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The Effect of Hyperarticulation on the Perception of Palatalization in Russian by L1 American English Speakers

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THE EFFECT OF HYPERARTICULATION ON THE PERCEPTION OF PALATALIZATION IN RUSSIAN BY L1 AMERICAN ENGLISH SPEAKERS

A Thesis
presented in partial fulfillment of requirements
for the degree of Master of Arts
in the Department of Modern Languages
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by

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ABSTRACT

The current study investigates a relationship between the ease of perception of a feature of secondary palatalization in Russian and a speech condition (casual and hyperarticulated). Forty-one L1 American English speakers – the students of the Russian program at The University of Mississippi – took part in two experiments. In addition, the research aimed to explore the influence of a hyperarticulated speech condition on a level of language proficiency of students (beginner or intermediate) and investigate whether students of a certain level benefit from hyperarticulation more. The results of two experiments showed that none of the groups of students benefited from hyperarticulation while perceiving a palatalized/unpalatalized consonant contrast. Moreover, the research provided the proof that hyperarticulation has no significant effect on perception of secondary palatalization in the Russian language.

In addition, the current research aimed to create a hierarchy of difficulty for perception of palatalized consonants in Russian. I found that sonorants were easier to perceive than obstruents, thus, the accurate perception of secondary palatalization in Russian is somehow related to sonority, which complements the hypothesis of Hacking (2011), who claimed that production of Russian palatalized consonants is linked to sonority as well. Another theory that is tested in the current research is the ‘listening by cue’ hypothesis by Kochetov (2006). He stated that preceding vowels provide acoustic cues for the perception of phonetic features. I tested and expanded Kochetov’s theory by adding more vowels to my research. He tested only three vowels; I tested all six vowels of the Russian language for my research. My study proved his hypothesis and I created a hierarchy of the Russian vowels according to their potential to create acoustic cues for the perception of consonants that follow them.
LIST OF ABBREVIATIONS AND SYMBOLS

L1 – first or native language
L2 – second or foreign language
L2 learner – learner of a foreign language
F2 – formant 2 (amplitude peaks in sound frequency spectrum)
H&H – hyper and hypoarticulated speech conditions (clear speech and mumbling)
x̄ – palatalized sound
C – consonant
V – vowel
CV – syllabic structure, where a vowel follows a consonant
C/V – palatalized consonant + vowel
CjV – palatalized consonant + glide + vowel.
EFL – English as a Foreign Language
ESL – English as a Second Language
AX task – acoustic discrimination task, where A always stays the same, but B is either the same or different
ABX task – method of comparing two choices of stimuli to identify detectable differences between them. A subject is required to identify X as either A or B.
PAM – Perceptual Assimilation Model
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TABLE OF CONTENTS

ABSTRACT ........................................................................................................ ii
LIST OF ABBREVIATIONS AND SYMBOLS...................................................... iii
ACKNOWLEDGMENTS....................................................................................... iv
LIST OF TABLES ................................................................................................ vi
LIST OF FIGURES ............................................................................................ vii
INTRODUCTION ................................................................................................. 1
LINGUISTIC BACKGROUND ............................................................................... 6
METHODOLOGICAL DESIGN ........................................................................... 18
  Participants .................................................................................................... 18
  Stimuli .......................................................................................................... 20
  Procedure .................................................................................................... 24
  Methods ...................................................................................................... 27
RESULTS AND DISCUSSION .......................................................................... 29
  Experiment 1 ............................................................................................... 29
  Experiment 2 ............................................................................................... 40
  Hierarchy of difficulty for perception of palatalized/unpalatalized consonants of the Russian language by L1 American English speakers .................................................. 48
  Vowels of Russian and their potential to provide acoustic cues for perception of secondary palatalization ................................................................. 50
TESTING THE EFFECT OF HYPERARTICULATION ...................................... 52
CONCLUSIONS ................................................................................................. 54
LIST OF REFERENCES ...................................................................................... 56
LIST OF APPENDICES .................................................................................... 60
VITA ................................................................................................................. 67
LIST OF TABLES

1. Russian consonants paired for the feature of palatalization .................................. 21

2. Error rate of target stimuli for the Russ 111 and Russ 301 groups (experiment 1) ..........35

3. Statistical results of experiment 1 for the two groups of students............................... 39

4. Statistical results of experiment 2 for the two groups of students...............................46

5. Difference between perception of stimuli in casual and hyperarticulated conditions........52
LIST OF FIGURES

1. Hierarchy of difficulty of production of palatalized consonants of Russian by L1 American English speakers .............................................................. 13

2. Vowel system proposed by the Saint-Petersburg phonology school ..................21

3. Results of experiment 1 for the Russ 111 group (all stimuli) ..........................29

4. Perception of target and control stimuli by the students of the Russ 111 group .......... 30

5. Results of experiment 1 for the Russ 301 group (all stimuli) ..........................31

6. Perception of target and control stimuli by the students of the Russ 301 group .......... 32

7. Compared perception of all stimuli by the Russ 111 and Russ 301 groups ........... 33

8. Perception of target and control stimuli by the Russ 111 and Russ 301 groups ..........34

9. Hierarchy of difficulty of palatalized/unpalatalized contrast perception for some voiceless and sonorous Russian consonants by the students of the Russ 111 group ...........36

10. Hierarchy of difficulty of palatalized/unpalatalized contrast perception for some voiceless and sonorous Russian consonants by the students of the Russ 301 group ...........37

11. Error rate for each target stimuli by the Russ 111 and Russ 301 groups (experiment 1) ..39

12. Percentage of accurate perception of hyperarticulated target stimuli by the beginner Russian group (experiment 2) .................................................................41

13. Percentage of correct perception of target stimuli by the beginner Russian group in experiments 1 and 2 .................................................................42

14. Percentage of accurate perception of hyperarticulated target stimuli by the intermediate Russian group (experiment 2) .................................................................43

15. Percentage of correct perception of target stimuli by the intermediate Russian group in experiments 1 and 2 .................................................................44
16. Accuracy of perception of target stimuli under a condition of hyperarticulation by the beginner Russian and the intermediate Russian groups (experiment 2) .................................45

17. Hierarchy of difficulty of production of palatalized consonants of Russian by L1 American English speakers...............................................................47

18. Hierarchy of difficulty of palatalized/unpalatalized contrast perception for some voiceless and sonorous Russian consonants by the students of the intermediate Russian group (experiment 2) ..........................................................48

19. Hierarchy of difficulty of palatalized/unpalatalized contrast perception of Russian consonants by L1 American English speakers.........................................................49

20. Potential of Russian vowels to provide acoustic cues for perception of secondary palatalization...............................................................50
1. INTRODUCTION

Palatalization is a phonological feature that appears in a number of languages like Russian, Irish, German, Italian, many African languages, etc. Kramer and Urek (2016) argue that although this phenomenon is wide-spread cross-linguistically, it displays a range of variation from language to language. They state that due to its diversity defining palatalization is challenging. However, Bateman (2011) manages to give a few definitions of the phenomenon by dividing it into two categories: full and secondary palatalization. Full palatalization can be found in most languages that have this feature, including Russian and English. During the process of full palatalization “a consonant changes its primary place of articulation and often its manner of articulation, while moving toward the palatal region of the vocal tract when adjacent to a high and/or front vocoid (Bateman, 2011, p. 590), e.g. /t/ - [ʧ] coat – coach. In the case of secondary palatalization, a consonant acquires “palatal articulation when adjacent to a high and/or front vocoid” (Bateman, 2011, p. 591), e.g. /t/ - [t̪]; Russian: [mat] – [mat’] checkmate – mother. This process does not completely change the sound but instead the sound becomes soft. Avanesov (1972) claims that “the softness of consonants is formed with a supplementary ‘i’-like articulation in the raising of the middle part of the tongue blade to the hard palate” (Avanesov, 1972: 36). The English language lacks secondary palatalization while Russian accommodates both types.

Secondary palatalization that provides a distinction between palatalized and unpalatalized consonants in Russian is a central feature of the phonological system of the Russian language. This distinction differentiates the meaning of many words, e.g. [kon] – [kon’] a round in a
game– a horse, so it is very important for L2 learners of Russian to be able to hear and produce the difference.

According to a ‘Feature Hypothesis’ (McAllister, Flege, & Piske, 2002), not having a certain feature in L1 makes it harder for a learner to acquire this feature in L2. Thus, L2 learners of Russian whose L1 is English supposedly have problems acquiring secondary palatalization. This type of palatalization is one of the hardest features to teach with regard to both perception and production. Because of the difference in place and manner of articulation of palatalized consonants in Russian and English, learners of Russian whose L1 is English are often unable to perceive or produce palatalized phones.

Russian language teachers have their hands busy in the classroom and thus phonological problems are often overlooked in class. Teachers do not pay attention to phonology as long as their students’ speech is intelligible. However, as mentioned before, secondary palatalization is distinctive for Russian; that is why it is important for students to hear and produce the difference.

Simonchyk & Darcy (2016) state that “palatalized and plain consonants share the same graphemes in Russian, and palatalization is not opaque in spelling” (p. 123). In Russian it appears in any position of a word – initial, medial, and final consonant. It can be expressed in two primary ways – as a consonant + soft vowel (и, е, я, ё, ю) combination, e.g. ‘дядя’ – [dᶨadᶨa] – ‘uncle’ or as a consonant + soft sign (ь) combination, e.g. ‘конь’ – [konᶨ] – ‘a male horse’. In my research I will only look at palatalization of consonants in a word-coda position, since previous studies (Kulikov, 2011; Hacking, 2011) proved it to be the most difficult for perception. This type of palatalization is commonly expressed by the combination of a consonant and a special letter called the ‘soft sign’ <ь>. 
One final phenomenon that is discussed in my work is hyperarticulation or clear speech. Maniwa and Jongman (2008) argue that deliberately clarified speech enhances understanding by 3-38 percent compared to casual conversational speech for hearing-impaired, elderly, and non-native listeners. Hazan et al. (1998, 2000) also have proven the positive effect of enhanced speech condition for non-native speakers of English, especially those who initially were least intelligible. In my research I use hyperarticulated or clear speech in experiment 2 to test whether it helps to improve perception of palatalized consonants in a coda position by American English listeners of different levels of proficiency in Russian. I also attempt to figure out if hyperarticulated speech has a different effect on the perception of palatalized consonants by students with different amounts of exposure (one semester of Russian vs. three semesters of Russian). According to Hazan et al. (1998), hyperarticulated conditions should be more helpful for the learners of lower proficiency; thus, I am expecting a larger distance between results of experiment 1 and experiment 2 for first semester learners of Russian.

My research questions were: (1) Is hyperarticulated speech condition more helpful for perception of palatalized consonants in Russian? (2) Does hyperarticulation have a different effect on students of different levels of proficiency in Russian? (3) Learners of what proficiency level benefit from speech enhancement more: novice or intermediate? (4) What palatalized consonants are easier for perception and what consonants are more difficult? (5) Does place of articulation of a consonant influence perception? (6) Do preceding vowels play a role in the accurate perception of palatalized consonants in coda position? (7) Which vowels create a more amenable environment for perception of palatalized/unpalatalized consonant contrast and which vowels complicate the perception?
Several previous studies have examined vowels preceding palatalized consonants and claim that their quality and duration are the two cues for perception of palatalization (Kochetov, 2006; Kulikov, 2011; Hacking, 2011). However, to my knowledge, none of the previous research has looked at all six Russian vowels before palatalized consonants. The highest number of vowels used in previous research is three. Thus, the additional aim of my study is to classify Russian vowels according to difficulty of perception of palatalized/unpalatalized consonants after them.

