THE INFLUENCE OF WRITTEN STRESS MARKS ON NATIVE ENGLISH SPEAKERS' ACQUISITION OF RUSSIAN LEXICAL STRESS CONTRASTS

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Introduction

Russian belongs typologically to what are termed non-predictable stress languages (Altmann) or lexical stress languages (Kijak); that is, stress is not phonologically specified, but must be encoded in each word's lexical representation. Pedagogical materials for beginning learners of Russian indicate the position of stress for virtually all words; the prevalent mechanism for this is to place an accent mark over the stressed vowel (e.g., рукá). As learners achieve greater proficiency, pedagogical materials reduce and/or discontinue the use of stress marks, thus becoming increasingly like authentic texts which employ stress marks in only a very few instances. The inclusion in some beginning materials of short texts with no stress marks and/or the discontinuation of stress marks for increasingly familiar vocabulary even at the earliest levels are strategies to increase textual authenticity, but overall, stress marks are ubiquitous in pedagogical materials. This fact suggests a belief among instructors of Russian that they are necessary for the acquisition of lexical stress, but to our knowledge there has been no empirical study of whether this is in fact the case. The goal of the present study is thus to investigate the impact of lexical stress marks on native English speakers' acquisition of lexical stress contrasts, providing an empirical basis from which to assess the common practice of providing stress marks in Russian pedagogical materials.

Background

A number of recent studies have provided evidence that written forms in the input to (literate) adult second language (L2) learners can support their acquisition of L2 phonology. For example, Escudero et al. demonstrated that second language learners can infer the presence of difficult-to-perceive contrasts in the input from the word's written forms. They taught native Dutch speakers, who have difficulty with the English /æ/-/ɛ/ contrast, auditory English nonwords which were (partially) differentiated by /æ/ and /ɛ/ in two word-learning conditions: one in which the auditory forms were accompanied by written forms (e.g., 'tenzer' and 'tandek'), and one without written forms. At test, participants who had been exposed to the written forms exhibited sensitivity to the vowel differences among the newly learned words, while participants who had not seen written forms did not. Escudero et al. concluded that the native Dutch participants were able to infer the phonological contrast from the differences in spelling (after all, 'a' and 'e' map to different vowels in Dutch as well) even though they were not able to detect the contrast in the auditory forms.

It is worth noting that this influence of written forms in the input to L2 learners may in fact be so powerful that it serves to "override" auditory input in cases where auditory and written input appear to learners to be in conflict. For example, Bassetti demonstrated that native English speakers experience interference from native grapheme-phoneme correspondences when learning Mandarin phonological forms due to mismatches in orthographic conventions in English and *pinyin*. Bassetti examined native English speakers' phonological awareness in Mandarin, and found that their exposure to *pinyin* (Romanized) orthographic forms influenced their phonological representations of Mandarin syllables, such that they neither counted nor segmented phonologically present vowels when those vowels were omitted (by convention) from the *pinyin* written forms. Further, Hayes-Harb, Nicol and Barker showed that native English speakers misremembered the phonological forms of newly learned nonwords when the words were spelled using grapheme-phoneme correspondences that differed from English. For example, when the word pronounced [fɑʃə] was spelled 'faza' during training, many participants accepted [fɑzə] as the correct pronunciation at test, while participants who did not see spelled forms during training did not make this mistake. Written input thus appears to influence the acquisition of L2 word forms, with learners applying native-language grapheme-phoneme correspondences to make inferences about the segmental makeup of newly learned words.

Showalter and Hayes-Harb ("Lexicon Study") demonstrated that the written symbols need not in fact be entirely familiar in order for learners to benefit from them. They taught native English speakers with no prior knowledge of Mandarin a set of eight Mandarin nonwords ([gi] and [fiɑn], each with four different lexical tones), in two word-learning conditions: one where the auditory forms were accompanied by *pinyin* written forms without tone marks (e.g., 'gi') and one where diacritics were used to indicate the lexical tones (e.g., 'gī', 'gí', 'gǐ', and 'gì'). Showalter and Hayes-Harb found that participants who saw the tone marks during word learning more accurately remembered which lexical tones were associated with which words at test, indicating that even unfamiliar diacritic marks may support learners' acquisition of novel L2 word forms. They further demonstrated that the benefit of written forms is not limited to learning the segmental makeup of words—in this study, native English speakers learned to associate lexical tone with newly learned words with the aid of the diacritic marks.

We have thus seen that L2 learners make inferences about the phonological structure of newly learned L2 words based on information provided by written forms, even in cases where the relevant written symbols are novel and cue a novel type of phonological contrast (e.g., diacritic lexical tone marks in Showalter and Hayes-Harb). Here we ask whether another unfamiliar written symbol—in this case, the lexical stress diacritic used in Russian pedagogical texts—is similarly helpful for native English speakers learning Russian lexical items differentiated by lexical stress. The case of Russian lexical stress is of particular interest for a number of reasons: (1) lexical stress of the type found in Russian is known to be quite difficult for native English speakers (see, e.g., Kijak for discussion); (2) lexical stress is indicated in Russian pedagogical texts by means of a diacritic mark that is not used for this purpose in English; (3) Russian also employs a different alphabet than English; and (4) as discussed below, stress marks are included in pedagogical texts for the express purpose of helping learners.

