LIFESPANS & STYLES
Undergraduate Papers in Sociolinguistics

Volume 6 Issue 2

2020

Rhotic Environments: Effects of Dialect Exposure on Perception of Rhoticity

Christina McDermott
christinammcdermott@outlook.com

ISSN: 2057-1720 doi: 10.2218/ls.v6i2.2020.5220

This paper is available at: http://journals.ed.ac.uk/lifespansstyles
Hosted by The University of Edinburgh Journal Hosting Service: http://journals.ed.ac.uk/

Rhotic Environments: Effects of Dialect Exposure on Perception of Rhoticity

Christina McDermott

This study examines if a listener's exposure to nonrhotic dialects of English affects how they perceive rhoticity in words spoken in a Boston English accent. Listener judgments on the rhoticity of both nonce words and words in phrases were elicited through a 120-question survey. The results suggest that listeners from the United States who grew up in regions where nonrhotic dialects are prevalent perceived /ɹ/ in certain nonrhotic articulations more than their counterparts did.

1 Introduction

Varying degrees of rhoticity in dialects of English continue to drive sociophonetic research on when and why individuals speak nonrhotically. Cross-linguistically, the term rhotic refers to the following set of taps, trills, and approximants: /r, R, ɹ, ɾ, ʁ, ɻ, ɽ, ɭ/. In studies on US English, the term rhotic implies the presence of the voiced postalveolar approximant /ɹ/. Nonrhotic English speech, therefore, occurs when an individual does not pronounce an [ɹ] in their articulation of a word where a rhotic English speaker would do so. The process of not pronouncing these /ɹ/s is sometimes referred to as r-dropping or r-vocalization. R-dropping is not the result of gestural hiding — other articulators do not overlap with an /ɹ/ pronunciation so that the acoustic signal of the /ɹ/ is masked. Rather, as noted in Demirezen (2012), /ɹ/ is simply not articulated.

Since William Labov's (1972) study on the social stratification of rhoticity in New York City, linguists have explored nonrhotic and rhotic speech in connection to social factors. This work launched sociolinguistic research that explored effects of audience, age, socioeconomic status, education, and geographic location on variation in rhoticity production. Yet, few studies have examined variation in rhoticity perception. Creel et al. (2016) compare adult and preschooler's ability to parse unfamiliar accents, Key (2012) examines the categorization of ambiguously rhotic sounds from nonrhotic speakers, and Walker (2018) studies how dialect familiarity affects one's ability to parse utterances in noisy environments. In this study, I consider the effect that exposure to a dialect has on perception of speech, asking if exposure to nonrhotic English affects whether one hears /ɹ/ in syllables where the acoustic correlate for /ɹ/ is weak. I also consider whether lexical context may affect one's perception of /ɹ/. Specifically, this study explores whether there is a correlation between hearing /ɹ/ in the coda position of syllables and the phrasal context in which to parse the word. My research questions are:

(1) Does word-hood and context affect an individual's perception of [ɹ] articulation?
(2) Do listeners who grew up in regions where nonrhotic dialects are prevalent perceive [ɹ] in partially rhotic and dropped /ɹ/ syllables more often than others?

I use audio material from Boston English speakers to develop a perception experiment with nonce words — words that are not English words but phonologically could be English words — and short phrases.

2 Literature Review

2.1 Nonrhotic Speech in Eastern Massachusetts

Nonrhotic accents of English first appeared in Boston during the late seventeenth century. In their paper, Irwin and Nagy (2007) claim that individuals in eastern Massachusetts were influenced by the nonrhotic speech from the upper class of southern England. Irwin and Nagy (2007) also outline the phonological constraints of r-dropping in Boston English. The envelope of variation is restricted to coda position. Thus, words like /kɑɹ/ can be pronounced [kɑ] but words like /pɹɑm/ are never pronounced [pɑm]. Additionally, in their study, Irwin and Nagy (2007:142) found evidence that suggests that "back vowels favor an r-full pronunciation" and "speakers are more likely to pronounce word-final [ɹ] and more likely to delete non-final /ɹ/". Irwin and Nagy (2007) also note that lexical words produce an r-full pronunciation more often than functional words do. Lastly, Irwin and Nagy's (2007) study examined the social constraints of r-dropping in Boston English. The linguists found evidence that suggests gender, age, and education affect one's perception of rhotic articulation in this region. R-dropping was highest among older men and lowest among young women. Additionally, r-dropping was highest among individuals without any college education and lowest among individuals with postgraduate levels of education. As pertinent to this study, these findings suggest that, if age is examined as a factor in /ɹ/ perception, older

individuals may be more accustomed to hearing nonrhotic articulations in phrases, as they are more likely to speak this way themselves.