The current thesis consists of an Introduction, four chapters (Literature review, Methodological design, Results and discussion, and Testing the effect of hyperarticulation), a Conclusion, a List of references, and an Appendix. In the Introduction, I provide a brief description of the topics that are discussed in the research, such as palatalization and hyperarticulation, and identify my research questions and expectations. In the ‘Literature review’ section, I provide theoretical background for the earlier mentioned topics summarizing and analyzing the past work that has been done in the area. I also identify any gaps in the literature that I attempted to fill with my study.

The ‘Methodological design’ section describes the methods that were used for collecting and analyzing the data, procedures, stimuli, and participants in the research. The ‘Results and discussion’ section provides the results of two experiments and includes tables, and figures illustrating the data. It has four subsections: ‘Experiment 1’, ‘Experiment 2’, that provide more specific results and a description for each of the experiments, ‘Hierarchy of difficulty for perception of palatalized/unpalatalized consonants by L1 American English speakers’, and ‘Vowels of Russian and their potential to provide acoustic cues for perception of secondary palatalization’. In the ‘Results and discussion’ section I analyze the collected data and discuss
the findings in connection with the literature background. Also, I discuss whether the research was able to fill the gaps and answer the research questions that were identified earlier. In the ‘Testing the effect of hyperarticulation’ section, I statistically analyze the data on casual and hyperarticulated speech conditions from the two experiments. The Conclusion provides a brief summary of the study and the findings. Limitations of the study and recommendations for future research are also discussed in this section.
2. LINGUISTIC BACKGROUND

Palatalization in Russian has been a subject of interest for over three decades now. The phenomenon itself originated in Old Russian about a millennium ago and arose from the loss of ‘jers’ (ultra-short front vowels [ɪ] and [u] in unstressed position) that previously followed consonants. The consonants followed by ‘jer’ developed features of secondary palatalization by that time, and even after the language lost ‘jers’, palatalization that primarily was provoked by these vowels remained (Padgett, 2003). Now it is an essential part of the modern Russian language that requires special attention while studying it.

A large body of research has been done in the area of perception of Russian palatalization (Diehm & Johnson, 1997; Kavitskaya, 2006; Kochetov, 2006; Babel & Johnson, 2007; Kulikov, 2011; Hacking, 2011; Bolanos, 2013, Hacking et al., 2016, 2017 among others). Researchers approach the topic differently – some study only perception by native speakers of Russian, looking for cues that enhance consonant recognition; others compare how native speakers and L2 learners of Russian perceive palatalization. For instance, Kochetov (2006) provides evidence of the importance of acoustic cues for perception of the Russian palatalized/unpalatalized contrast of coronal stops [t]-[tᶞ] using the Listening by Cue Hypothesis (Steriade 1997), which states that contrast will be more visible in the environment that provides more acoustic cues. He examines the perception of six native speakers of Russian. The results of the experiments prove the hypothesis for the consonants following the contrast but fail to explain the lack of neutralization for front vowels. The hypothesis states that the contrast will be neutralized after all vowels;
however, some experiments show that certain vowels provide more cues for listeners; thus, they create the environment where the contrast is easier to perceive. Hacking et al. (2017) agrees with Kochetov (2006) and supporting Fant (1970) and Purcell (1979) states that “vowels before palatalized consonants have final F2 values that are 300-500 Hz higher than those before unpalatalized consonants” (p. 10).

Not only vowels help to differentiate between palatalized and unpalatalized consonants. Previous research has discovered the existence of another acoustic cue that allows for this: characteristics of a consonant release burst. Ordin (2010) and Hacking et al. (2017) claim that a consonant release burst is longer in duration for palatalized consonants than for their unpalatalized counterparts. Thus, the environment of palatalized consonants differs from the environment of unpalatalized consonants; this fact should help L2 learners of Russian to distinguish one from another even if they are unable to hear the difference between the palatalized/unpalatalized sounds themselves.

Unlike Kochetov (2006), Kavitskaya (2006) examines not the surroundings of palatalized/unpalatalized consonants but phones themselves. She tests Stevens’ and Keyser’s (1986) ‘enhancement theory’, which states that certain features of sounds are more salient (or primary), which makes them easier for perception. She describes palatalization as a secondary feature as opposed to primary features of sonority or voicing; thus, she assumes that palatalization is marked in the Russian language and it is harder to perceive than unmarked features of sonority or voicing. The researcher examines perception of palatalized consonants from different categories (sonorants and obstruents) by 10 native speakers of Russian. She uses monosyllabic stimuli with a CV structure that is considered unmarked in most of the languages and, thus, is easier for perception. She tests the tokens on four different gates (30ms, 60ms,
90ms, and 120ms). Bruno et al. claim that “adults require as little as 150 ms of the word (less than half the length of a typical spoken word) to identify highly familiar words” (p. 185). In other words, the authors state that the more acoustic information is given, the easier it is for a listener to identify a word (or a syllable). Kavitskaya’s gates are shorter because she tested syllables, not whole words, thus, the chosen gates were adequate enough for perception of the feature. However, the gates of 60ms and 30ms were hard for perception even for native speakers. Kavitskaya proves Stevens’ and Keyser’s theory partially wrong because confusion of palatalized and non-palatalized sounds appears to go against their predictions: in Kavitskaya’s research the sounds were differentiated easily in normal conditions. However, other factors like place of articulation and a time gate turned out to be significant for differentiation of palatalized consonants. Kavitskaya’s study tested native speakers of Russian. Native speakers require less acoustic information than L2 speakers of a language (Hazan et al., 1998). Thus, in our case, more acoustic information and a longer time gate are needed for successful perception of palatalized/unpalatalized consonants.

In contrast to Kochetov (2006) and Kavitskaya (2006), Kulikov (2011) was interested in the perception of palatalization by non-native speakers of Russian. He conducted an experiment with 40 L1 American English students perceiving the palatalized/unpalatalized consonant contrast in different syllabic position (onset and coda). The author tested and evaluated two models of acquisition of the phonological contrast – a ‘feature-based’ model by Brown (1998) and a ‘cue-based’ model by Archibald (2009). According to Brown’s model, accurate perception of L2 features by non-native speakers is “governed solely by features available in the native language (L1)” (Kulikov, 2011: 193). He claims that a phonological contrast cannot be acquired unless it exists in L1. In this case, it is unlikely for L1 American English speakers to acquire or
even perceive secondary palatalization (a contrast between palatalized/unpalatalized sounds) in Russian, as American English lacks this feature. On the other hand, Archibald (2009) argues that acquisition can be facilitated by phonetic cues that are stored in a learner’s L1. For instance, he talks about robust phonetic release of coronal stops, e.g. [t]–[tᶾ] in English as a feature that can facilitate palatalized consonants’ perception. However, he notes that none of the models makes predictions about the perception of obstruents, e.g. [f]–[fᶾ], and sonorants, e.g. [m] – [mᶾ].

After testing both models Kulikov (2011) discovered that the manner of articulation was an important feature for accurate coda perception and the place of articulation was significant for perceiving a palatalized phone in the onset position. The author concluded that the study results prove the Brown’s ‘feature-based’ model – features that are present in the L1 – are acquired more easily than the absent ones. However, other results of the experiment, like influence of the syllabic position, are better explained with Archibald’s ‘cue-based model’. He also states that both models failed to explain why coronal palatalized phones were more difficult to perceive than labial palatalized ones.

Another approach to examining perception of palatalization was taken by researchers who compared the perception of palatalization by native speakers and L2 learners of Russian (Diehm & Johnson, 1997; Babel & Johnson, 2007; Bolanos, 2013; Larson-Hall, 2004; Ullakonoja, 2011 etc.). I am particularly interested in learners whose L1 is American English, but there are also studies on perception of Russian palatalization by L1 Finnish speakers (Ullakonoja, 2011), L1 Japanese speakers (Larson-Hall, 2004) and others.

Bolanos (2013) conducted a number of experiments that included testing of perception and production of Russian palatalized consonants by 14 naïve (unexperienced in other languages) listeners of American English and Russian. He stated that Russian speakers’
perception of palatalized sounds was overall better than the perception of naïve American
English listeners. The researcher interpreted the results in terms of the Perceptual Assimilation
Model (PAM), which states that L2 categories are perceived as L1 categories or assimilated to
them, since a category of secondary palatalization is present in the Russian language, Russian
listeners were able to identify palatalized phones even in pseudo-words. American English naïve
listeners had a perceptual problem because of the absence of this category in the language. The
production experiment revealed that Americans and Russians have a different place of
articulation for palatalized phones: Russian speakers palatalized consonants themselves, e.g.
[tʰa], but American English speakers palatalized the transition zone between consonants and
vowels following them, e.g. [tja]. As for perception, it is impossible to tell if L2 learners of
Russian hear palatalization of a consonant or of a transitional zone; however, hearing a
transitional palatalization can also serve as an acoustic cue and, thus, facilitate perception of
palatalization in Russian.

The article by Diehm & Johnson (1997) displayed another side of perception and proved
that non-native perception may be less accurate but at the same time it is less biased. The
researchers investigated perception and production of Russian palatalized consonants that appear
in four different sequences (CV, CjV, CijV, CijjV) by Russians and Americans. The authors’
special interest was near-mergers – the last two sequences (CjV, CijV). In Russian, although
they bear same semantic and functional load, there is only a slight difference in style. It has been
found that native speakers of Russian were able to produce these near-mergers but had trouble
distinguishing the sequences when they heard them. The authors stated that it had happened
because “the native speakers listened ‘linguistically’ while the learners tended to listen
‘phonetically’” (Diehm & Johnson, 1997, p. 12). The data that were obtained from L1 American
English speakers on the perceptual experiment of differentiating the near-mergers showed that they could hear the contrast better than native speakers. The conclusion was that “L2 learners may attend at a psychoacoustic level to phonetic phenomena which are ignored by native speakers” (Diehm & Johnson, 1997, p.18). To avoid the effect of ‘linguistical’ listening in current research, I chose to use pseudowords as stimuli.

Another factor to take into consideration during the research is the task-dependence of the result. Babel and Johnson (2007) compared basic acoustic and language-specific perceptions of Russian palatalized consonants by naïve listeners whose L1s were Russian and English. The authors’ goal was to prove that the results of experiments depend highly on a task. They carried out two experiments: one was acoustic (an AX task), and the other one was more specific – the participants were given a Likert scale with five options (very similar, somewhat similar, moderately different, somewhat different, and very different). The same stimuli were used for both experiments. The results proved the hypothesis: Russian and American English speakers had similar performances on the acoustic experiment. However, their performance was different with a language-specific experiment.

The data from the first experiment differ from the data provided by Bolanos (2013), who reported significant differences in the perception of Russian palatalization by native speakers of Russian and naïve American English listeners. However, the studies used a different distribution of stimuli – AX and AXB tasks.

Hyde-Simon et al. (2008) explain an AX task type as a discrimination task where A is a constant stimulus that remains the same from trial to trial, but B can be either the same as A or different. Subjects are asked to compare B to A. The authors claim that an AX discrimination task requires very small memory load and it has a low degree of stimulus uncertainty, which
makes it the easiest acoustic task for listeners. An ABX task is considered more specific. Hyde-Simon et al. write that “in the ABX task, A and B are tokens of different phonetic categories and X is the same as A or B” (Hyde-Simon et al., 2008: 161). After listening to a triplet, listeners are asked to state whether X=A or X=B. This type of task may look significantly harder; however, Hyde-Simon et al. claim that it needs a small load of working memory as well. This task type has higher stimulus uncertainty; thus, for our experiments, an ABX task seems to be more adequate, since it is not too easy and does not require a large memory load. Also, an ABX task is proven to give more significant results than an AX task (Babel and Johnson, 2007; Bolanos, 2013).