Russian Lexical Stress

Stress in Russian is not phonologically restricted to a particular syllable, as exemplified by the following three-syllable words with initial, medial and final syllable stress respectively: *xólodno* 'cold'; *berjóza* 'birch tree'; *molokó* 'milk'. A second property of Russian stress is its mobility. Stress may be fixed throughout all morphological forms of a lexical item, but there are also nominal, verbal and adjectival paradigms that evidence shifting stress (e.g., *górod* 'city *masc.nom.sg.*' ~ *gorodá* 'cities *nom. pl.*'; *smotrjú* 'I look' ~ *smótriš* 'you look'; *bólen* 'sick *masc.sg*' ~ *bol'ná* 'sick *fem.sg.*'). Therefore, unlike an L2 learner of, for example, Czech, who must learn that stress (with a few exceptions) falls on the first syllable of the word, learners of Russian must learn the position of stress for each new lexical item they encounter. A concomitant feature of lexical stress is the existence of stress minimal pairs of which Russian has approximately 150 (Cubberley), in addition to minimal pairs that are the product of stress shifts within morphological paradigms (e.g., ['ruki] 'hands *nom.pl.*' versus [ru'ki] 'hand *gen.sg*').

Native English Speakers and L2 Lexical Stress

Like Russian, English also contrasts lexical items on the basis of lexical stress (e.g., English: ['prɛzənt] 'present *n.*' versus ['prə'zɛnt] 'present *v.*'). In Russian, English, and other lexical stress languages, lexical representations contain information about stress, providing for the opportunity to use lexical stress in minimally distinguishing words. However, as noted by Cutler and Pasveer, "stress languages are curiously reticent in exploiting [lexical stress] for making distinctions between words" (250). In fact, English has very few (i.e., fewer than two dozen) minimal pairs differing *only* in stress, "and the same is true of other European stress languages such as Russian, German, Dutch or Spanish" (250). That is, languages with lexical stress—like English and Russian—tend to have segmental reflexes of stress such that very few so-called stress minimal pairs are actually contrasted on the basis of stress alone. For example, in English, vowels in unstressed syllables are typically reduced to schwa, and in Russian, certain vowels (i.e., /a, o, e/) in unstressed syllables are reduced in some phonological environments (e.g., [dəga'vor] 'agreement') in which stress on the final syllable accounts for the full realization of /o/.

Given these similarities among lexical stress languages, we might expect a native speaker of a lexical stress language to have little difficulty using stress to contrast words in a lexical stress L2. Indeed, this expectation is formalized in the Stress Deafness Model (SDM) (Peperkamp and Dupoux) and the Stress Typology Model (STM) (see Altmann). According to the SDM, native speakers of languages with completely regular stress do not have phonological representations for stress and are thus "deaf" to lexical stress in a second language. The STM arrays languages typologically based on type of stress system and it suggests that speakers of languages with unpredictable stress may have fewer problems with the perception of L2 stress than speakers of languages with predictable stress. However, native English speakers exhibit notorious difficulty with lexical stress in second language acquisition (e.g., Saalfeld; Ortega-Llebaria, Gu and Fan), counter to the predictions of these models. There are (at least) two types of explanation for this. First, to the extent that English differs from other languages in the acoustic manifestation of lexical stress, native English speakers may experience difficulty perceiving stress in the L2. For example, Ortega-Llebaria et al. demonstrated that native English speakers differ from native Spanish speakers in the cues they attend to in lexical stress perception in Spanish.

The second explanation for native English speakers' difficulty with L2 lexical stress may have to do with limits on the utility of stress information in auditory word recognition in English. While lexical stress languages in general tend not to have large numbers of stress-only minimal pairs due to a tendency for vowel reduction in unstressed (or less-stressed) syllables, English appears to exhibit more widespread and neutralizing vowel reduction than at least some other lexical stress languages (e.g., Dutch: Cutler, Wales, Cooper and Janssen; Russian: Iosad). Thus native English speakers may rely more on vowel alternations than on prosodic information during word identification, which has a low functional load in English due to its redundancy in combination with vowel quality. Indeed, even in the extremely limited number of instances in English where there is less (or no) vowel difference between members of lexical stress pairs (e.g., ['trʌsti] 'trusty' versus [trə'sti] 'trustee'), Cutler found that native English listeners effectively treat these words as homophones in a listening task.

