with lower confidence ratings as a sign of defectiveness. The first experiment tests the hypothesis in (1) by comparing three groups of verbs described below.

3.1   Stimuli
The stimuli consisted of 36 dental verbs and 36 labial verbs. Dental verbs had average lemma frequency of 0.6 ipm (sd=0.73) and were divided into three groups. The first group (group 1) contained recognized defective verbs (see footnote 3), e.g., *želtit'* 'yellow.' The second group (group 2) contained verbs that are not recognized as defective, but whose root never appears with the expected alternation, e.g., *tuzit'* 'pummel.'

The hypothesis in (1) predicts a gap in the first singular form for such verbs. Finally, the third group (group 3) consisted of verbs which have the expected alternation elsewhere in their family, e.g., *orosit'* `dew' (cf. *orošennyj* "dewed"). Each group had four verbs for each dental obstruent, and the groups were roughly matched in terms of the length of the verbs and their stress patterns. The labial verbs were divided into low-frequency (mean=0.55 ipm, sd=0.5) and high frequency verbs (mean=7.4 ipm, sd=2.3), with the caveat that all f-final verbs were of low frequency due to the sparsity of such verbs in the Russian lexicon. The list of stimuli together with the experimental results are available online in TROLLING (Tromsø Repository for Language and Linguistics: http://opendata.uit.no/).

3.2 *Experimental Procedure and Participants*

223 native speakers of Russian (who were not linguists) took part in the experiment, but not all of them completed all trials (the data from all participants was included in the analysis). Participants completed an on-line cloze reading task that required them to provide 1p.sg., 2p.sg., and 3p.sg. non-past forms of Russian second conjugation verbs. Participants first saw each verb in the infinitive form in a carrier sentence and pushed a button to go on to the next screen. They were then asked to fill in the blank in a second sentence with an appropriate singular form of this verb (which also appeared below the blank in the infinitive). An example trial appears below:

(2) Sentence 1: Perestan'te tam taraxtet' na kuxne!
                   'Stop making hubbab in the kitchen.'
    Sentence 2: Ja posudu moju, a ne ____ (taraxtet')!
                   'I'm washing dishes, and not ____(to make hubbab).'

Participants were asked to rate how confident they were in their response on a 5-point Likert scale, with 5 being "completely confident" and 1 being "not confident at all". The stimuli were counterbalanced so that each participant only had to provide one response (either 1p.sg., 2p.sg., or 3p.sg.) for each verb.

3.3   Results

We excluded all responses that used the wrong form (e.g., a past instead of the non-past tense, a plural instead of a singular form). The rest of the responses were categorized into three groups: the expected alternation, non-alternation, and "other" which included circumlocutions, blanks, or unexpected alternations[4]. First, our results confirm that 1p.sg. forms are problematic for the speakers in a way that 2p.sg. and 3p.sg. forms are not (15% of all 1p.sg. responses were comprised of unexpected non-alternations or "other" responses compared to 1% of such responses for 2p.sg. and 2% for 3p.sg.).

3.3.1   Dental Verbs. Table 4 summarizes the percentages of different types of 1p.sg. responses across the three verb groups of interest. For a statistical analysis we treated all responses as binomially distributed into "expected alternation" vs. "all other" and used a logistic regression mixed-effects model (fit by maximum likelihood with Laplace approximation) with subject and item as random effects.

Table 4: Percent of 1p.sg. responses collapsed over subjects

Response type	Group 1 (known defective)	Group 2 (suspected defective)	Group 3 (suspected non-defective)
alternation	59%	74%	94%
non-altern.	31%	19%	2%
other	10%	7%	4%

We tested how proportion of alternations in the experiment depended on group, stem-final consonant, lemma-frequency, stress, and number of syllables. The best model (based on Akaike information criterion or AIC) was the model with a single predictive variable – group. All three groups of dental verbs were significantly different from each other. Subjects were less likely to produce alternations in verbs of group 1 (known defective) compared to group 2 (suspected defective): coeff.=1.12, 95% CI: 0.036, 2.21, p=0.03. They were also more likely to produce alternations in verbs of group 3 (non-defective) compared to group 2:

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[4] Interestingly, half of the unexpected alternations were due to the labial alternation being applied to a dental stem (e.g., *kadl-ju* for *kad-it'* 'to burn incense').

coeff.= –2.4, 95% CI: –3.57, –1.2, p<0.05. Fig. 1 shows the box-plot for the distribution of expected alternations in the responses for the three groups.