Overall, the previous studies found that palatalization is better perceived in the onset position than in coda of words (Kochetov, 2006; Babel & Johnson, 2007; Kulikov, 2011; Bolanos, 2013). Deficiency of perception in a word-final position can be explained by the process of neutralization (or final devoicing) that is common for words in Russian. Simonchyk & Darcy (2015) argue that “learners whose native language preserves voicing contrasts word-finally, e.g. English, must learn to discard the feature [+voice] in that position for a neutralizing language such as Russian” (p. 85). The statement was made for production of word-final consonants but knowing about this feature of Russian is also important for perception. L2 learners of Russian (especially those whose L1 differentiates voiced and voiceless endings, e.g. English) must concede the possibility of words not having the sound that they hear but its voiced counterpart that was devoiced due to the linguistic properties of Russian.

In my research I excluded voiced endings that tend to be devoiced in casual speech to avoid interference of ‘linguistic’ perception (Diehm & Johnson, 1997). However, even without devoiced endings it is difficult for non-native speakers to perceive the feature of palatalization in
unstressed word-final position. Thus, the palatalized/unpalatalized contrast in the coda position is the most challenging for L2 learners of Russian.

Hacking (2011) examined the production of 6 devoiced palatalized consonants ([tᶨ], [pᶨ], [sᶨ], [nᶨ], [rᶨ], and [lᶨ]) in word-final position. She admitted that these palatalized consonants had different difficulty range for her participants, and she made an assumption that these results could have accrued due to different levels of sonority of the consonants. The more sonorous the sound was, the easier it was for production by L2 Russian learners. In addition, it was more accurately recognized by native speakers of Russian. Her conclusion was that “palatalization is somehow more compatible with sonority and hence easier for the second language learner to produce when the consonant falls on the more sonorous end of the hierarchy” (Hacking, 2011: 98). After her production experiments the researcher arranged the 6 palatalized consonants as follows:

![Hierarchy of difficulty of production of palatalized consonants of Russian by L1 American English speakers](Hacking, 2011:97)

She analyzed the most difficult palatalized consonants [tᶨ], [pᶨ], and [rᶨ], claiming that although Russian [t] and [p] are somewhat similar to American English [t] and [p], they differ in the status of the final release. She writes that the final release in English is optional while in Russian it is not. As for the [rᶨ] sound, she explains that Russian [r] is too different from American English [r], thus it was very hard to produce, although [r] is considered a sonorant.
Hacking (2011: 98) citing Kochetov (2006) notes that “Russian utterance–final stops are always audibly released, with the releases accompanied by strongly aspirated either velarized or palatalized off-glides” (Hacking, 2011: 98). Kochetov (2006) states that the release of consonants in the coda position is the main acoustic cue for perception of palatalization. Although, the findings of Kochetov (2006) were purely perceptual, Hacking (2011) used them to explain poor performance of students in the production experiment. Kochetov’s assumption is also valuable for our experiments since it was noted that our participants had the most trouble perceiving stops as well.

According to several studies (Zsiga, 2000; Kulikov, 2011; Bolanos, 2013, etc.) not only does the position of a consonant facilitates its perception and production, but also the manner of its articulation. Bradlow & Bent (2002) and Hazan et al. (1998) argue that clear speech is more intelligible than conversational speech. Seyfarth (2016) states that “if a spoken word is likely to be misunderstood, a talker may enhance it to make it easier to identify… if only a single segment has been misunderstood… talkers may limit their enhancement to that segment” (p. 31). Thus, if a word ending is enhanced or hyperarticulated, it should make it easier for listeners to perceive the contrast in word-final position.

Picart et al. (2010) focused on investigating the properties of different speech styles based on degree of articulation. He singled out three speech conditions: neuter speech, hyperarticulated and hypoarticulated speech. In my research, I will look only at neuter speech (a synonym for casual speech), as it is typically used in everyday communication, and hyperarticulated speech as a means of enhancing perception of palatalized consonants in word-final position.

Hazan et al. (1998) claimed that phonetic enhancement of speech significantly increases intelligibility even for nonsense words (pseudowords). The authors also emphasized
intelligibility improvements in hyperarticulated conditions for non-native listeners. Hazan et al. (1998) conducted a number of experiments that involved native speakers of English, L1 Japanese learners of English, and L1 Spanish learners of English. The aim of the experiments was to prove that phonetic enhancement improves general perception of speech in noise. They used nonsense VCV sequences with 12 consonants – [b], [d], [g], [p], [t], [k], [f], [v], [s], [z], [m], [n] – and three vowels – [a], [i], [u]. Aside from proving that the enhanced condition generally increases perception of speech in noise for all categories of listeners – native and non-native – they also found that enhancement was more effective for some consonants than for others. Thus, they concluded that phonetic enhancement was especially helpful for perception of plosives, e.g. [p], [t], [k], [b], [d], [g], and non-sibilant fricatives, e.g. [f], [v]. Two plosives, [p] and [t], and one non-sibilant fricative, [f], are tested in my research; thus, I can expect that the results of experiment 2 (hyperarticulated condition) will be more significant for these three consonants.

According to the ‘H&H’ hypothesis (Lindblom, 1983), which highlights two degrees of articulation (Hyper- and Hypoarticulation), hyperarticulated speech is distinguished by maximization of speech clarity. Hyperarticulated speech is also characterized by “a lower speech rate, a higher number of breaks (thus a longer pausing time), and more syllables (final Schwa insertions), resulting in an increase of the total speech time” (Picart et al, 2010, p. 273).

There are a few studies that examine hyperarticulated consonants in different languages. For instance, Maniwa & Jongman (2008) investigated the acoustic properties of clearly spoken English fricatives. They scrutinized the speech of 20 speakers of American English producing words containing the fricatives in VCV (vowel+consonant+vowel) position in conversational and hyperarticulated conditions. The researchers found that “there are systematic acoustic-phonetic modifications in the production of clear fricatives” (p. 3972). Along with Picart et al.
(2010), they noted longer duration and energy at higher frequencies, and they also spotted lower relative amplitude compared to neuter speech. In addition, the authors stated that “the acoustic distances between minimally contrasting sounds were enlarged in clear speech” (p. 3972). Their results may mean that a hyperarticulated speech condition potentially provides more acoustic cues that increase the difference between phonological contrasts and, thus, ensures easier perception of these contrasts (palatalized/unpalatalized consonants in my case). The results of the study coincide with my expectations concerning perception of a palatalized-unpalatalized contrast in Russian in hyperarticulated conditions: I expect more accurate perception of consonants during experiment 2.

Unlike Maniwa & Jongman (2008) and Hazan et al. (1998), Seyfarth (2016) examined the effect of enhancement (or hyperarticulation) on a phonological contrast in a word-final position. He measured the cues that helped to differentiate the voicing contrast [s] and [z] in English. The author stated that according to the results of his experiment, speakers enhanced the duration of the vowels and coda consonants based on the context which required sometimes elongation and sometimes shortening. He concluded that “talkers are capable of targeted, context-sensitive temporal enhancements” (p. 31). Context is a powerful tool for intelligibility enhancement and it certainly can serve as a perceptual cue, however, having a context may provoke ‘linguistic’ perception of palatalization that is based on knowledge of words. In my research, I am targeting pure acoustic perception that can be enhanced solely by cues of consonant burst release and duration of a preceding vowel.

Barnes (2007) examined properties of hyperarticulated speech as well. However, he used clear speech to investigate the relationship between phonetic duration and unstressed vowel reduction in Russian. He conducted a number of experiments with four native speakers of
Russian to examine the connection between vowel reduction and hyperarticulation in Russian. The researcher came to the conclusion that hyperarticulation was a valuable tool for a phonological contrast enhancement, but in his case the enhancement appeared to be shallow. I hypothesize that hyperarticulation of consonants will provide more significant results.

Kulikov (2011) states that the manner of articulation is an important feature for accurate perception of consonants in the coda, but the place of articulation is significant as well. He noticed that coronal palatalized consonants were more difficult to perceive than palatalized labials. My research contains both coronal and labial palatalized and unpalatalized consonants; thus, I will be able either to prove or refute his results in my first experiment. Contrastively, Hacking (2011) connects difficulty of palatalized consonants with their sonority: the more sonorous the consonant is, the easier it is for perception. Her theory contradicts Kulikov’s findings because according to Kulikov (2011), [p] should be perceived easily since it is a labial consonant. However, Hacking (2011) puts [p] in a category of the least sonorous consonants and, thus, argues that it is one of the most difficult consonants to perceive. It will be very interesting to compare the results of my experiments with the results of the research of Kulikov (2011) and Hacking (2011).

As for the second experiment (hyperarticulation), I will test Seyfarth’s (2016) hypothesis that hyperarticulated final consonants are perceived more accurately than the ones that are produced in casual (neuter) speech. Although there is a fair amount of research examining the effect of hyperarticulation on consonants (including final consonants) there is no evidence of the influence of enhanced palatalized/unpalatalized contrast on the perception of palatalization, and, more specifically, palatalization in the Russian language. This is the gap that I will attempt to fill.
3. METHODOLOGICAL DESIGN

3.1. Participants

Three native speakers of Russian (2 females and 1 male, ranging in age from 20 to 25) were recorded in order to create phonetic tasks for the experiments. All 3 participants have degrees in higher education and speak standard Russian. The speakers reported no speech, hearing or neurological disorders. One of the three speakers reported to be a Kazak – Russian bilingual with Russian being his dominant language. Two of the three participants speak English fluently, but they started learning it after the age of 10 and in an EFL environment. One speaker has been in the United States for four years, another one has been here for 7 months, and a third participant has never been to any English-speaking countries and speaks English at the intermediate level.

Forty-one students in the Russian program at The University of Mississippi took part in perception experiments 1 and 2. Experiment 1 took place in November 2018; it included groups 111 and 301. There were 24 first semester learners and 17 third semester learners, ranging in age from 18 to 25. The second experiment was held in February 2019. 18 students from group 211 and 13 students from group 302 participated in experiment 2. They were the same students but since the new semester started, their group index had changed. None of the participants had ever been to Russia or any other Russian-speaking country or had Russian-speaking friends. Their exposure to the Russian language had been mostly from Russian classes that they took at the
University of Mississippi. Only four students reported watching Russian TV series or listening to Russian pop music regularly. All of the participants were American English L1 speakers except for one student whose L1 was Cantonese (group 302). The Cantonese L1 speaker participated in the experiments but his results were later excluded from the tables and charts since his L1 could have affected performance, giving him an advantage in the acoustic experiments. I later analyzed his performance and compared it to the performance of L1 American English speakers.

For experiment 1, students were not asked if they spoke any other foreign languages, but before experiment 2, I asked the participants to write all languages they had ever learned on top of their exercise sheets. While analyzing the results I took into consideration the nature of languages that students mentioned and tried to see if that affected the higher/ lower error amounts for palatalization in Russian. Both experiments were done anonymously, and no identifying information was asked of the participants.