Additional support for the functional load explanation for English speakers' relative "stress deafness" can be found in studies of vocabulary structure. Cutler, Norris and Sebastian-Galles computed the number of embedded words in the English and Spanish lexicons (e.g., English: 'bar' in 'barber'; Spanish: [bar] 'bar' in ['barbaro] 'cool/awesome'). Embedded words have the potential to cause difficulties in auditory word recognition, as they provide competitors which must be eliminated by the listener in order to correctly identify the word intended by the speaker. Cutler, Norris, et al. found that when they computed embedding solely on the basis of segmental sequences, Spanish has an average of 2.32 embedded words per 2-6-syllable word, while English has an average of 0.94. When they added stress to the computation, the embeddings dropped by only one-third in English but by up to two-thirds in Spanish. Remarkably, the average number of embeddings without considering stress in English and with considering stress in Spanish were very similar, leading the authors to conclude that while "Spanish listeners [...] are greatly assisted by their language's use of suprasegmental distinctions between lexical items," "stress plays an almost insignificant role in signaling lexical contrasts in English" (68). In a follow-up to this study, Cutler and Pasveer found that the lexical embedding patterns found in German and Dutch, both lexical stress languages, are more similar to that in Spanish than to that in English. Similar conclusions concerning the functional load of lexical stress information in English relative to other lexical stress languages are reached by, e.g., Cutler, Wales, Cooper and Janssen; Kijak; Lukyanchenko, Idsardi and Jiang; and Saalfeld.

We know of no empirical studies that have specifically investigated the acquisition of Russian lexical stress by English-speaking learners; however, given the difficulty that English speakers exhibit with lexical stress in other L2s (see, e.g., Face; Lord; Saalfed), we expect native English speakers to also have difficulty with Russian lexical stress. In addition, there is a sense among Russian language teachers that this is an area of persistent difficulty for learners. In a study of error gravity, Rifkin investigated listener responses to a variety of error types, including stress. He characterized the errors tested as "typical of errors made by learners in oral proficiency interviews and were also typical of errors made by learners in third-year Russian classes taught by the primary investigator" (479). Narrative comments from a survey conducted by the authors support the idea that Russian stress is an area of difficulty for learners. Respondents commented extensively about the importance of learning the location of stress, noting that stress marks were important in learner texts because, for example, "they [students] still make very very frequent mistakes," and "it's common for second-year students to make mistakes in stressing words" (unpublished survey by the authors).

Lexical Stress Marks in Russian Texts

As mentioned above, Russian lexical stress is indicated in most L2 pedagogical texts via stress marks. Introductory textbooks typically include an explanation of word stress and describe the system used to indicate stressed syllable. The following from *Golosa*, a textbook used extensively for beginning level college Russian classes, is typical,

> The stress may fall on any syllable in a word. To help students pronounce how some of the vowel letters are pronounced, we mark it for all the words you need to pronounce (in dialogs, glossaries, and tables). (Robin, Evans-Romaine and Shatalina 3)

Given that stress marks are included in Russian pedagogical texts, then, for the express purpose of helping learners acquire lexical stress, here we ask: Do stress marks actually help native English speakers associate lexical stress with newly learned Russian lexical items? We address this question by means of an artificial lexicon study, where we taught native English speakers with varying levels of Russian language experience a set of Russian nonwords differing in lexical stress. Participants were assigned to various word-learning conditions, differing primarily in the presence/absence of lexical stress marks. We then tested participants on their ability to differentiate lexical stress minimal pairs. If the stress marks support native English speakers' ability to accurately associate lexical stress with newly learned words, participants who saw stress marks during word learning should perform more accurately at test than those who did not.

Artificial lexicon study

Participants

Participants were forty-four native English speakers with no prior significant exposure to the Russian language (twenty-seven female, sixteen male), in addition to twenty-nine students enrolled in university-level Russian language classes at the time of the study (eleven female, eighteen male). Twenty-six of the Russian learners were native speakers of English; the remaining three self-identified as heritage speakers of Russian. Table 1 summarizes the Russian and English backgrounds of the participants.

Table 1. Study participants' Russian and English backgrounds

<table>
<tr><th></th><th>Russian Background</th><th>Native language</th><th>Number</th></tr>
<tr><td>Inexperienced learners</td><td>No Russian language study</td><td rowspan="3">English</td><td>44</td></tr>
<tr><td rowspan="3">Experienced learners</td><td>1st-year Russian</td><td>9</td></tr>
<tr><td>3rd-year Russian</td><td>17</td></tr>
<tr><td>Heritage speakers of Russian
one in 1st-year; two in 3rd-year</td><td>English and Russian</td><td>3</td></tr>
</table>

It is worth noting that participants reported having studied a number of other second languages, including French, Italian, Tamil, Spanish, American Sign Language (ASL), Tagalog, Japanese, German, Lithuanian, Portuguese, Korean, Danish, Arabic, Swedish, and Mandarin. One of the heritage speakers of Russian also reported knowledge of Serbian. We did not control for familiarity with other second languages, and a number of our participants had studied languages that employ diacritic stress marks to some extent (i.e., Spanish, Italian, Portuguese, Swedish, and Danish). Given that participants were randomly assigned to the word-learning conditions described below, participants with previous stress mark experience were also randomly distributed (6–7 participants in each of the four conditions for inexperienced learners and 3 and 4 in the two conditions for experienced learners). This means that for at least some subjects, the stress marks would not be entirely unfamiliar.