Confidence scores were analyzed using Cumulative Link Mixed Model fitted with the Laplace approximation (Agresti 2002). The model with the best fit (presented in Table 5) included group, stem type, lemma frequency, and number of syllables as fixed effects. Verbs of group 2 were not significantly different from verbs of group 1, but verbs of group 3 received significantly higher confidence ratings compared to verbs of group 2. Fig. 2 shows the box-plot for the distribution of confidence ratings in the three groups. Although all confidence ratings were skewed towards the top of the scale, no verb in group 3 received a rating lower than 3, while verbs in groups 2 and 1 received ratings as low as 1. Confidence scores were also significantly higher for verbs with higher lemma frequency, verbs whose stems ended in -*t*, and verbs with greater number of syllables.

Table 5: Fixed effects of the Cumulative Link Mixed Effects Model on confidence ratings of dental stems in Experiment 1

Predictor	coeff. (logit)	95% CI (LL,UL)	p
group 2	0.53	-0.1, 1.16	0.1
group 3	2.56	1.90, 3.21	1.75e-14 ***
lemma freq	1.17	0.50, 1.84	0.0005 ***
syllable #	0.61	0.22, 1.02	0.002 **
stem type: -t	0.75	0, 1.51	0.05 *
stem type: -s	0.22	-0.53, 0.97	0.56
stem type: -z	-0.17	-0.90, 0.66	0.77

Finally, we found a significant correlation (r=0.64) between the mean proportion of produced alternations and confidence ratings in dental verbs. This fact confirms that the variation (or low interspeaker agreement) in dental verbs is due to defectiveness, since, as mentioned earlier, co-existence of multiple grammatical variants does not typically lead to decrease in confidence.
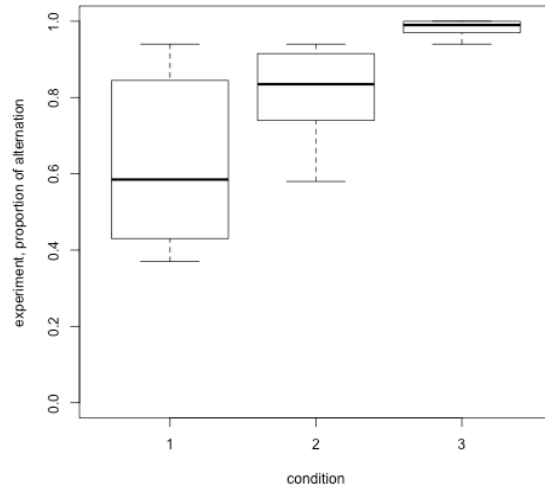
Fig. 1: Dental verbs: proportion of expected alternations in groups 1, 2, 3
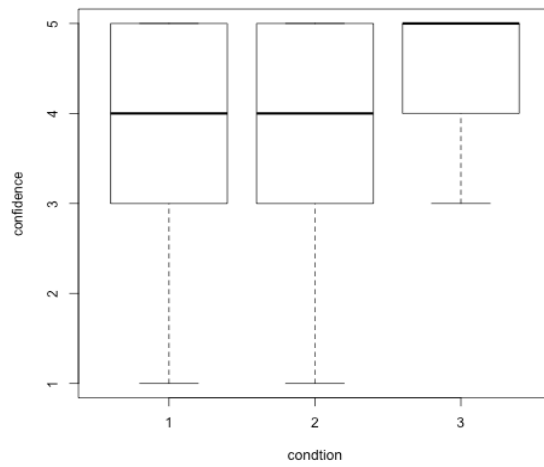

Fig. 2: Dental verbs: confidence rating in groups 1, 2, 3

3.3.2   Labial Verbs. Labial verbs were analyzed in the same way as dental verbs. Low-frequency labial verbs were slightly less likely to have the expected alternation (coeff. = −1.94, 95% CI: −3.03, −0.85, p<0.05) compared to high-frequency labial verbs. Additionally, labial verbs with stem-final -f differed from the reference category, b-final verbs, (coeff. = 1.67, 95% CI: 0.5, 2.84, p=0.05) with no other types of stems showing differences.   Table 6 summarizes mean proportions of alternations in labial verbs broken down by stem-final consonant and frequency.