Experiment 1 contained 32 triplets with palatalized and unpalatalized contrasts like гат – гать ([ɡʌt]- [ɡʌtᶨ]) and 32 control triplets like кот – ком ([kot]- [kom]). After analyzing the results of experiment 1, two participants (group 301) were excluded from the analysis because they did not meet the task expectations. The students were expected to hear correctly at least 60% of the stimuli to continue participation in the study. The two excluded students had an equal amount of errors in target and control triplets, which tells us that they could not hear the difference or were not paying enough attention to the task. The experiment was anonymous, so we do not know the reasons why these two students did not pass. Thus, I had 38 students whose results were used to generate the charts and tables for experiment 1 and 30 students for experiment 2. I did not exclude anyone based on their results from experiment 2 since all of the 64 triplets were palatalized/unpalatalized counterparts.
I chose testing two groups of students with different levels of exposure because I wanted to figure out whether the amount of exposure influenced perception of palatalized consonants in word-final position. Ultimately, my experiment tested hyperarticulated perception. That is why I was more interested in studying perception of students of lower levels of proficiency (beginners and intermediate learners). Also, groups Russ 111 (211) and Russ 301 (302) were chosen because of their size. These two groups are the largest in the Russian program at the University of Mississippi. Other groups have fewer than 10 people.

3.2. Stimuli

I examined perception of the palatalized/unpalatalized contrast in Russian in word-final position. The word coda was chosen because previous studies (Kochetov 2006; Kavitskaya et al. 2009; Hacking 2011) revealed that this position is the most problematic for both production and perception. Hacking et al. (2017) supported Antonova’s (1988) and Bryzgunova’s (1963) claim that English speakers tend to perceive sequences like palatalized consonant – vowel as unpalatalized consonant – glide – vowel. The word coda environment makes it impossible to hear a glide after a target consonant since there are no vowels after it. In addition, Hacking et al. 2016 indicate that word-final position provides fewer acoustic cues for palatalized contrasts, which allows them to be isolated from the rest of the word and diminish the influence of other sounds.

There are twelve palatalized/unpalatalized consonantal pairs in Russian that can appear in a word-final position; they are shown in the Table 1 (Hacking et al., 2017: 10).
Table 1: Russian consonants paired for the feature of palatalization

<table>
<thead>
<tr>
<th></th>
<th>Labial</th>
<th>Dental/ Alveolar</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>unpalatalized</td>
<td>Palatalized</td>
</tr>
<tr>
<td>Voiceless stop</td>
<td>p</td>
<td>pʲ</td>
</tr>
<tr>
<td>Voiced stop</td>
<td>b</td>
<td>bʲ</td>
</tr>
<tr>
<td>Voiceless fricative</td>
<td>f</td>
<td>fʲ</td>
</tr>
<tr>
<td>Voiced fricative</td>
<td>v</td>
<td>vʲ</td>
</tr>
<tr>
<td>Nasal</td>
<td>m</td>
<td>mʲ</td>
</tr>
<tr>
<td>Lateral liquid</td>
<td></td>
<td>l</td>
</tr>
<tr>
<td>Trill</td>
<td></td>
<td>r</td>
</tr>
</tbody>
</table>

The current research concentrated on perception of 8 pairs of consonants (five obstruents – [t-tʲ], [s-sʲ], [p-pʲ], [f-fʲ], [r-rʲ]; and three sonorants – [m-mʲ], [n-nʲ], [l-lʲ]). I chose these pairs because out of 12 palatalized/unpalatalized pairs that may appear in a word-final position in Russian, four are usually devoiced in casual speech – [z-zʲ], [d-dʲ], [v-vʲ], [b-bʲ]. They sound the same as their voiceless counterparts; thus, it is impossible to produce a meaningful difference between them, for instance, [d-dʲ] and [t-tʲ] will both sound like [t-tʲ] in a word-final position in casual speech.

While creating the stimuli, I used all six vowels that exist in the Russian language. I chose to follow the Saint-Petersburg (Leningrad) phonology school, which proposes the following vowel characteristics: front vowels – [i] and [e], central vowels – [a] and [i], and back vowels – [u] and [o].

Figure 2: Vowel system proposed by the Saint-Petersburg phonology school
Although, there are studies that claim that a back-vowel environment provides more acoustic information for palatalized/unpalatalized consonants (Kochetov, 2006; Hacking, 2011), and, therefore, is more beneficial for perceiving the contrast, I am interested in comparing the perception of secondary palatalization by L1 American English speakers in all possible vowel environments. Kochetov (2006) investigated three vowels – front [i], central [a], and back [u] in his experiment. According to his research, [a] created the best acoustic conditions for perception of palatalization, [u] was in second place, and [i] created the hardest environment. As far as I know, no research has been done on perception of the palatalized/unpalatalized contrast after all six vowels of the Russian language. Unfortunately, due to time limitations and the complexity of the structure of an ABX task, I have no opportunity to test the perception of a contrast for all consonantal pairs after all vowels. However, this kind of experiment could be a suggestion for a future research.

There were two experiments conducted within the study. Experiment 1 contained 192 monosyllabic pseudowords – 96 target tokens + 96 controls. Examples of target words would be – пом [pom] – помь [pomy], and лок [lok] – лос [los] would be an example of a control contrast. According to a traditional model of an ABX task, a token appears in four different sequences. It allows us, on the one hand, to exclude random mishearing, but, on the other hand, it sets limitations on the number of stimuli, since every token must be multiplied by four.

Experiment 2 included two groups of monosyllabic pseudowords as well (192 tokens). Originally, it was planned that only consonants that caused problems in perception during experiment 1 would comprise the stimuli for experiment 2. However, all the palatalized/unpalatalized contrasts appeared to be problematic to different extents. Thus, experiment 2 consisted of two word groups: group 1 contained the target stimuli from the first experiment, e.g.
гат [gat] – гать [gati] – 96 tokens, and group 2 had the same amount of words (96 tokens) with the same palatalized/unpalatalized consonants as group 1, but the tokens were different, e.g. ват [vat] – вать [vat]. I am interested in seeing whether repetition of stimuli plays a role in their perception. If it does, then word group 1 (experiment 2) will have a lower error rate than group 2.

The stimuli were presented in a randomized order. Each vowel was used once except for the back vowel [o] and the central vowel [a], which were used twice. These two vowels were chosen not only because of the adjuvant environment that they create for a following consonant, but, also, because the general number of words that contain [o] and [a] is higher in the Russian language.

An example of a stimuli in the ABX format and how they are pronounced:

Гат – гать – гат

Гат – гать – гать

Гать – гат – гат

Гать – гат – гать

The full lists of initial stimuli and the full scripts of both acoustic tasks (the stimuli in randomized order) are presented in Appendices A, B, C, and D.

Both experiments took the same form: the triplets (groups of three words) were presented in groups of five with equal time gaps between the tokens in triplets (500ms) and between the triplets (2000ms). The last group had 4 triplets. There was a longer time gap in the middle of the task (4000ms) to allow the participants to turn the page. The time gaps were set according to the recommendations of previous acoustic studies on palatalization (Simonchyk & Darcy, 2015). There were also words – ‘часть 1’ (part 1), ‘часть 2’ (part 2) and so on – between the groups (13 parts in all). This was done in case the participants get lost in the task; identifying the place
where they currently are would help them get back to the task and continue it. The full lists of stimuli (both experiment 1 and 2) and how they were presented to the participants are in the Appendix.

Two audio files (one for experiment 1 and one for experiment 2) were created for the study at different time periods of the research: one in November, another one in February. Each file was approximately five to six minutes in length. Together with the audio files, there was a students’ sheet made for the task. Here is the example of one part (out of 13) of a students’ sheet and how it was presented to the participants:

Часть 1

1 2
1 2
1 2
1 2
1 2
1 2
1 2

Although, each triplet contained three tokens, the students were only given the numbers 1 and 2, as they were asked to compare a third token to the previous two and decide whether the third token sounded like the first or the second. The complete version of a students’ sheet with instructions for the task can be found in Appendix E.

3.3. Procedure

I started the work by creating a list of stimuli that contained 50% target triplets and 50% control triplets for experiment 1. The project was approved by the university’s Institutional
Review Board, and after that I recorded my three native speakers of Russian to create an acoustic task. I used “Easy Voice Recorder” software and a Samsung laptop to record the speakers. The laptop allowed me to record good quality audio, so no special equipment was needed. I used the software “Audacity” to work with the audio files to create the task. For experiment 1 that tested perception of palatalization in casual speech, all participants were asked to read all stimuli in their normal speaking style and tempo. At the time of experiment 1 the native speakers were not aware of the goal of my study, so they did not hyperarticulate the word endings. Later, I cut out the pieces that I needed for the tape from each speaker. For instance, from the triplet ГАТ [gat]-ГАТЬ [gatி] – ГАТ [gat], I cut out the first [гат], produced by female speaker 1, the second [гать], produced by female speaker 2, and the third [гат] from male speaker 3. Thus, I had Speaker1 – Speaker 2 – Speaker 3 producing ГАТ – ГАТЬ – ГАТ. The reason why I asked them to produce the whole triplet, although I knew that I was going to use only one stimulus out of the triplet, is because I needed the final task to sound natural. Producing the whole triplet allowed my speakers not to concentrate on one word and thus to avoid unnaturally clear production in experiment 1.

After creating the task, I launched a pilot study to make sure that my experiment did not have errors. The pilot study involved six people – students of different departments at The University of Mississippi. Four of them were native speakers of Russian and two were L1 American English speakers learning Russian as a second language. The L1 American English speakers had taken 5 semesters of Russian at the time of the experiment. After the pilot study I analyzed the results and corrected the mistakes that occurred in the experiment. For instance, I had to make a longer pause at the page turn and to modify the students’ sheet (see Appendix B) to make the task and the instructions clearer.
The next step was recruiting the participants. All participants were asked to sign a consent form that explained the nature of the research and informed them that they have a right to withdraw from participation at any time. All students of the target groups (111 and 301) had equal chances to participate and receive extra credit for participation. The participants were presented the audiotape at a comfortable listening level in a regular classroom using classroom equipment (computer, loudspeakers). I did not use headphones or any other special equipment because I wanted the experiment to be maximally close to conditions of a normal Russian lesson.

Experiment 1 took approximately 10 minutes (a six-minute tape and four minutes of instructions). The instructions and examples were provided before the test. All instructions were given in English. In addition, there was a soundcheck performed to ensure that everyone in the classroom could hear the tape normally.

After manually counting and analyzing the results of experiment 1, I created a list of stimuli for experiment 2 that aimed to check the perception of hyperarticulated consonant contrasts. Then I recorded the same 3 native speakers of Russian; however, this time they were informed about the goal of the experiment and were instructed to produce the tokens as clearly as possible. After recording the speakers, I created another audiotape using the same software Audacity. The endings of tokens were not amplified in the program; only natural enhancement from the native speakers was used to make the experiment as close to classroom conditions as possible.

Experiment 2 was conducted in a similar environment to experiment 1: in a regular classroom, using regular classroom equipment. All participants of one level were tested together in one room; thus, there were two tests – for group 302 and for group 211 separately. The participants were given instructions in English before the test, although they all still remembered
how to do it after experiment 1. After providing the instructions and before the start of the test, the participants were asked to enumerate which languages that they speak or have ever learned. Most of the participants wrote this information at the top of their students’ sheets. Also, after the experiments the participants were asked which of the two experiments was easier, the answer for both groups was ‘experiment 2’ (hyperarticulated condition), thus I was expecting better results for experiment 2 than for experiment 1. The results of both experiments were later analyzed, compared, and discussed. Charts and tables were created.