Auditory Stimuli

For the purpose of the study we created a set of twelve Russian nonwords[1] in six lexical stress minimal pairs (see Table 2 for a complete list). In an effort to isolate the feature of lexical stress in our stimuli, all segments overlapped with English phonemes, though their phonetic realizations may differ in some ways between the two languages.

Table 2. Complete list of nonwords used in the study.

сýба-субá ['suba-su'ba]	пýда-пудá ['puda-pu'da]
лáна-ланá ['lana-la'na]	тáба-табá ['taba-ta'ba]
мáза-мазá ['maza-ma'za]	дýка-дукá ['duka-du'ka]

We then asked two female native speakers of Russian to read from a dictionary-entry-like presentation of words (i.e., the words were written in Cyrillic with stress marks). One token of each of the twelve words by each talker was selected for presentation in the experiment. Tokens were amplitude-normalized so as to avoid differences in amplitude among the auditory stimuli. We performed acoustic analyses of the stimuli: vowel duration (in milliseconds) and first and second formant frequencies (F1, F2; roughly corresponding to tongue height and tongue backness, respectively), and next calculated the stressed-unstressed duration ratio for each stimulus. Duration ratios are expected to be greater than one, with stressed syllables containing longer vowels than unstressed syllables. However, Tables 3 and 4 indicate that three of the twelve words produced by talker 1 and one by talker 2 had stressed-unstressed duration ratios below one, which we attribute to natural variability in native Russian production.

1. All nonwords are in the nominative case.

Table 3. Acoustic properties of productions by talker 1 (vowel 1 and vowel 2 duration, F1, and F2, and stressed-unstressed duration ratio).

	Vowel 1			**Vowel 2**			
	Vowel Dur (msec)	F1 (Hz)	F2 (Hz)	Vowel Dur (msec)	F1 (Hz)	F2 (Hz)	**Duration Ratio**
'taba	181	859	1753	151	952	1497	1.20
'duka	132	452	963	190	963	1567	0.69
'lana	181	1079	1392	150	893	1764	1.21
'maza	179	1009	1439	154	997	1892	1.16
'puda	122	452	928	200	939	1578	0.61
'suba	102	440	1056	171	858	1416	0.60
ta'ba	82	812	1567	201	916	1369	2.45
du'ka	57	556	1416	214	858	1357	3.75
la'na	118	916	1276	191	1008	1513	1.62
ma'za	115	440	1567	244	1114	1648	2.12
pu'da	53	603	1172	233	928	1311	4.40
su'ba	50	557	1384	194	893	1381	3.88

Table 4. Acoustic properties of productions by talker 2 (V1 and V2 duration, F1, and F2, F1, and F2, and stressed-unstressed duration ratio).

	Vowel 1			**Vowel 2**			
	Vowel Dur (msec)	F1 (Hz)	F2 (Hz)	Vowel Dur (msec)	F1 (Hz)	F2 (Hz)	**Duration Ratio**
'taba	178	940	1486	102	847	1521	1.75
'duka	142	412	940	104	847	1486	1.37
'lana	220	963	1404	85	905	1660	2.59
'maza	222	870	1312	130	893	1753	1.71
'puda	154	441	1066	128	789	1788	1.20
'suba	157	441	870	169	835	1474	0.93
ta'ba	84	870	1718	220	905	1393	2.62
du'ka	68	464	1103	232	917	1346	3.41
la'na	102	952	1463	214	893	1428	2.10
ma'za	140	998	1799	266	940	1416	1.90
pu'da	52	510	1079	224	963	1439	4.31
su'ba	59	499	905	221	905	1288	3.75

To the extent that vowel duration ratios provide an important cue to lexical stress (see, e.g., Fry), Tables 3 and 4 demonstrate that talker 2 may have produced a larger and more consistent ratio (mean = 2.3, with only one token showing a ratio <1) than talker 1 (mean ratio = 1.97, with three tokens showing the unexpected ratio <1).

Visual Stimuli: Pictures

Each of the nonwords was associated with a different non-object picture. The rationale for using non-object pictures to indicate the words' "meanings" was that the Russian language learners in the study would already have a (developing) Russian lexicon, and we did not wish to confuse subjects by suggesting a new word label for an existing meaning. Non-object pictures readily solve this problem by providing new "meanings" for which participants will not have already learned word labels. This particular set of non-object pictures has been used in previous studies of this type (e.g., Escudero et al.; Showalter and Hayes-Harb, "Lexicon Study"). Figure 1 presents the non-object pictures that were associated with the minimal pair ['duka-du'ka].

Figure 1. Example nonword-picture pairings.

Visual Stimuli: Written Forms

The second type of visual stimuli used in the study was the written forms. In order to tease apart the contribution of the novel L2 alphabet (Cyrillic) from that of the diacritic stress marks, we crossed two levels of alphabets (Latin, Cyrillic) with two levels of stress marks (Stress Marks, No Stress Marks) to form four word-learning conditions. Table 5 provides an example of the visual information presented in each condition.