Table 6: Mean proportion of alternations in responses for labial verbs

Stem final consonant	High-frequency	Low-frequency
f	-	0.89
b	1.00	0.99
p	1.00	0.94
v	1.00	0.99
m	0.99	0.98

Confidence ratings for labial verbs also depended on both group and stem-final consonant. Verbs with higher lemma frequency had somewhat higher confidence ratings (coeff.=1.44, 95% CI: 0.76, 2.12, p<0.05). Stems ending with -f had lower confidence ratings compared to those ending in -b (coeff.= −1.72, 95% CI: −2.89, -0.55, p<0.05), while verbs with other stems did not show any differences.

3.4   Discussion
Overall, the results of this experiment confirm the hypothesis in (1) and the asymmetry between dental and labial stems. That is, participants almost always produced expected alternations for all labial verbs even those of low frequency (except for a few -f final stems) but not for all dental verbs. Participants were less likely to alternate when a dental verb had no alternations in related derivatives (groups 1 and 2) compared to verbs that did (group 3). There was also a significant difference between group 1 and group 2 in the proportion of produced alternations for which we do not have a good explanation. It is possible (although unlikely) that some of the verbs in group 1 were known to speakers as defective. There was no difference between groups 1 and 2 in terms of confidence scores, indicating that speakers were equally (un)confident about 1p.sg. forms of

recognized defective verbs and suspected defectives of group 2 (while they were significantly more confident about group 3 verbs).

Another interesting finding of Experiment 1 was that f-final verbs elicited lower confidence and lower alternation rates compared to other low-frequency labial verbs. This finding is consistent with what Pertsova (in press) reports for novel borrowings whose stems end in -f. The behavior of these verbs can be explained by the fact that there are very few f-final verbs in Russian and almost all of them are infrequent. Artificial language learning experiments, such as Linzen and Gallagher (2013), also show that subjects are less likely to apply a general pattern to a specific instance that conforms to the pattern but that was not attested during the training. Such findings raise questions about the generality vs. specificity bias during learning, which requires further exploration.

The results of Experiment 1 can be interpreted as supporting the Lexical Conservatism hypothesis (Steriade 1997, 1999, 2008, Burzio 1998, and others), according to which a wordform can be influenced by the phonological properties of its derivational relatives (even those from which is was not derived). An extreme form of Lexical Conservatism would lead to complete avoidance of wordforms which contain novel allomorphs of the stem (i.e., variants of the stem that do not occur in any derivational relatives frequent enough to be stored). Such avoidance would then produce defectiveness if all other options of realizing the wordform were illicit. However, other explanations are possible as well and the exact nature of such trans-derivational effects and their connection to defectiveness are not well understood. The goal of our next experiment is to clarify whether the influence of related forms on a word is gradient or categorical. It is plausible that the more experience people have with the alternating allomorph of a root, the more likely they are to use it in the 1p.sg. form. Such behavior, for example, would be predicted by exemplar models of morphological learning.

4   Experiment 2

This experiment was similar to experiment 1, except it included only dental verbs and tested whether confidence and proportion of alternations

produced in 1p.sg. increased proportionally to the increase in frequency of alternations in the derivational nest of a verb and a couple of related variables described below.

4.1 Stimuli
The stimuli consisted of 45 dental verbs that differed from each other in proportion of alternating forms in their verbal derivational nest and two other related variables, frequency of the nest and nest size.

The derivational nest for a stem was defined as a set of forms which included all inflectional forms of the simplex verb with that stem (e.g. forms of *gorodit'* 'enclose'), all forms of verbs that are derived from a simplex verb via productive prefixes (e.g., forms of *otgorodit'* 'fence off', *peregorodit'* 'partition'), secondary imperfectives derived from the prefixed forms (e.g. forms of *otgoraživat'* 'fence off $_{\text{IPFV}}$'), and reflexive forms derived from the verbs mentioned above (e.g. forms of *otgorodit'sja* 'fence off $_{\text{RFV}}$' *otgoraživat'sja* 'partition off $_{\text{IPFV}}$')[5].