3.4. Methods

I used the Easy Voice recorder software installed on my laptop to obtain the data from the three native speakers of Russian. The Audacity software was used to create the recordings. For both experiments on casual and hyperarticulated speech I created an ABX discrimination task (one for each experiment) for data collection. An ABX task, compared to a classic acoustic AX task, is more specific, thus it was expected to provide more high-quality phonetic data. Although Pastore at al. (1976) argues that this type of task may be influenced by working-memory issues – it requires keeping the first two words in memory until hearing a third one – it eliminates the response bias and gives a chance of obtaining more relevant results. In addition, Hyde-Simon et al. (2008) claim that although an ABX task is harder than an AX task, it still does not require a large memory load. Also, using tasks of the same type for both experiments excludes a possible task bias when one task seems to be easier than another and subjects score higher on it not because they hear the difference but due to a 50/50 chance of choosing a correct response. The
acoustic experiments were done in a regular classroom before or after Russian lessons in the tested groups with help of classroom sound equipment.

The experiments were not orthography-based, but entirely acoustic. Students received sheets of paper (students’ sheets) and were instructed to choose numbers 1 or 2 for each triplet after hearing a third item (the example of a student sheet with instructions is provided in the appendix).

Figures and tables were created to show the results of the two experiments and to answer the research questions that were posed in the Introduction. All results were counted manually. For organization and presentation of the data I used Microsoft Excel software. To answer the main question of my research – does hyperarticulation have a different effect on students of different levels of proficiency in Russian? – I needed a more profound analysis. Thus, for these purposes I ran a one-way ANOVA in SPSS and a Chi-square online. The statistical results were later analyzed taking into consideration a coefficient of significance of the data. Figures and tables were created and explained.
4. RESULTS AND DISCUSSION

4.1 Experiment 1

The aim of experiment 1 was to investigate the perception of palatalized/unpalatalized consonants in word-final position in normal speaking conditions (casual speech) by L1 American English speakers. Two groups of L1 American English speakers with different amounts of exposure to the Russian language were tested.

Figure 3 shows the results of experiment 1 by group Russ 111 (intensive beginner Russian). By the time of the experiment the students had had six hours of the Russian language classes weekly for 14 weeks. They reported no other sources of exposure outside the classroom.

Figure 3: Results of experiment 1 for group Russ 111 (all stimuli)
Figure 3 shows the percentage of correct perception of all palatalized/unpalatalized stimuli (target and control) by all 24 students of the group Russ 111. The ordinal number of a student in the bottom of the chart (St 1, St 2, etc.) is not linked to a certain student. My aim was to show the results of all 24 students without comparing their proficiency. The data turned out to be consistent: the mean rate of perception for the group Russ 111 was 75% with the lowest percentage of perception being 64% and highest being 86%. All students from the group Russ 111 were later approved to take part in experiment 2 since they all scored more than 60% on the first task. However, the results on control and target stimuli were counted separately afterwards to see the percentage of perception of the target triplets only. Figure 4 displays the difference between perception of target and control stimuli by the students of the group Russ 111.

**Figure 4:** Perception of target and control stimuli by the students of group Russ 111

As was expected, the percentage of correct perception of control stimuli was higher because control stimuli were not supposed to be differentiated by the feature of palatalization. In fact, they all were either palatalized or unpalatalized and only had different ending consonants,
e.g. комь - коль – [komʲ] - [kolʲ]. It is supposedly easier to differentiate between sounds and not features (palatalized/unpalatalized), thus, controls were expected to show higher results of perception. Almost all students scored from 80% to 100% on control stimuli with the group mean rate of 92%. The situation with target stimuli was different: the students scored between 44% and 78% with the mean rate being 58%. Looking only at these numbers I can say that the feature of secondary palatalization causes perceptual problems for learners whose L1 lacks this feature. Also, there is no relation between perception of target and control stimuli: hearing controls well did not guarantee hearing target stimuli well. Thus, I can conclude that the general perception of sounds does not influence the perception of palatalization. However, I am not excluding the influence of musical hearing on perception of linguistic features: my research did not take it into consideration, thus, I cannot state that it does not provide any influence. Further and deeper research is needed to prove or refute this hypothesis.

As for the Russ 301 group, they displayed the following results in the first experiment:

![PERCENTAGE OF CORRECT PERCEPTION OF ALL STIMULI](image)

**Figure 5**: Results of experiment 1 for the Russ 301 group (all stimuli)
Figure 5 shows the results of the accurate perception of all stimuli in the first task by all 17 students of the Russ 301 group. It was expected that students of the Russ 301 group would have better results than students of the Russ 111 group because of a larger amount of exposure (almost three semesters of Russian). However, surprisingly, the more proficient group scored lower than the beginner group. The mean rate of perception in the Russ 301 group was 72% with the highest percentage of perception being 85% and the lowest being 52%. After I counted the results, two students of the Russ 301 group were excluded from further analysis: they scored 56% and 52%. I decided not to exclude the student who scored 59.5% since he/she was very close to the lowest border of 60%. The two students who scored 56% and 52% had many stimuli that were not circled at all. I assume that these students either got lost in the task or did not treat it seriously. That is why I thought that it would be fair to exclude them from the analysis so as not to let their results influence the statistics of the whole group. With the two excluded outliers, the mean rate of perception for the Russ 301 group (experiment 1) was 75%. The next figure displays the separate perception of the control and target palatalized/unpalatalized consonants for the Russ 301 group.

Figure 6: Perception of target and control stimuli by students the Russ 301 group
Figure 6 shows the correct perception of the target and control stimuli separately by the students of the Russ 301 group. The mean rate of perception for all 17 students is 57% for target stimuli and 88% for controls. However, without the outliers it is slightly higher – 59% for target stimuli and 90% for controls. The two outliers can be easily detected from the chart since their scores are the lowest: they are students 16 and 17. If the percentage of correct perception of target stimuli does not vary much (from 50% to 69%) with most listeners scoring between 59% and 63%, the perception of controls displays more variation – from 72% to 100%. I could not find the explanation for these data since I expected the results to be the opposite. As for the Russ 111 group, there is no correlation between accurate perception of control and target stimuli. Student 10, who scored the highest at 69% on target stimuli, displayed a low result on controls (81%); and both students who had 100% of correct perception of control stimuli scored an average of 63% on target stimuli.

Comparing the results of experiment 1 for both groups is crucial for answering some of the research questions that were posed in the introduction.

![Perception of All Stimuli by Two Groups](image)

**Figure 7:** Compared perception of all stimuli by the Russ 111 and Russ 301 groups
Figure 7 shows the perception of all the stimuli by both groups. As it was mentioned before, the mean rate of accurate perception for the Russ 111 group is 75% with lowest 64% and highest 86%. Meanwhile, for the Russ 301 group it is 72% with highest 85% and lowest 52%. Even if I exclude the outliers, the numbers are 75% mean rate with the lowest 59.5%, which is still lower than the results of the Russ 111 group. These data are surprising since I expected the perception of palatalization by the students of the group Russ 301 to be significantly higher than the perception by the group Russ 111 because of a larger amount of exposure to the language and its phonology over the years of studying Russian. The next figure displays the compared results for target and control stimuli separately by the two groups.

Figure 8: Perception of target and control stimuli by the Russ 111 and Russ 301 groups

Figure 8 displays data on how the students of both tested groups perceived target and control stimuli during experiment 1. Expectedly, the control triplets were heard better than the target ones in both groups. However, surprisingly, the students of the Russ 111 group performed better on the test than the students of the Russ 301 group in terms of perception of both target and control stimuli. The results of the Russ 111 group are less diverse; they all had about the
same perception of both target and control stimuli. On the opposite end of the spectrum, the results of the Russ 301 group are ‘jumpy’: some students scored high, others scored low. I do not know what could influence these data, since both groups were presented the same recording. Possibly the sound in a classroom where the Russ 111 group had class was better, although I did not notice the difference during experiment 1. Also, maybe students of the Russ 111 group were more motivated or had better hearing. Further research is needed to figure out the reasons why I obtained data like this.

The purpose of experiment 1 was not only to find out how L1 American English listeners perceive secondary palatalization in casual speech but also to detect the most problematic sounds and create their hierarchy. I planned to design experiment 2 on the base of the most problematic consonants and exclude the ones that were least problematic. Table 3 shows that in experiment 1 both groups of students had problems with all target stimuli. The contrast тал-таль [tal-tal] turned out to be the easiest to perceive. Overall, the sonorants [m-m], [n-n], [l-l] appeared to be slightly easier for perception than obstruents. Two possible explanations can be offered here: either there is something special about sonorants and the environment that they create, or their perception was facilitated by the preceding vowels. It is possible that, both factors influenced the perception of palatalized/unpalatalized sonorants.

Table 2: Error rate of target stimuli for the Russ 111 and Russ 301 groups (experiment 1)

<table>
<thead>
<tr>
<th>Target stimuli</th>
<th>Total error amount</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Russ 111</td>
</tr>
<tr>
<td>Ноп-нпъь</td>
<td>35 (11%)</td>
</tr>
<tr>
<td>Лэс-лэсьь</td>
<td>51 (16%)</td>
</tr>
<tr>
<td>Бон-боньь</td>
<td>42 (13%)</td>
</tr>
<tr>
<td>Пур-пурьь</td>
<td>43 (13%)</td>
</tr>
<tr>
<td>Гат-гатьь</td>
<td>44 (14%)</td>
</tr>
<tr>
<td>Тал-талььь</td>
<td>24 (8%)</td>
</tr>
<tr>
<td>Лыф-лыфьь</td>
<td>40 (12%)</td>
</tr>
<tr>
<td>Зим-зимьь</td>
<td>43 (13%)</td>
</tr>
</tbody>
</table>
The hardest stimuli were different for the two groups. Russ 111 had problems with лэс-лэсь [les-les/] – 51 errors (16% of the total amount of errors made), and for Russ 301 the hardest one was лыф-лыфь [lif - lif] – 27 errors (16% of the total amount of errors made). The mishearing of the contrast may have also been caused by difficulties in perception of the preceding vowels. Experiment 2 will show it is true. The stimuli that are marked in bold in the table тал-таль [tal-tal/] are the only target stimuli that had an error percentage lower than 10%. Thus, according to the original plan, it was not supposed to be included in experiment 2. However, since the error rate is not significantly lower than 10% (8% for Russ 111 and 9% for Russ 301), and this is the only stimuli that scored that high, I decided to keep it in experiment 2 as well.

The lowest error rate was found in [l-l’] opposition. This result is not entirely unexpected since previous studies proved the [l-l’] contrast to be the easiest to produce for L1 American English learners of Russian (Hacking 2011, Hacking et. al. 2016). Hacking 2011 proposed the hierarchy of difficulty for the tested consonants with [t-t’] and [p-p’] being the hardest and [l-l’] being the easiest to produce. This hierarchy proved to be somewhat close to the hierarchy of the perception of the palatalized consonants that is offered in the current research. The figures below present the hierarchy of difficulty for the eight target consonants for the Russ 111 and Russ 301 groups.