Table 5. Visual stimuli by word-learning condition for the word target [du'ka].

Latin-Stress	Cyrillic-Stress	Latin-NoStress	Cyrillic-NoStress
Latin script with stress marks	Cyrillic script with stress marks	Latin script without stress marks	Cyrillic script without stress marks

Procedure

All parts of the experiment were conducted in a sound-attenuating booth, where participants were seated at a computer. Auditory stimuli were played over headphones at a comfortable listening level; visual stimuli were presented on a computer screen visible through a window in the booth (approximately eighteen inches in front of the participant), and participants recorded their responses by pressing buttons on a computer keyboard. The entire experiment lasted approximately one hour.

Word-Learning Phase. Inexperienced learner participants were randomly assigned to each of the four word-learning conditions: Latin-Stress, Cyrillic-Stress, Latin-NoStress, and Cyrillic-NoStress. Participants in the experienced learner group, given that they had prior exposure to written Russian and might have found the Latin conditions confusing, were randomly assigned to only the two Cyrillic conditions. In this way, only participants without prior exposure to Russian permitted comparisons concerning the impact of a familiar (Latin) versus and unfamiliar (Cyrillic) script, but both groups of participants allowed us to address the primary question of the usefulness of the stress marks in helping learners acquire lexical stress contrasts.

During the word-learning phase, each of the twelve auditory words with its corresponding picture was presented twice per block. A "presentation" consisted of the simultaneous presentation of the auditory word and the visual stimulus, with the visual stimulus remaining on the screen for approximately 1.5 seconds after the auditory form finished playing. The block was presented four times. The items in the block were presented in a different random order each time the block was repeated, and in a different set of random orders for each subject. At this point, no response was required of participants—they were simply instructed to learn the words and their meanings as well as possible.

Criterion Test. In order to ensure that participants generally succeeded at learning the words, we employed a two-way forced-choice auditory word-picture matching test. In this part of the experiment, which immediately followed the word-learning phase, participants were asked to match pictures (no written forms) with auditory forms. Each of the twelve auditory words was played twice, once with a correctly-matched picture and once with another picture. At this point, the incorrectly matched picture did not correspond to the pictured word's minimal pair counterpart; for example, in one incorrectly matched criterion-test item, participants were asked whether the picture of the [du'ka] matched the auditory form [la'na]. If participants did not perform with at least 90% accuracy on the criterion test, they returned to the beginning of the experiment. They were required to repeat the word-learning and criterion-test cycle until they reached 90% accuracy.

Final Test. The final test was identical to the criterion test with one crucial difference: the incorrectly matched items now involved minimal pairs (e.g., participants were asked whether the picture of the [du'ka] matched the auditory form ['duka]). As in the criterion test, each of the twelve words was presented twice—once in the matched condition and once in the incorrectly matched condition for a total of twenty-four test trials.

Results

Number of Word-Learning–Criterion-Test Cycles

First, in order to ensure that participants in the various subject groups and word-learning conditions did not have differing amounts of exposure to the new words, we looked at the number of word-learning–criterion-test cycles that participants in each word-learning condition required. Table 6 provides this information.

Table 6. Mean number of word-learning–criterion-test cycles by subject group and word-learning condition (standard deviation).

	Latin-Stress	Latin-NoStress	Cyrillic-Stress	Cyrillic-NoStress
Inexperienced learners	2.545 (1.368)	2 (1.095)	2.364 (1.120)	2.364 (1.027)
Experienced learners	—	—	1.786 (0.802)	1.667 (0.724)

The word-learning–criterion-test cycles data summarized in Table 6 were submitted to an Analysis of Variance (ANOVA) with subject group (two levels: inexperienced learners, experienced learners) and word-learning condition (two levels: Cyrillic-Stress, Cyrillic-NoStress) as between-subjects variables. There was a main effect of group, with inexperienced learners requiring significantly more cycles than experienced learners ($F(1,47)=6.157$, $p=0.017$, partial eta squared=0.116); neither the main effect of word-learning condition ($F(1,47)=0.054$, $p=0.818$, partial eta squared=0.001) nor the interaction of the two ($F(1,47)=0.054$, $p=0.818$, partial eta squared=.001) was significant. Thus the inexperienced learners overall required more exposure to meet the word-learning criterion; however, there were no differences between participants in the two Cyrillic word-learning conditions.

Effects of Word-Learning Condition—Final Test

Word form–learning "success" was first operationalized here as accuracy on the final test. Table 7 provides the proportion of correct scores.

Table 7. Mean proportion correct on the final test by subject group and word-learning condition (standard deviation).