To create a database of derivational nests, we culled all verbs with dental stems from Zalizniak's (1980) dictionary and generated nests for each stem as follows. For each simplex verb, we first automatically generated all possible prefixed forms, secondary imperfectives and reflexive *sja*-forms using a list of verbal prefixes in Russian, a list of imperfective suffixes, and a list of alterations that can occur in these forms. The result of this automatic generation was checked against the modern subcorpus of the Russian National Corpus. All derived forms that were attested in the corpus were then checked manually in order to make sure that they belong to the intended nest.

For each nest, we calculated the following parameters: nest size, frequency of the nest, and proportion of alternating forms. For example, the nest *gorodit'* contains thirty-two different verbs, whose combined forms add up to 4549 tokens in the modern subpart of the RNC. Thus, the nest *gorodit'* has nest size 32 and token frequency of the nest 4549.

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[5] We did not include nominal or adjectival derivatives to simplify our searches, but a reviewer also points out that Moscoso del Prado Martín et al. (2004) show that for morphologically rich languages, only closely related derivatives might play a role.

2365 of these tokens do not contain alternations expected in 1p.sg., while the remaining 2184 of the tokens do contain this alternation (e.g., all occurrences of the 1p.sg. forms such as *gorožu*, all occurrences of participles such as *peregorožennnyj, otgoraživajuščijsja* and all forms of secondary imperfectives such as *otgoraživat', peregoraživat'*). Thus, about half (2184/4549=0.48) of the *gorodit'* nest consists of wordforms with the alternating allomorph of the stem.[6] We sampled 45 verbs from our nest database to get a set of verbs with diverse values for the proportion of alternating tokens in the nest, which ranged from 0 to 1 with 75% of the verbs falling in the range between 0 and 0.65.

4.2   Experimental Procedure and Participants

124 native speakers of Russian, who were not linguists, took part in the experiment. The task and the procedure were identical to Experiment 1, except that we changed the 5-point Likert scale to a 7-point scale in hope of getting more fine-grained distinctions at the top of the scale.

4.3   Results

In analyzing results of Experiment 2, we standardized several variables in order to put them on a comparable scale. For example, nest size ranges from 1 to 32, while frequency ranges from 1 to 9458 ipm. We used R library *arm* (Gelman and Su 2015) for rescaling each variable by centering each value and dividing it by two standard deviations (sd). As a result 95% of all data for each rescaled variable is located between –1 and 1, where the center of the distribution is located at 0. The following variables were rescaled: proportion of 1p.sg. alternations in the nest, nest size and nest frequency.

4.3.1   Proportion of Alternations in Responses.   We analyzed the results using the same methods as in Experiment 1 fitting logistic regression mixed-effects models to predict presence of alternations with subject and item as random effects and token frequency of alternating forms, token frequency of the nest, nest size, and stem type as fixed

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[6] A few verbs have slightly different alternations in past participles than those that occur in 1p.sg. (the Old-Church Slavonic alternations). We did not include these alternations into the analysis discussed here, because only a handful of verbs in our sample had them, and our preliminary analysis revealed that including such alternations did not change the results in any way.

effects. The model with the best AIC score showed three factors to be statistically significant in predicting alternations in 1p.sg. responses: the proportion of alternations in the nest (with higher proportion of alternations leading to more alternations in the 1p.sg. responses), nest size (with larger nests leading to more alternations in the 1p.sg. responses) and stem-type (with t-final stems having more alternations). Of these factors, the proportion of alternations in the nest was the strongest (coeff.= –2.4, 95% CI: –3.5, –1.3, $p < 0.05$). A closer examination of this effect shows that it is categorical rather than gradient. Consider Fig. 4 showing the relationship between proportion of alternating forms in a nest of a particular verb and proportion of alternations in the 1p.sg. forms of this verb produced in the experiment. For example, for the verb *sbrendit'* 'go berserk (colloquial)' 9 out of 41 responses contained the expected alternation (i.e., *sbrenžu*). This verb has no forms in the nest with the d ~ ž alternations, so its proportion of alternation in the corpus is 0, while proportion of alternation in the responses is 0.22 (9/41). This verb is represented by a point in the left bottom corner of Fig. 4.