Most difficult ........................................................................ Least difficult
/s-s’/ /t-t’/ /m-m’/ /n-n’/ /f-f’/ /p-p’/ /l-l’/ /r-r’/

**Figure 9:** Hierarchy of difficulty of palatalized/unpalatalized contrast perception for some voiceless and sonorous Russian consonants by students of the Russ 111 group
Somewhat similar results were received from the Russ 301 group. The difference between the stimuli error rates was sometimes very small. For instance, [r-rʲ] scored 43 and [t-tʲ] scored 44 in the Russ 111 group; that is why they stand close to each other. The further the sounds are from each other on the figures, the greater is the difference between their perception. For example, [l-lʲ] is far from [r-rʲ] and [p-pʲ] on Figure 4. This means that the error rate is significantly lower for [l-lʲ] than for [r-rʲ] and [p-pʲ]. On the other end of the spectrum, [m-mʲ], [t-tʲ], and [r-rʲ] stand close because they scored 20, 21, and 22 respectively. Also, there are contrasts like [r-rʲ] and [p-pʲ] that stand in one column on Figure 10, they scored the same amount of errors. I do not provide the exact count of errors because the amount of people in two groups was different and since the Russ 111 group had more people, they made more errors. Giving the number of mistakes would not be a reflection of reality, and that is why I counted the percentage.

The hierarchy of difficulty of a palatalized/unpalatalized contrast perception for the Russ 301 group does not look the same as the hierarchy for the Russ 111 group:

Most difficult

/F-lʲ/ /s-sʲ/ /m-mʲ/ /t-tʲ/ /r-rʲ/ /l-lʲ/

/ŋ-nʲ/ /p-pʲ/ 

Least difficult

Figure 10: Hierarchy of difficulty of palatalized/unpalatalized contrast perception for some voiceless and sonorous Russian consonants by students of the Russ 301 group

As predicted by Hacking (2011), the contrast [l-lʲ] appeared to be the easiest to perceive for both groups. She suggests that “palatalization is somehow more compatible with sonority and hence easier for the second language learners to produce” (Hacking 2011: 98). In my case, sonority may have become an important acoustic cue for perception, however, not for all consonants. For instance, the sonorant [n-nʲ], which was somewhat easy for production, appeared to be hard to perceive. By contrast, the obstruent [p-pʲ] took second position in my perception.
experiment. Hacking (2011), however, claimed it to be somewhat difficult for production. Also, Hacking (2011) did not test the sonorant [m-mi], so I cannot compare her data with my results for this consonant.

One more sound that Hacking (2011) did not test was [f-fᶨ]; its position in my research is controversial. Surprisingly, it had a different error percentage in the two groups: it was difficult to perceive for the Russ 301 group (16% error rate) and somewhat easy for the Russ 111 group (12% error rate). The difference in percentage may not seem significant, but, in fact, it is meaningful since 16% is the highest error percentage for both groups. Further research is needed to explain why the contrast [f-fᶨ] is perceived better by students with less exposure to the language. However, the obstruents [f-fᶨ] and [s-sᶨ] fall into the same category – fricatives, making the results of the group Russ 301 more phonologically predictable.

According to the sonority hierarchy, the contrast [r-rᶨ] is supposed to be easier to produce/perceive, but Hacking (2011) assumes that difficulties with this contrast come from universal properties of palatalized trills. Zigis (2004) points at the markedness of palatalized trills within the category of trills: “… plain trills are unmarked with respect to their palatalized counterparts.” (Zigis 2004:137). However, L1 American English speakers may have also had trouble perceiving the Russian trills because their native language lacks phonemes with similar properties – in American English the [ɾ] sound is a retroflex approximant and it has properties that are totally different from a Russian trill. The following figure displays the percentage of errors for each target stimuli separately comparing the results of students from the Russ 111 and Russ 301 group.
The first experiment showed that despite the different amount of exposure to the Russian language, all subjects displayed similar results – the mean percentage of the correct perception for the Russ 111 group was 75%, and for the Russ 301 group was 72% (75% without outliers). This fact refutes the hypothesis that a level of exposure to a language may influence acoustic perception of sounds. To make sure that perception cannot be influenced by the proficiency of students (at least in the first couple of years of language learning) I ran a one-way ANOVA using SPSS software. Table 3 displays the results of the comparison of the two groups in experiment 1.

**Table 3:** Statistical results of experiment 1 for the two groups of students

<table>
<thead>
<tr>
<th></th>
<th>Sum of Squares</th>
<th>df</th>
<th>Mean Square</th>
<th>F</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Between Groups</strong></td>
<td>1.569</td>
<td>1</td>
<td>1.569</td>
<td>.017</td>
<td>.898</td>
</tr>
<tr>
<td><strong>Within Groups</strong></td>
<td>3640.382</td>
<td>39</td>
<td>93.343</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>3641.951</td>
<td>40</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
We can see that the p-value (Sig.) of the difference between the two groups is .892. According to the requirements of statistical analysis, the p-value must be \( \leq 0.05 \) for a result to be considered significant. Thus, the statistical analysis shows that for my study the difference of perception between the beginner and the intermediate groups of students was insignificant.

The worst results were found in the Russ 301 group (59.5% correct) and the best result was detected in the Russ 111 group (86% correct). Also, both outliers that failed experiment 1 were from the Russ 301 group. However, experiment 1 only had one stimulus for each consonant opposition, and perhaps the influence of a vowel that stood before a consonant played a more important role in perception, since some vowels provide more acoustic cues for accurate perception than others. Experiment 2 has more variety in terms of a vowel-consonant combination, and it doubles the amount of target stimuli. Thus, experiment 2 will provide additional data which will help to state whether the hypothesis is correct or incorrect.

### 4.2 Experiment 2

Unlike experiment 1, experiment 2 consisted only of target stimuli. I kept the same structure and length of the experiment, but this time instead of controls there was an additional group of target stimuli. Thus, I had each target consonant in two variations with two different vowels. Experiment 2 was designed this way not only to test the perception of hyperarticulated consonants more profoundly, but also to investigate the role of a preceding vowel for perception of the feature of secondary palatalization. According to Kochetov (2006), vowels can create an environment that has more or fewer acoustic cues for perception of a following consonant. In his experiment he stated that a central open vowel [a] created the best environment for perceiving
palatalized consonants. A close back [u] followed [a] closely, and a close front [i] was the most inconvenient. Kochetov (2006) used only the vowels that exist in both the Russian and American English phonological systems. In my research I added a close central vowel [ɨ], that is forend only in the Russian language. In experiment 1, the consonant contrast that followed this vowel was perceived badly in both groups of students – 12% and 16% error rate. In experiment 2 I tried to figure out if it was misperceived because the students could not hear the contrast between a palatalized and unpalatalized obstruent or because the vowel [ɨ] gave them fewer acoustic cues for perception. The following figure displays the accuracy of perception of stimuli by the Russ 211 group in experiment 2.

![PERCENTAGE OF CORRECT PERCEPTION](image)

**Figure 12:** Percentage of accurate perception of hyperarticulated target stimuli by the beginner Russian group (experiment 2)

For experiment 2, there was no minimal percentage of perception, all results were significant since there were no control stimuli. The mean rate of perception for the beginner group was 60% with the highest perception percentage being 72% and the lowest being 50%.
Moreover, to avoid confusion the tested groups will be referred to as the beginner Russian group and the intermediate Russian group, since experiment 2 was done at the beginning of the second semester and the groups changed their indices (Russ 111 became Russ 211 and Russ 301 became Russ 302). The next figure compares the perception of target stimuli in experiments 1 and 2 by the beginner Russian group.

**Figure 13:** Percentage of correct perception of target stimuli by the beginner Russian group in experiments 1 and 2

The results of experiment 2 turned out to be more consistent: the gap between the highest and the lowest perception rates was only 22% this time compared to 34% in experiment 1. The mean rate of perception of the target stimuli is also slightly higher in experiment 2 – 60% compared to 58% in experiment 1. However, I expected higher results on experiment 2 since hyperarticulation was predicted to have a positive impact on perception of a palatalized/unpalatalized contrast. A hyperarticulated condition seems to be helpful for students whose level of perception was low in experiment 1 since in experiment 2 nobody scored lower than 50% compared to 44% in experiment 1. However, I cannot exclude the task effect – the students were
familiar with a task type after experiment 1 – and possibly it made them feel more comfortable during experiment 2. Meanwhile, the highest perception rate dropped: it was 78% in experiment 1, and it became 72% in experiment 2. The results of experiment 2 for the intermediate Russian group can be found below.

![Figure 14: Percentage of accurate perception of hyperarticulated target stimuli by the intermediate Russian group (experiment 2)](chart)

The results of the intermediate Russian group were unexpected. The hyperarticulated condition was hypothesized to have more significant impact on the beginner Russian students, but the intermediate Russian group was also expected to display a higher result on perception of secondary palatalization in clear speech. Surprisingly, the mean rate of perception of target stimuli was even lower in experiment 2 – 56% compared to 59% in experiment 1. Also, this time the lowest percentage of perception dropped to 34% compared to 47% in experiment 1. However, the highest perception rate was 77% compared to 69% in experiment 1. Interestingly, 77% was scored by a Mandarin and Cantonese L1 student (ST 12 MC in the chart). Having a
language with tones probably enhanced his hearing on secondary features a foreign language. However, the second highest result by L1 American English listener was not far from the Mandarin and Cantonese L1 student – 76%. The following is a figure that compares the perception of target stimuli by the intermediate Russian group in experiments 1 and 2.

**Figure 15:** Percentage of correct perception of target stimuli by the intermediate Russian group in experiments 1 and 2

As we see, the results of experiment 1 are more coherent even taking into consideration the two outliers. The hyperarticulated condition gave worse results than casual speech. This made me think that hyperarticulation possibly does not influence the perception of a palatalized/unpalatalized contrast at all and the slight improvement in the beginner Russian group is random or it happened due to task effect. Also, being exposed to other L2s did not have any positive impact on the perception of secondary palatalization. For instance, the two students from the intermediate Russian group who scored over 60% on the stimuli in experiment 2 only listed Spanish as their other L2. Thus, there was no correlation noticed between the number of foreign
languages studied and the perception of secondary features, unless the students just did not put hard work into acquiring their phonological systems. By contrast, the student who claimed to be exposed to four other foreign languages besides Russian had the lowest rate of perception – 34%. The next figure shows the compared perception of target stimuli in experiment 2 by the students of both tested groups.

![PERCEPTION OF TARGET STIMULI BY THE TWO GROUPS](image)

**Figure 16:** Accurate perception of target stimuli under a condition of hyperarticulation by the beginner Russian and the intermediate Russian groups (experiment 2)

The beginner Russian group showed better results than the intermediate Russian group in both experiments – on casual and hyperarticulated speech. The beginner group displayed coherent results, while the intermediate group turned out to be inconsistent – the best and the worst results were detected within the intermediate Russian group. Overall, not only the performance of the intermediate group was worse than the performance of the beginner group, but also, the performance of the intermediate group on experiment 2 (hyperarticulation) was worse than their performance on experiment 1 (casual speech). These results are surprising and,
at the same time, not surprising, since both outcomes can be explained. On the one hand, hyperarticulation was supposed to boost the perception of palatalization and, thus, the scores of the groups. On the other hand, experiment 2 was more difficult in terms of stimuli – it had a 100% target (palatalized/ unpalatalized contrast) stimuli. In experiment 1, the intermediate group scored higher due to having controls (palatalized/palatalized or unpalatalized/unpalatalized stimuli that varied by different consonants). The experiments showed that the perception of secondary palatalization is highly person-dependent and does not correlate with level of exposure to a foreign language. However, to see how significant these data are, I performed statistical analysis on the results on experiment 2. The following is a one-way ANOVA table for experiment 2.