2.2 Effects of Context and Dialect Familiarity on Perception

Previous studies on dialect perception in general have found evidence that the context in which a word is spoken affects a listener's perception of that word. In their study, Creel et al. (2016) tested adults' and preschoolers' understanding of words and phrases spoken in both familiar and unfamiliar accents. Specifically, they surveyed 49 adult speakers of American English and 32 preschool speakers of Californian American English, all of whom were monolinguals. Creel et al. (2016:161) explain that a comparison shows "that children have difficulty in comprehending words that adults also have difficulty in comprehending". Pertinent to this study is Creel et al.'s (2016) work with adults. These adult participants produced transcriptions of words and sentences in both California English and Mexican Spanish-accented English in sensical and nonsensical contexts. Adult participants heard words and phrases five times, each from different speakers. Then, Creel et al. (2016) studied the overall accuracy of the transcripts and, specifically, the accuracy of the transcripts when a phrase was transcribed for the first time. The results found that adults were slightly better at transcribing familiarly accented speech than non-familiarly accented speech, and were slightly better at transcribing words in context, rather than isolated words. After considering Creel et al.'s (2016) results with adults, one would expect speakers unfamiliar with the Boston accent to be less accurate in their perception of sentences. One might also anticipate that participants in the following experiment would hear more /ɹ/ in words where /ɹ/ is dropped in phrasal contexts than in nonsensical contexts. In phrasal contexts, listeners have the stimuli to know that the word is usually pronounced with /ɹ/.

Additional literature supports the claim that familiarity with a dialect or accent affects one's perception of it. Walker's (2018) study finds evidence that individuals are better able to discern words spoken in their own dialect than in other dialects, at least in circumstances where words are difficult to parse. Walker (2018) tasked 90 expatriate and non-migrant listeners in both the United States and the United Kingdom with transcribing recordings spoken in Standard American English and Received Pronunciation. These recordings had significant background noise which obscured some of the speech. The experiments were conducted in London, England, and in Columbus, Ohio. After analysing the resulting transcripts, Walker (2018) found that listeners from the United States composed more accurate transcriptions when listening to the recordings in Standard American English, while listeners from the United Kingdom were more accurate when transcribing phrases spoken in Received Pronunciation. This work suggests that a listener's familiarity with Boston English may significantly affect the perception of the words heard in the present study.

Key's (2012) dissertation includes an examination of rhotic perception that compares rhotic and nonrhotic speakers from New England. In this study, 26 participants completed 864 trials testing their rhotic perception. Specifically, Key (2012) conducted a categorization task in which he manipulated the /ɹ/ segment in several words on a continuum, from a fully rhotic pronunciation of a given word to a fully nonrhotic one, with several additional manipulations in between. Key (2012) asked, at each increment, if a listener heard a rhotic or a nonrhotic pronunciation of the word. Key's (2012) nonrhotic participants heard /ɹ/ for longer than the rhotic participants for all syllable positions.

3 Methodology

3.1 Participants

This experiment tests the perception of rhoticity by using a force-choice task. Stimuli consisted of audio files of nonce words in isolation and of real-word, grammatical phrases. To recruit participants, I advertised my survey on my personal Facebook page, recruited family members to take the survey themselves, and encouraged them to send the survey to colleagues and friends. I also distributed fliers on a University of California, Berkeley, visit day for prospective students.

At the start of the survey, participants were tasked with selecting the region of the USA where they grew up. If a participant was from multiple places, or outside the USA, they selected either the "outside USA" or the "other" response. If the individual selected "other", they were then asked to specify where they were from. Participants were from both the United States and abroad. Most participants, however, were from the Northeast, the West, and the Northwest regions of the United States. I also collected data on the participants' age, native language, and knowledge of linguistics. Data on age is not analysed here due to time and space constraints. Participants' native language was collected in order to exclude non-native English speakers from analysis, as studying the phoneme perception of these individuals in relation to rhoticity was not within the scope of this study. Lastly, data on experience with linguistics was collected to ensure that most of my participants were unfamiliar with phonetics.

3.2 Materials

The audio segments I used to create the experimental stimuli were taken from phone interviews with three Boston English speakers. I conducted these phone interviews during a previous study (McDermott et al. 2017). All three of the speakers were women between the ages of 38 and 60. I obtained permission from each individual to use her voice for this study.