From Fig. 4 one can see that the proportion of alternating 1p.sg. responses for most verbs in the experiment was on average between 0.8 and 1. The only verbs that had low proportion of alternations in the experiment (< 0.8) were verbs whose proportion of alternating forms in the nest was 0, plus one verb whose proportion of alternations in the nest was 0.1 (*pakostit'* 'play tricks'). Thus, the relationship between frequency of alternations in the nest and the proportion of alternations in the responses appears to be categorical: there is a threshold on the proportion of attested alternating tokens in the nest (near 0) that determines the boundary between verbs for which speakers almost always produce expected alternations and verbs for which they begin producing non-alternating forms or resort to circomlocutions.
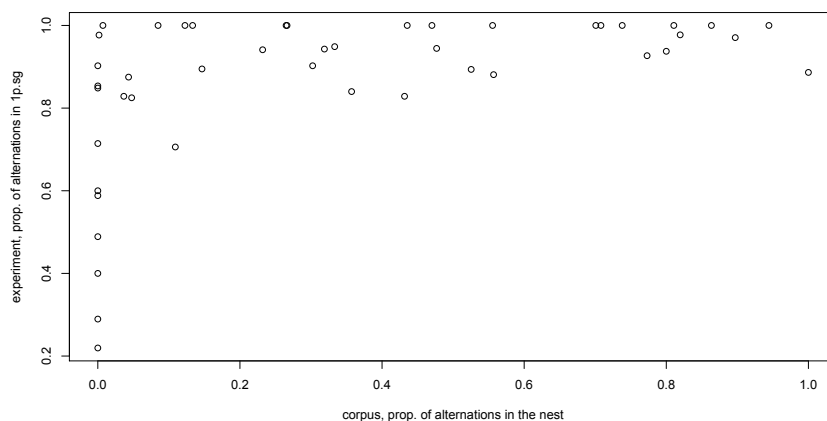
Fig. 4: Proportion of alternation in the responses as a function of
proportion of alternations in a derivational nest.

However, five verbs whose proportion of alternating forms in the nest is near 0 still had a high proportion of alternations in the experiment (top left corner in Fig.4). Two of these verbs are *oxladit'* 'cool down' and *predupredit' 'warn,'* whose proportion of alternations in the corpus is low but is actually not 0. The former's verb proportion of alternations in the corpus is 0.001 and the latter verb's – 0.007. The latter verb is particularly frequent and occurs in the RNC with the expected alternation in 1p.sg. 109 times. Thus, it is likely that speakers have memorized the 1p.sg. of these verbs. One other verb, *izborozdit'* 'plow over' that had no relatives with the expected alternation, appeared with this alternation in the experiment on average 85% of the time.

The last two verbs with unexpectedly high proportion of alternating responses were the only two verbs with *-t* final stems among the verbs with no alternations in the corpus (*volokitit'* 'drag out' and *otkološmatit' 'give a beating'*). Recall that t-final verbs were in general found to have higher proportion of alternations, and in Experiment 1 they elicited higher confidence ratings. Proportion of defective t-final verbs is also one of the lowest compared to other dental verbs (Pertsova, in press).

The fact that t-final stems are more likely to alternate is a mystery, especially given that these stems are the only irregular stems admitting two possible alternants.