**Table 4: Statistical results of experiment 2 for the two groups of students**

<table>
<thead>
<tr>
<th>% of correct perception of target stimuli</th>
<th>Sum of Squares</th>
<th>df</th>
<th>Mean Square</th>
<th>F</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Between Groups</td>
<td>80.000</td>
<td>1</td>
<td>80.000</td>
<td>.994</td>
<td>.327</td>
</tr>
<tr>
<td>Within Groups</td>
<td>2252.667</td>
<td>28</td>
<td>80.452</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>2332.667</td>
<td>29</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The p-value in experiment 2 is .327, which is higher than 0.05, and, thus, indicates that the difference of perception between the beginner and the intermediate groups of students is insignificant in the hyperarticulated condition as well. Both ANOVAs (for experiment 1 and experiment 2) were ran only within one experiment, and they do not show whether hyperarticulated condition gave better results than the casual speech. The statistical analysis
performed only indicates that there is no correlation between the level of proficiency in Russian and the ability to perceive secondary palatalization.

However, the data that were obtained in both experiments are significant in another way. After experiment 2, I was able to create a more accurate hierarchy of difficulty in the perception of a palatalized/unpalatalized consonant contrast in the Russian language. The following are the results of experiment 2 for the beginner Russian group.

Most difficult ←  /s-/s/  /m-/m/  /t-/t/  /p-/p/  /r-/r/  /f-/f/  /n-/n/  /l-/l/  → Least difficult

**Figure 17:** Hierarchy of difficulty of perception for some voiceless and sonorous palatalized/unpalatalized Russian consonants by students of the beginner Russian group (experiment 2)

The data that were obtained in experiment 2 are slightly different from the data obtained in experiment 1. For instance, [n-ni] moved closer to the ‘least difficult’ position, as was predicted by Hacking (2011). However, [m-mi] stayed in the same spot, although it is a sonorant and was supposed to be perceived somewhat like [n-ni]. Even combining [m-mi] with another vowel did not boost its perception. Everything else stayed about the same in the hierarchy but experiment 2 clarified the position of a sonorant [n-ni].

As for the intermediate Russian group, the results changed drastically. They became more reminiscent of the data of Hacking (2011) on the difficulty of production of palatalized consonants in the Russian language by L1 American English speakers of Russian. It is possible that, combining consonants with different vowels helped the students. Also, controversial [f-ф] became more stable. In experiment 1 the perception of [f-ф] was probably overpowered by the preceding vowel [i] which caused difficulty. In experiment 2, [f-ф] was combined not only with [i] but also with [o], which, perhaps, created a better environment for the perception of
consonants. Below is the hierarchy of difficulty of perception of a palatalized/unpalatalized consonant contrast in the Russian language for the intermediate Russian group in experiment 2.

Most difficult ←………………Least difficult

/r/-r/ /f-f/ /s-s/ /m-m/ /l-l/ /p-p/ /t-t/ /n-n/

**Figure 18:** Hierarchy of difficulty of palatalized/unpalatalized contrast perception for some voiceless and sonorous Russian consonants by students of the intermediate Russian group (experiment 2)

The sonorants proved to be the easiest for perception as all three of them are on the ‘least difficult’ end of the hierarchy. The contrasts [l-l] and [n-n] had the same perception percentage in experiment 2, although [l-l] was predicted to be easier to perceive than [n-n]. Surprisingly, [r-r] moved to the ‘most difficult’ position from the middle of the hierarchy after experiment 2. However, this was predicted by Hacking (2011), who also noted [r-r] as ‘difficult’ due to the differences in its nature in the American English and the Russian languages. In addition, this change could have been influenced by the combination of [r-r] with mid front vowel [e]: the number of mistakes in [per – per] was two times higher than in [pur – pur]. Hacking (2011) claimed that [p-p] is a hard contrast to produce; my experiment showed that it is also hard to perceive.

### 4.3 Hierarchy of difficulty for perception of palatalized/unpalatalized consonants of the Russian language by L1 American English speakers

One of my research goals was to create a hierarchy of difficulty of perception of palatalized Russian consonants for L1 American English speakers. Below are approximate results of both tested groups after both experiments. The classification is approximate because
sometimes the position of consonants was dubious. For instance, [f] had a very different
perception level in the two groups in experiment 1.

Most difficult ← Most difficult

<table>
<thead>
<tr>
<th>consonant</th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>/s-s/</td>
<td>186</td>
<td>171</td>
<td>169</td>
<td>167</td>
<td>165</td>
</tr>
<tr>
<td>/r-r/</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>/t-t/</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>/f-f/</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>/m-m/</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>/n-n/</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>/l-l/</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>115</td>
</tr>
</tbody>
</table>

**Figure 19:** Hierarchy of difficulty of palatalized/unpalatalized contrast perception of
Russian consonants by L1 American English speakers

These are the cumulative results of the perception of the eight palatalized/unpalatalized
sonorants and obstruents by the two groups. The numbers of errors were obtained by means of
adding all misperceived stimuli that contained the same consonant for both groups in both
experiments. For instance, [l-l] = 115 was calculated as 21 (beginners experiment 1) + 16
(intermediate experiment 1) + 44 (beginners experiment 2) + 34 (intermediate experiment 2).
The further the contrasts are from each other on the scale, the larger the error gap is. As can be
seen, [r-r], [t-t], [f-f], [m-m], and [p-p] had a small difference in errors. [l-l] was the easiest to
perceive; it is followed by [n-n]. As expected, the contrast [s-s] turned out to be the hardest for
perception. I agree with Hacking (2011) on her theory that sonority and the ease of production/
perception are somehow connected, because all sonorous consonants appeared on (or closer to)
the ‘least difficult’ end of the hierarchy. On the other hand, [s-s], [r-r], and [t-t] turned out to be
the most difficult for L1 American English speakers, and Hacking (2011) had the same data on
production of palatalized/unpalatalized Russian consonants (see p. 13 of the current thesis). In
her work, [p-p] was also in the middle but closer to the ‘most difficult’ end.
4.4 Russian vowels and their potential to provide acoustic cues for the perception of secondary palatalization

Another goal of my research was to create an approximate hierarchy of difficulty of the Russian vowels for perception of secondary palatalization. As it was mentioned before, I used the vowel classification by the Saint Petersburg Phonology School, which claims that the phonological system of the Russian language has six vowels: a front close [i], a front mid [e], a central close [ɨ], a central open [a], a back close [u], and a back mid [o].

Kochetov (2006) in his research on cues for perception of secondary palatalization in Russian thoroughly investigated only three out of the six vowels – [i], [a], and [u] – front, central, and back. My research aims to propose a hierarchy of difficulty for all six vowels, however, it is a rough classification, since vowels are not my primary concern. Each vowel is used once in experiment 1 except for [a] and [o], which are used twice. In experiment 2, I double the number of target stimuli; thus, all vowels are used twice in different CVC variations. Meanwhile, [a] and [o] are used four times each. To equalize the number of errors per consonant count, I had to divide the results for [a] and [o] by 2, because their frequency of appearance in stimuli was two times higher than the frequency of appearance of other vowels. For instance, I counted the results for [a] as follows: (63 (beginner group experiment 1) + 38 (intermediate group experiment 1) + 122 (beginner group experiment 2) + 71 (intermediate group experiment 2)) / 2 = 147. After manually counting the results for each vowel, I created the following hierarchy:

Worst environment \[ \text{[e]} \quad \text{[i]} \quad \text{[ɨ]} \quad \text{[u]} \quad \text{[o]} \quad \text{[a]} \] Best environment

**Figure 20:** Potential of Russian vowels to provide acoustic cues for perception of secondary palatalization
Figure 20 has the terms ‘worst environment’ and ‘best environment’ at different ends. They reflect the potential of a vowel to create an environment for the successful perception of secondary palatalization after it. As in the Kochetov’s research, [a] turned out to be providing more acoustic cues for perception than other vowels. This means that the students had a higher chance of perceiving a palatalized/unpalatalized consonant contrast successfully if it followed [a]. The number of errors for [a] was 147. Other vowels that provided conducive environment for perception followed [a] very closely – [o] had an index of 151.5 and [u] scored 152. On the other hand, [e], [i], and [ɨ] created a less beneficial environment for the perception of secondary palatalization: both [i] and [ɨ] scored 171, but [e] was the worst – 199. Thus, all six vowels can be divided into two groups – vowels that facilitate the perception of secondary palatalization, and vowels that make the perception more difficult. The results of my experiments supported the data provided by Kochetov (2006): [a] and [u] turned out to provide more acoustic cues for the perception of secondary palatalization after them than [i].

Obviously, it is more expedient and beneficial to use vowels of the first group while conducting research on the perception of consonants after vowels. If I continue my research in the future, I will create my stimuli with these three vowels to minimize the intervention of acoustic cues that make the perception of a palatalized/unpalatalized contrast more difficult.
5. TESTING THE EFFECT OF HYPERARTICULATION

The primary goal of my research was to figure out whether emphasizing and hyperarticulating words can help language learners to perceive certain phonological features – secondary palatalization in my case. After conducting two experiments (one on casual speech and one on hyperarticulated condition) I manually counted the results and realized that there was almost no difference in perception of a palatalized/unpalatalized contrast under the two conditions. To make sure that the acquired data were legitimate I ran a statistical analysis on the results of the two experiments. Unlike ANOVAs, which I ran to determine whether there is a difference in the perception of palatalization between the two groups of students, a chi-square analysis aimed to compare the two conditions of speech. Thus, ANOVAs were conducted within the experiments while a chi-square analyzed the results of both experiments at the same time. Below are the results of the statistical analysis of the difference in perception of secondary palatalization by L1 American English learners under the two conditions:

Table 5: Difference between the perception of stimuli in casual and hyperarticulated conditions

<table>
<thead>
<tr>
<th></th>
<th>Results</th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>casual</td>
<td>hyperarticulated</td>
<td>Row Totals</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>correct</td>
<td>793 (778.19) [0.28]</td>
<td>1124 (1138.81) [0.19]</td>
<td>1917</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>incorrect</td>
<td>519 (533.61) [0.41]</td>
<td>796 (781.19) [0.28]</td>
<td>1315</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Column Totals</td>
<td>1312</td>
<td>1920</td>
<td>3232 (Grand Total)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The chi-square statistic is 1.1664. The p-value is .28014. The result is not significant at p < .05.
Table 5 displays the cumulative results of both groups of students in different experiments. For instance, $793 = 446 \text{ (Russ 111)} + 347 \text{ (Rus 301)}$ is the number of target stimuli that were perceived accurately in experiment 1 (casual speech). The p-value is .28014, which means that the difference between casual and hyperarticulated speech conditions is insignificant. Overall, the beginner group perceived 446 (58%) out of 768 target stimuli correctly and 332 (42%) incorrectly in experiment 1. For experiment 2, the results were the same: 674 (58%) out of 1,152 stimuli correct and 478 (42%) incorrect. As for the intermediate group, their results were the following: 347 (64%) out of 544 in the casual speech experiment and 450 (59%) out of 768 in the hyperarticulated speech experiment were perceived accurately, and 197 (36%) in experiment 1 and 318 (41%) in experiment 2 were perceived inaccurately. As can be seen, a hyperarticulated speech condition was not beneficial for perception of a palatalized/unpalatalized consonant contrast for the beginner and intermediate groups of students. Thus, extra attention to palatalized/unpalatalized word endings is not necessary in class at least in the first couple of semesters of language learning, when students usually worry about grammar and vocabulary more than about how they sound.
6. CONCLUSIONS

The primary goal of this thesis was to investigate whether a hyperarticulated speech condition is more beneficial for the perception of secondary palatalization in Russian by L1 American English speakers. I hypothesized that under clear speech condition a palatalized/unpalatalized consonant contrast should be easier to perceive, since a large amount of research has proved that speech enhancement is advantageous for perception of various phonological features. However, in my research the students of both groups tested did not profit from hyperarticulation. Moreover, the intermediate Russian group displayed better results in experiment 1 when stimuli were produced in casual speech. The beginner Russian group had the same perception results for experiment 1 and experiment 2. A statistical analysis revealed that the difference in perception of secondary palatalization in Russian by L1 American English speakers was insignificant for both experiments and that perception did not depend on a speech condition. Thus, there is no need for teachers to spend extra time in class teaching students to hear the difference between palatalized and unpalatalized words. Although secondary palatalization is a feature that helps to differentiate the meaning of words, students of lower levels of proficiency (beginner and intermediate) are unable to perceive it. These students likely rely on context more than on phonology. However, this fact does not mean that students of higher proficiency levels are not able to perceive this phonological feature. Unfortunately, I could not include advanced students in the study due to size and time limitations but investigating the perception of palatalization by such students could be an idea for future
research. My second and third research questions were whether hyperarticulation has a different effect on students of different levels of proficiency in Russian and what proficiency level of students benefits from speech enhancement more: beginner or intermediate. My hypothesis was that hyperarticulation should be more helpful for students of a lower proficiency level (beginner) since they have less exposure to the language. The data obtained in both experiments and two one-way ANOVAs proved that hyperarticulation does not influence the perception of secondary palatalization in Russian and is not beneficial for either beginner or intermediate levels.