	Latin-Stress	Latin-NoStress	Cyrillic-Stress	Cyrillic-NoStress
Inexperienced learners	0.572 (0.336)	0.557 (.377)	0.606 (0.389)	0.515 (0.435)
Experienced learners	—	—	0.673 (0.301)	0.667 (0.325)

Next, we operationalized learning "success" instead as the ability to discriminate between matched and mismatched test items, using signal detection theory, by converting the proportion correct scores to d-prime scores. This provides a measure of detectability, or participants' ability to distinguish matched from mismatched items. A d-prime at (or near) zero indicates chance performance, while positive (or negative) d-primes indicate an ability to distinguish matched from mismatched items at test (with negative d-primes associated with switched labels, e.g., systematically pressing the "matched" button when a "mismatched" response is intended). Table 8 presents the d-prime scores for the inexperienced learners.

Table 8. Mean d-prime scores by subject group and word-learning condition (standard deviation).

	Latin-Stress	Latin-NoStress	Cyrillic-Stress	Cyrillic-NoStress
Inexperienced learners	0.394 (0.773)	0.312 (0.924)	0.653 (1.270)	0.096 (0.713)
Experienced learners	—	—	1.37 (0.77)	1.24 (1.06)

As expected based on the proportion correct data presented in Table 7, all d-prime scores were very low in the inexperienced learner group, with somewhat higher scores for the experienced learner group. For inexperienced learners, d-primes were not significantly above zero in any of the word-learning conditions (Latin-Stress: t(10)=1.687, p=0.122; Latin-NoStress: t(10)=1.119, p=0.289; Cyrillic-Stress: t(10)=1.706, p=0.119; Cyrillic-NoStress: t(10)=0.449, p=0.663). For experienced learners, however, both word-learning conditions exhibited d-prime scores that were significantly above zero (Cyrillic-Stress: t(13)=6.687, p<0.0005; Cyrillic-NoStress: t(14)= 4.541, p<0.0005).

The d-prime scores summarized in Table 8 were then submitted to an ANOVA with subject group (two levels: inexperienced learners, experienced learners) and word-learning condition (two levels: Cyrillic-Stress, Cyrillic-NoStress) as between-subjects variables. There was a main effect of group, with experienced learners significantly outperforming inexperienced learners (F(1,47)=10.797, p=0.001, partial eta squared =0.195); the main effect of word-learning condition (F(1, 47)=1.541, p=0.221, partial eta squared=0.032) and the interaction (F(1,47)=0.613, p=0.437, partial eta squared=0.013) were not significant.

The significant effect of group indicates that experienced learners of Russian were overall more successful at distinguishing the newly learned words on the basis of lexical stress than were the inexperienced learners. The lack of main effect of word learning condition, and of the interaction of the two variables, indicates that the presence/absence of the stress marks in the input to participants had no effect on their performance. The extremely small effect sizes (both 0.02 or lower) suggest that even with more statistical power (e.g., with more participants), these effects are unlikely to become statistically significant.

Because the inexperienced learners were additionally assigned to the Latin word-learning conditions, a two-way ANOVA was conducted on their d-prime scores with script (two levels: Latin, Cyrillic) and stress marks (two levels: stress marks, no stress marks). The main effects and interaction were not significant (all $p>0.2$).

To better understand the mean d-prime scores (and the large standard deviations), we next present the distribution of d-prime scores in each group (see Figures 2 and 3).

In Figure 2, we first see that most individual participants' d-prime scores are between -1 and 1. We also see that the d-prime scores in the four groups largely overlap, and that the Cyrillic-Stress group's slightly higher mean was carried by a single participant with a d-prime above 3. Next we turn to the experienced learner group d-prime data (Figure 3).

As with the inexperienced learners, the distributions of d-prime scores largely overlap between groups. However, unlike the inexperienced learners, the experienced learners' d-prime scores are nearly all positive, and tend to be higher than those of the non-learners.

Effects of Experience Level among Experienced Learners

As detailed above, the learners of Russian included in this study were recruited from university-level Russian language classes. We attempted to include learners who were relatively inexperienced (first-year) and relatively experienced (third-year). Among these students were also a number of students who may be classified as heritage learners of Russian. Up to this point

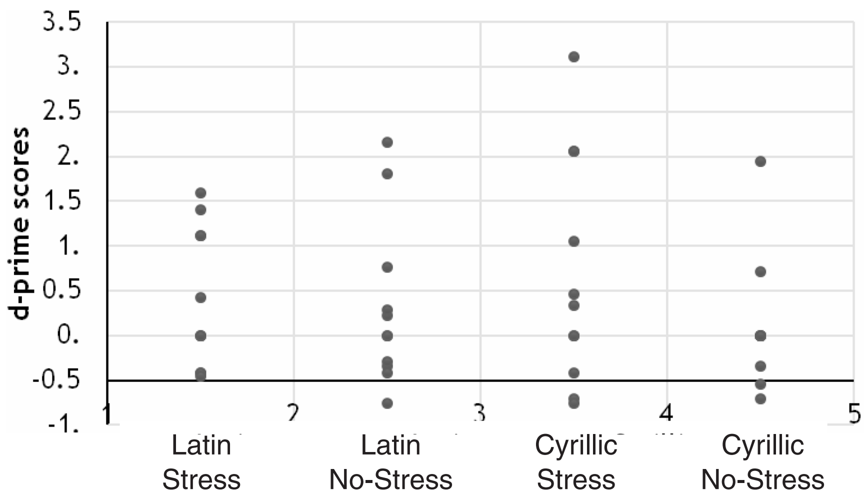

Figure 2. Distribution of d-prime scores in each of the inexperienced learner word-learning conditions.