To create the test tokens, I used Praat (Boersma and Weenink 2016) to extract consecutive syllables from phrases. Each of these phrases included a word with an /ɹ/ in coda position. This /ɹ/ syllable was the first building block for my nonce word. I extracted one or two syllables preceeding this syllable, one or two syllables following this syllable, or one to two syllables both preceeding and following this syllable. For example, from the short phrase, *I take the regular T* [a train line], I extracted syllables to form the nonce word *gulartee* and its nonrhotic variant, *gulatee*. I manipulated the length of the vowel and/or fricative or approximant of each extracted syllable to create a nonce word that I judged to sound word-like (see Appendix A). The speeds of the tokens were adjusted with Audacity Cross-Platform Sound Editor (Mazzoni 2018). Each token was slowed to approximately 0.94 times its original speed to aid in intelligibilty. Because these words were formed with syllables in different parts of words, I adjusted the tempo of the syllables to create what I felt was believable English rhythm. In adjusting tempo, I altered the relative amplitude of each syllable in each word, shifting the lexical stress for the sake of a naturalistic percept. As a result of this process, I developed 34 rhotic nonce words of at least two syllables long and 44 filler nonce words. Some of them had a clearly articulated [ɹ] in coda position, some of them had a clearly dropped [ɹ] in coda position, and some of them had what I percieved to be a partially articulated [ɹ] in coda position. The initial judgments as to how much [ɹ] was articulated in each token were made by me.

Due to the poor quality of the audio source (phone interviews), the third formant was obscured for most of the test words. As Boyce and Epsy-Wilson (1997) note, there is a dip in F3 is the acoustic correlate of an [ɹ] approximate. Because I could not reliably track F3, I could not make an acoustically supported judgment on whether and how much [ɹ] was present in tokens. Instead, I built a short audio classification survey. I sent this survey to professors, graduate students, and undergraduate students who had experience in phonetics. The survey asked the participants to listen to each nonce word and record whether they heard no [ɹ] articulated, a lightly [ɹ] colored vowel articulated, some [ɹ] articulated, or a full [ɹ]. This survey also included a feedback section which allowed participants to note which tokens they struggled to hear due to background static in the audio or the token's speed. Six responses were collected. Tokens that were hard to hear were adjusted. These tokens were slowed further, and as much backgroud noise as possible was filtered out. I re-surveyed my participants with the same set of questions. With the data from the latter survey, I coded the perceived rhoticity of the relevant nonce word tokens by giving a score between 0 and 1 to each level of /ɹ/ heard and then averaging the scores for each word. Table 1 shows the scores awarded to each category of /ɹ/ heard.

Table 1: Rhoticity survey judgment scores

Option selected	**Score given**
No /ɹ/ articulated	0
/ɹ/-colored vowel articulated	0.333
Some /ɹ/ articulated	0.667
Full /ɹ/ articulated	1

Words with an average score of 0.25 or below were judged nonrhotic. Words with an average score of 0.75 or higher were judged rhotic, and words with a score between 0.25 and 0.75 were judged partially rhotic. The distribution of /ɹ/-fullness in the test tokens is detailed in Table 2.

Table 2: Distribution of token type: Rhoticity testing tokens

Nonrhotic nonce words	**Partially rhotic nonce words**	**Rhotic nonce words**
16	11	6

I developed two possible spellings for all nonce words, keeping in mind typical patterns in English orthography. The spellings needed to look like plausable English words so that listeners would depend on their knowledge of how English orthographic patterns relate to sound when selecting a choice. Additionally, the words needed to be novel-looking, so as to avoid lexical bias when selecting a spelling. Lexical bias occurs when a novel word looks like a familiar word, prompting a listener to select the familiar word, regardless of the sounds that they

hear. I based my spelling decisions on my intuitions as a native English speaker and the orthographic tendencies of English outlined in Venezky (1967).

In the questions that featured the rhoticity testing tokens, one spelling option included an 'r' for the rhotic syllable in question. The other spelling option for many words included no letter where the 'r' would be. For example, the word *reehar* had the nonrhotic spelling *reeha*. Alternatively, /ɹ/ was replaced with /l/ or with /h/ if the r-less spelling resulted in a word with an orthographic structure that would produce a pronunciation with fewer syllables than the nonce word had in the audio (for example, *touber* became *toubel*). In addition, /ɹ/ was replaced with /l/ or with /h/ when I could hear, and see on Praat, what I felt was clear noise distinguishable from the last vowel (*baror*'s alternate spelling was *baroh*, for example). One token included an [ɔ] followed by a half-articulated [ɹ]. For this token, I used '-wough' for the nonrhotic spelling of the final syllable. Thus, *kwourthow* became *kwoughthow* for the nonrhotic spelling option.