4.3.2. Confidence. As in experiment 1, we analyzed confidence ratings provided by the participants using Cumulative Link Mixed Model. Our model indicated that increase in proportion of alternations in the corpus (coeff.=1.38, 95% CI: 2.8, 0.68, $p<0.05$), token frequency of the nest (coeff.=0.91, 95% CI: 1.6, 0.22, $p<0.05$), and nest size (coeff. = 0.81, 95% CI: 1.5, 0.09, $p=0.02$) all significantly increased confidence ratings, while stem type did not have a significant effect (although there was a non-significant trend for t-final stems, $p=0.08$). Fig. 5 demonstrates that the mean confidence rating for each verb is related to its proportion of expected alternations in the corpus in a categorical rather than gradual way much like the relationship in Fig. 4. For most verbs, mean confidence rating was high, ranging between six and seven. The verbs for which mean confidence fell below six were almost exclusively those verbs that had 0 attested alternations in the derivational nest in the corpus. The only exception to this pattern were three verbs with 0 or near 0 alternations in the corpus but relatively high confidence ratings. These verbs are also among those discussed in 4.2.1 as verbs with unexpectedly high proportion of alternating responses (namely, *oxladit', predupredit',* and *otkološmatit'*). The apparent outlier in the bottom right portion of the graph is the verb *obeskislorod-it'* 'deoxygenize' (prop. of alternations in the corpus 1, mean confidence 5.6). The reason why this verb has such a high proportion of alternations in the corpus is because it is highly infrequent and has a single occurrence in the corpus in a participial form *obeskislorož-ennyj* (hence, proportion of alternations is 1). Recall that the token frequency of the nest is taken into account in our statistical model.
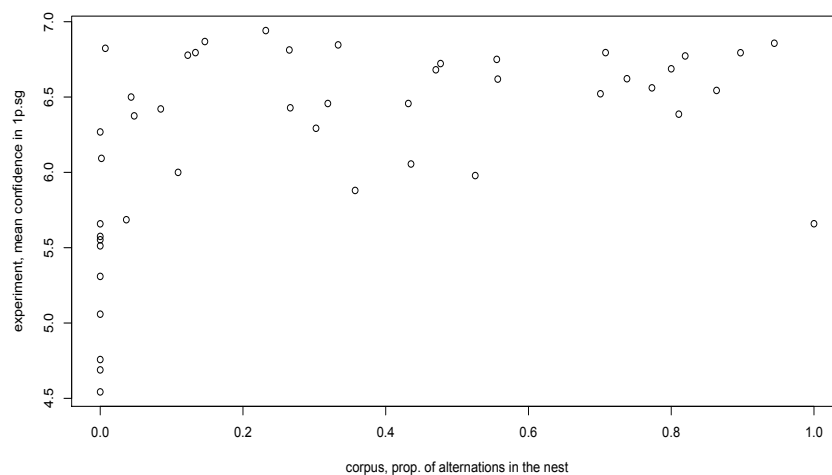
Fig. 5: Mean confidence in responses as a function
of proportion of alternations in a derivational nest

4.4   Discussion

In the second experiment like in the first experiment, we found that participants disagree with each other about the 1p.sg. forms of certain dental verbs and report lower confidence in their responses for these verbs. These verbs are exactly those that have no dental alternations in their derivational relatives. We did not find this effect to be gradient.

That is, there was no sign of a gradual decrease/increase in confidence and alternation rates with the decrease/increase in the frequency of alternations in the derivational nest. For example, the verb *molotit'* 'hammer' whose proportion of alternating forms in the nest is 0.08 behaved similarly to the verb *namagnitit'* 'magnetize' whose proportion of alternating forms in the nest is 0.74 (both verbs were used with alternations in the experiment 96% of the time, and their mean confidence scores were 6.4 and 6.6 correspondingly).

We also discovered that other factors affect confidence and proportion of alternations: namely, factors related to frequency and possibly type of stem, with t-final stems being somewhat less "gappy". This latter finding is rather surprising since -*t* verbs are the only dental verbs that

are irregular in having two different alternating patterns (the participants in our experiments used the majority t ~ č alternation, not the Old-Church Slavonic t ~ šč alternation).

5   Conclusions

The evidence presented in this paper confirms the hypothesis that what separates dental defective verbs in Russian from the non-defective ones is existence of other derivationally related forms with the expected alternations. This finding is consistent with the phenomenon of Lexical Conservatism (discussed in section 3.4), according to which derivational relatives can affect the phonology of a specific derivation.

Our second experiment tested whether this transderivational effect was gradient, which could potentially indicate mutual and additive reinforcement that morphological relatives exert on each other during lexical access. However, we found that the transderivational effect was categorical instead. The only verbs that significantly differed from the rest were the verbs that had 0 relatives with expected alternants in the stem-final position.   This fining lends support to defining Lexical Conservatism constraints the way Steriade does, namely as negative constraints punishing forms which do not have *any* related forms with the expected alternation.

We also note that a simple theory on which speakers avoid creating novel allomorphs at all costs, producing forms without alternations or producing nothing at all (a gap) is probably too strong. In general, we do not want to say that alternations could never be projected to novel forms. It is known that certain alternations (e.g., flapping in English or vowel reduction in Russian) can be extended to novel or rare roots.   The fragility of dental alternations and their sensitivity to lexical factors (the Lexical Conservatism effect) is probably due to the fact that these alternations are phonologically opaque, stem-altering, and relatively fragmented (there is no single phonological rule to perfectly capture all dental alternations). In contrast, the labial alternation which involves epenthesis at a morpheme boundary does not alter any segments of the stem and there is a single phonological rule that covers all labial

consonants. These factors are likely explanations for why labial alternations are more productive and do not lead to defectiveness.

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