In addition to answering the previous three questions, I had several smaller goals for my research. One of them was to create a hierarchy of difficulty of perception for palatalized consonants in a word-final position in Russian by L1 American English speakers (Figure 19, page 48 of the current thesis). I figured out that the perception of a consonant mostly depends on the manner of articulation of a consonant and not on its place of articulation. For instance, students had less trouble with stimuli that contained sonorants than obstruents. In addition, I confirmed Kochetov’s theory that a preceding vowel can create either a beneficial or unfavorable environment for the perception of a consonant. I also classified all six vowels of Russian according to their potential to create acoustic cues (Figure 20, page 50 of the current thesis). Due to time and space limitations, I had to use a limited number of stimuli and vowels for them, which only allowed me to create an approximate vowel classification. However, testing a larger number of vowels in different variations could have helped to create a more solid hierarchy of vowels according to their potential for providing acoustic cues.
7. LIST OF REFERENCES


Pastore, R. E., Friedman, C. J., & Baffuto, K. J. (1976). Comparative evaluation of the AX and two ABX procedures. The Journal of the Acoustical Society of America, 60(S1), S120-S120.


8. LIST OF APPENDICES
**Appendix A: The list of stimuli for experiment 1**

**Target items**

<table>
<thead>
<tr>
<th>[t]-[tʰ]</th>
<th>[I]-[Iʰ]</th>
<th>[n]-[nʰ]</th>
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<table>
<thead>
<tr>
<th>[s]-[sʰ]</th>
<th>[p]-[pʰ]</th>
<th>Controls</th>
</tr>
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<table>
<thead>
<tr>
<th>[f]-[fʰ]</th>
<th>[r]-[rʰ]</th>
<th>[m]-[mʰ]</th>
</tr>
</thead>
</table>

| Тинь – тись – тинь | Тинь – тись – тинь | Тинь – тись – тинь |
| Тинь – тись – тинь | Тинь – тись – тинь | Тинь – тись – тинь |
Appendix B: The script of experiment 1

Часть 1
гать  —  гать  —  гать
пыр  —  пыш  —  пыш
бон  —  бонь  —  бонь
нопь  —  ноп  —  нопь
таль  —  тал  —  тал

Часть 2
кать  —  кать  —  кать
лэс  —  лэсь  —  лэсь
tuft  —  тус  —  тус
возь  —  ворь  —  ворь
бон  —  бонь  —  бонь

Часть 3
коль  —  комь  —  комь
кап  —  каз  —  каз
тый  —  тишь  —  тишь
зимь  —  зимь  —  зимь
пурь  —  пурь  —  пурь

Часть 4
tos  —  точ  —  тос
лэс  —  лэсь  —  лэсь
tyff  —  тыфь  —  тыфь
ворт  —  ворь  —  ворь
tus  —  тус  —  тус

Часть 5
лэсь  —  лэсь  —  лэсь
toch  —  точ  —  точ
gать  —  гать  —  гать
ворт  —  ворь  —  ворь
нопь  —  ноп  —  нопь

Часть 6
каз  —  кап  —  каз
пыш  —  пыр  —  пыш
таль  —  тал  —  таль
пурь  —  пурь  —  пурь
тый  —  тишь  —  тишь

Часть 7
тыфь  —  тыфь  —  тыфь

Часть 8
tal  —  таль  —  таль
кап  —  каз  —  каз
тый  —  тишь  —  тишь
tus  —  тус  —  тус
tыфь  —  тыфь  —  тыфь

Часть 9
комь  —  комь  —  комь
бонь  —  бонь  —  бонь
комь  —  кось  —  комь
нопь  —  ноп  —  нопь
пурь  —  пурь  —  пурь

Часть 10
gать  —  гать  —  гать
зимь  —  зимь  —  зимь
tыфь  —  тыфь  —  тыфь
toch  —  точ  —  точ
пыш  —  пыр  —  пырь

Часть 11
bonь  —  бонь  —  бонь
нопь  —  нопь  —  нопь
лэсь  —  лэс  —  лэс
kапь  —  каз  —  каз
пурь  —  пурь  —  пурь

Часть 12
коль  —  комь  —  комь
tal  —  таль  —  таль
tый  —  тишь  —  тишь
cать  —  казь  —  казь
зимь  —  зимь  —  зимь

Часть 13
toch  —  точ  —  точ
пырь  —  пышь  —  пырь
cаз  —  казь  —  казь
**Appendix C:** The list of stimuli for experiment 2

<table>
<thead>
<tr>
<th>Word group 1 (repeated)</th>
<th>Word group 2 (new)</th>
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<tbody>
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<td>гат – гать – гат</td>
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<tr>
<td>гат – гать – гать</td>
<td>ват – вать – вать</td>
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<td>гать – гат – гат</td>
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<tr>
<td>[s]-[s̢]</td>
<td>[s]-[s̢]</td>
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<tr>
<td>лэс – лэсь – лэс</td>
<td>пос – пось – пос</td>
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<tr>
<td>лэс – лэсь – лэсь</td>
<td>пос – пось – пос</td>
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<tr>
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<td>[p]-[p̢]</td>
<td>[p]-[p̢]</td>
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<td>[f]-[f̢]</td>
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<tr>
<td>лыф – лыфь – лыф</td>
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<td>лыф – лыфь – лыфь</td>
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<td>[r]-[r̢]</td>
<td>[r]-[r̢]</td>
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<td>пур – пурь – пур</td>
<td>пэр – пэрь – пэр</td>
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<td>пурь – пур – пурь</td>
<td>пэрь – пэр – пэрь</td>
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<tr>
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<td>[m]-[m̢]</td>
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<td>зим – зимь – зим</td>
<td>тум – тумь – тум</td>
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<td>тум – тум – тумь</td>
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<tr>
<td>[n]-[n̢]</td>
<td>[n]-[n̢]</td>
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Appendix D: The script of experiment 2

Часть 1
gат – гать – гат
tал – таль – таль
бонь – бон – бон
зим – зимь – зим
лэс – лэсь – лэс

Часть 2
ноп – нопь – ноп
лыф – лыфь – лыф
вать – ват – вать
пурь – пур – пурь
бань – бан – бан

Часть 3
tум – тумь – тумь
бон – бонь – бонь
пэрь – пэр – пэр
пос – пось – пось

Часть 4
коф – кофь – коф
рыль – рыл – рыл
зимь – зим – зим
гать – гат – гат
нопь – ноп – ноп

Часть 5
лыфь – лыфь – лыфь
лэсь – лэсь – лэсь
вать – ват – вать
кофь – кофь – кофь
пэрь – пэр – пэр

Часть 6
tум – тумь – тумь
бань – бань – бань
пос – пось – пось
таль – тал – тал
пурь – пур – пур

Часть 7
бонь – бон – бонь
рыл – рыл – рыл
зимь – зим – зимь
лэсь – лэсь – лэсь
кофь – кофь – кофь

Часть 8
лыфь – лыфь – лыфь
пос – пос – пос
бань – бань – бань
таль – таль – таль
пур – пур – пур

Часть 9
лыфь – лыфь – лыфь
пос – пос – пос
бань – бань – бань
таль – таль – таль
пур – пур – пур

Часть 10
рыль – рыл – рыль
кофь – кофь – кофь
зимь – зимь – зимь
лэсь – лэсь – лэсь
бонь – бонь – бонь

Часть 11
нопь – нопь – нопь
пэрь – пэр – пэр
пос – пос – пос
гать – гат – гать
лыфь – лыфь – лыфь

Часть 12
таль – таль – таль
рыл – рыл – рыл
тумь – тум – тумь
бань – бан – бань
лэсь – лэсть – лэсть

Часть 13
Ват – ват – ват
пур – пур – пур
нопь – нопь – нопь
лэсь – лэсть – лэсть

64
Appendix E: The students’ sheet for experiments 1 and 2 (page 1)

Student’s sheet

You will hear sets of sounds. Each set consists of three sounds: 1, 2, and either 1 or 2. Circle the one that sounds similar to the last sound in a sequence. If you missed a sound or a whole sequence, do not try to guess, just skip it and go on.

This test has 13 parts, each part contains 4-5 sequences. The test will take approximately 5 minutes.

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### Appendix E: The students’ sheet for experiments 1 and 2 (page 2)

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<td>1  2</td>
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</tbody>
</table>
VITA

EDUCATION:

2016-2017  Non-degree  
University of Mississippi  
Oxford, MS, USA

2014-2016  MA in Pedagogical Education (diploma with honors)  
Volgograd State Socio-pedagogical University  
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Thesis: Linguistic and Cultural Specifics of Phraseological Units Containing  
Ethnicons (on the material of British, American and Australian Variants of  
English Language).

2009-2014  Specialist in Teaching English and French languages (diploma with honors)  
Volgograd State Socio-pedagogical University  
Volgograd, Russia  
Thesis: Linguistic and Cultural Characteristics of Phraseological Units Containing  
Ethnonyms in British and American Variants of the English Language

PROFESSIONAL EXPERIENCE:

Community English as a Second Language (CESL) program instructor at the University of Mississippi, September 2018-present.  
Created lesson plans and teaching materials, taught an advanced level class.

Volunteer at Community English as a Second Language (CESL) program at the University of Mississippi, March 2017.  
Created teaching materials, taught an intermediate level class.

Graduate Teaching Assistant of Russian, August 2016-present, University of Mississippi, Oxford, MS, USA.  
Created Syllabus, lesson plans, teaching materials, and taught an intermediate Russian class.  
Graded homework and tests of all levels in the program.

English Language Instructor, October 2013-July 2016, Private school of foreign languages “Easy Way”, Volgograd, Russia.
HONORS AND AWARDS:

2016-2017  Fulbright Foreign Language Teaching Assistant (FLTA) grant, University of Mississippi, Oxford, USA

2014  Best paper award at the Annual Student Linguistic Conference “Language and culture”, Volgograd, Russia

2009-2016 Scholarship for academic excellence, Volgograd State Socio-pedagogical University, Volgograd, Russia

PUBLICATIONS


LANGUAGES:

Russian - native speaker
English – fluent
French – fair