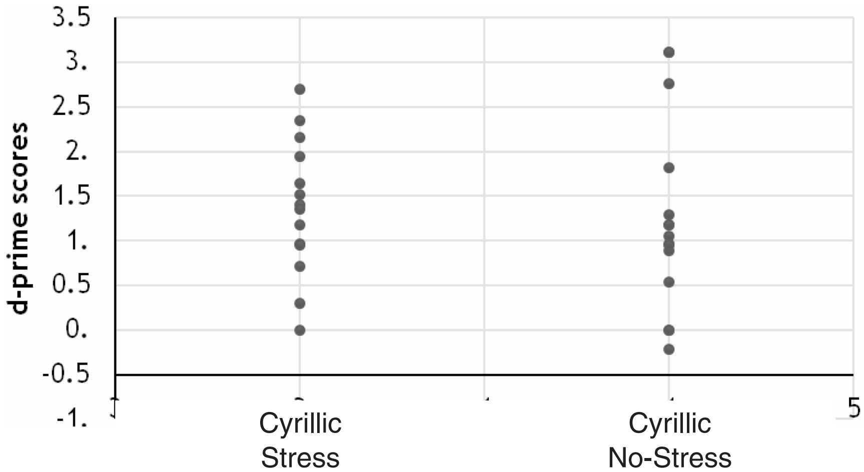

Figure 3. Distribution of d-prime scores in each of the experienced learner word-learning conditions.

in the analyses, we have averaged across learners with these three profiles. Now we will consider their data separately in order to determine whether participants' ability to learn the words and/or benefit from the availability of stress marks is affected by Russian language experience level (see Table 9 for d-primes by experience level and word-learning condition).

Table 9. Mean d-prime scores by experience level and word-learning condition (standard deviation).

	Cyrillic-Stress	N	Cyrillic-NoStress	N
First-year	1.640 (0.625)	3	1.249 (1.393)	6
Third-year	1.258 (0.844)	10	1.362 (0.944)	7
Heritage	1.642 (n.a.)	1	0.795 (0.365)	2

Due to the large differences in number of participants in each of the combinations of experience level and word-learning condition (ranging from one to ten participants in each group), inferential statistics is not appropriate. However, looking at the descriptive data, we can at least observe that degree of experience does not appear to predict learners' ability to benefit from the availability of stress marks, with some first-year students in the Cyrillic-Stress condition in fact outperforming the third-year students in the same condition.

Number of Trained Talkers?

The extremely low d-primes found in the present study raised the question of whether adjustments could be made to render the word-learning task easier for subjects. Recent studies using a similar word-learning procedure (e.g., Showalter and Hayes-Harb, "Unfamiliar"; "Native") have provided evidence that the task of novel word-learning may be made easier when the number of voices heard during the word-learning phase is reduced to one. While we do not yet know the exact reason for this effect, it seems reasonable to hypothesize that when a learner is faced with the task of learning a novel phonological contrast, the task is made easier when phonologically irrelevant variability (in this case, inter-talker variability) is reduced. In addition, as demonstrated in Tables 3 and 4 above, the two talkers differed in the extent to which they produced tokens with longer stressed than unstressed vowels. Of the two talkers, talker two produced larger stressed-unstressed vowel duration ratios, and with fewer exceptions to the expected ratio of >1. We thus conducted a small-scale follow-up study, using the word productions of only talker two. We recruited five native English-speaking participants with the same criteria as the inexperienced learners described above. Their d-primes are presented in Table 10.

Table 10. Mean d-prime scores by word-learning condition in follow-up study with one talker (standard deviation).

	Latin-Stress	Latin-NoStress	Cyrillic-Stress	Cyrillic-NoStress
Inexperienced learners	.952 (1.451)	.856 (1.184)	.964 (.922)	.112 (.932)

The d-prime scores in Table 10 are all below 1, indicating that the manipulation in this follow-up study provided no apparent benefit to participants in terms of their ability to associate lexical stress with the newly learned words. We have thus found that even when the auditory input is manipulated to minimize phonologically irrelevant variability and to maximize the salience of differences between stressed and unstressed syllables, native English speakers with no Russian language experience appear to be unable to learn Russian nonword minimal pairs distinguished by lexical stress under the conditions presented in this study.

Discussion

We begin the discussion with a summary of the main findings of the study. First, there was no effect of word-learning condition on d-prime scores for inexperienced learners; that is, neither the availability of stress marks nor the use of Latin versus Cyrillic script affected inexperienced learners' ability to associate lexical stress with newly learned Russian nonwords. Second, there was no effect of word-learning condition on d-prime for Russian language learners—the availability of stress marks did not affect experienced learners' ability to associate lexical stress with newly learned Russian nonwords.

Third, there was an effect of learner status on d-primes, with experienced learners outperforming inexperienced learners—Russian language experience increases ability to associate lexical stress with newly learned Russian nonwords; however, there was no effect of experience level on d-prime among experienced learners. Finally, there was still no effect of word-learning condition on d-prime for inexperienced learners when the word-learning task was made easier by reducing the number of talkers to one.

Together, these findings indicate that native English speakers experience a great deal of difficulty with Russian lexical stress. At first this result may be puzzling given that English, like Russian, makes use of lexical stress contrasts. However, as discussed above, it appears that the functional load carried by lexical stress in English with respect to online auditory word recognition may be quite low compared to that in other lexical stress languages (e.g., Spanish, Dutch, German: Cutler et al.; Cutler and Pasveer). To the extent that the auditory word-processing strategies developed by native English speakers rely less on lexical stress than those developed by speakers of these other lexical stress languages, native English speakers may approach the task of Russian word-learning with strategies that are non-optimal for learning lexical stress contrasts. Indeed, the difficulty that native English speakers experienced in the present study with Russian lexical stress contrasts is consistent with findings concerning their acquisition of other lexical stress languages (Polish: Kijak; Spanish: Saalfeld).

In the present study we have found no evidence of a benefit associated with the availability of lexical stress marks (even experienced learners who had prior exposure to stress marks did not appear to benefit from them in this study). This result may also be surprising given the facilitative effect of orthographic input that encodes difficult L2 phonological contrasts found in other studies (e.g., Escudero et al.; Showalter and Hayes-Harb ”Lexicon Study”). However, this facilitative effect has not been found to be robust across all second language–learning situations—for example, Simon, Chambless and Alves found no benefit of written forms for native English speakers learning some French vowel contrasts, and Showalter and Hayes-Harb (”Native”) did not find a benefit of written forms for native English speakers learning Arabic velar-uvular consonant contrasts. We are thus seeing that the beneficial effects of (certain types of) orthographic input in second language acquisition may be limited; research aimed at probing this issue further is needed.

Earlier we detailed the rationale for and prevalence of the use of stress marks in texts aimed at Russian language learners. While the present results call into question the utility of those stress marks, it is important to note that we have only shown that the availability of stress marks in the input does not have a significant beneficial effect on word learning under the very specific set of conditions in our study. We have thus not demonstrated that stress marks are never helpful to learners. It is possible that stress marks are in fact very helpful under certain input conditions—for example, in the absence of auditory input, a learner may rely on stress marks to indicate stress patterns. Furthermore, stress-marked forms in textbooks can serve a reference function much as they do in dictionaries. Indeed, this is the case with Russian language dictionaries aimed at native speakers—dictionaries are one of the few authentic Russian language texts that include stress marks. It is thus yet unclear whether and to what extent the stress marks that are inserted into Russian texts for the purpose of supporting second language learning of Russian lexical stress actually serve that purpose.

Conclusion

In the present work we sought to investigate the usefulness of the lexical stress marks that are typically provided to second language learners of Russian. We found that native English speakers did not experience a word-learning benefit from the availability of these stress marks. However, such a result must be interpreted with caution, as this laboratory-based study cannot capture essential elements of real-world language-learning conditions. The contribution of the present study is thus to challenge the assumption that lexical stress marks will be helpful to learners, with the caveat that further research is needed to determine the ecological validity of the present findings.

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Аннотация

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Влияние обозначенного ударения на усвоение носителями английского языка контрастных по лексическому ударению пар в русском языке

Недавние исследования содержат доказательства положительного влияния орфографической информации при усвоении фонологических контрастов во втором языке. В частности, было показано, что презентация орфографических контрастов улучшает способность изучающих второй язык дифференцировать недавно выученные английские слова, содержащие сложные слуховые контрасты. Так, например, буквы «a» и «e» могут помочь носителям голландского языка различать английские слова, содержащие звуки /æ/ и /ɛ/ (Escudero, Hayes- Harb & Mitterer, 2008). В настоящем исследовании мы попытались выяснить, могут ли диакритические знаки, обычно используемые в русском языке для обозначения лексического ударения в учебных текстах, быть столь же полезными учащимся, не являющимся носителями русского языка. Мы предлагали носителям английского языка с разной степенью владения русским языком выучить определённое количество несуществующих русских слов, содержащих минимальные пары, различающиеся по лексическому ударению. Варьируя учебные ситуации, мы изменяли наличие указанного ударения в предоставляемой участникам информации, а затем проверяли их способность дифференцировать вновь выученные минимальные пары, различающиеся по лексическому ударению. Мы не обнаружили, что наличие обозначенного ударения оказало влияние на участников исследования, чей уровень знания русского языка находился в широком диапазоне: от нулевого знания до третьего года изучения русского языка в колледже. В заключение обсуждается существенное различие между условиями обучения в ходе настоящего исследования и условиями усвоения русского языка в реальном мире. Авторы считают целесообразным дальнейшее исследование эффекта обозначенного ударения в условиях, приближенных к аутентичным.