3.3 Procedure

I used Qualtrics (2019), an online survey platform, to administer my experiment and collect data. The survey had three sections. The first section collected demographic information. In the second one, participants were asked to make spelling judgments on nonce words. The question format is shown in Figure 1. The nonce words were mixed with the dummy tokens through a randomization feature.

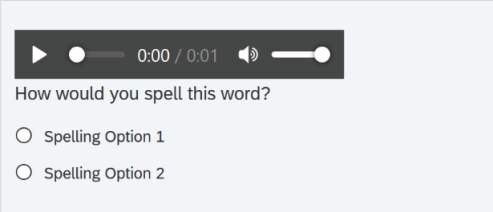

Figure 1: The format for nonce word questions.

The third section then asked participants to listen to a full phrase and determine if the speaker pronounced the [ɹ] in a particular word or not. The words the listeners responded to in the context condition were real English words. Part of each of these testing words in context was used in the nonce words, as the nonce words were spliced from these sentences across lexical boundaries. For example, the nonce word 'gulartee' is from the sentence *I take the regular T*. The corresponding /ɹ/-testing word in context is *regular*. Participants were asked if they heard an 'r' in that word and then selected 'yes' or 'no'.

Figure 2: The format for phrasal questions.

The survey's final question asked if the participants recognized any of the voices from the audio in the survey so that familiarity with the speakers could be considered as a potential variable when analysing results.

4 Results

The survey received 66 responses, the majority being from the Northeast, followed by the West, the Northwest, outside the USA, the Mid-Atlantic, Mid-West and Southwest, and lastly a combination of States. To simplify, I grouped listeners from the Mid-Atlantic with listeners from the Northeast and listeners from the Northwest with listeners from the West. I justified these groupings on the assumption that individuals from the Northeast and the Mid-Atlantic regions have been exposed to nonrhotic dialects of English whereas those in the second grouping have had less exposure. Two large cities in the Northeast and Mid-Atlantic area — Boston and New York City — are centers of nonrhotic English speech in the United States. These cities also draw the surrounding population to them for social outings. Finally, several other communities in the region speak nonrhotic English, including eastern New Hampshire, Rhode Island, and Maine. These states are reasonably close (within a 5-hour driving distance) to the Mid-Atlantic region. Thus, individuals from these areas have likely been exposed to nonrhotic English personally and semi-regularly. This Northeast/Mid-Atlantic group is henceforth described as "the Eastern listeners" and the Northwest/West group as "the Western listeners". Note that the Eastern listener category does not include listeners from the American Southeast, as there were no participants exclusively from this region.

The ages of the participants ranged from 13 to 71, with most participants at the time of the study reporting they were between the ages of 20 and 40. An analysis of age's effect on rhotic perception is left for future work. Of the participants, 83% were native English speakers and an additional 6.8% were multilingual, having mastered English before the age of 6. Lastly, four participants reported knowledge of linguistics at a bachelors' level. These individuals remain in the study, because their results did not differentiate from the other participants' in any discernable way.

The proportion of full/partial/no-/ɹ/ tokens that participants labeled as being pronounced with an [ɹ] in nonce words and in real-word phrases is shown in Figure 3. The y-axis shows the proportion of /ɹ/ heard. The x-axis shows the type of token. The blue boxes show the distribution of /ɹ/ heard in phrases, while the orange boxes show the distribution of /ɹ/ heard in nonce words.

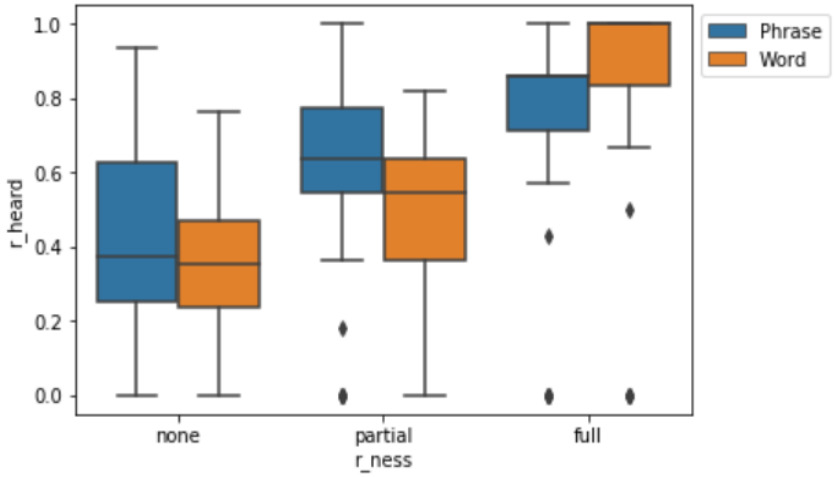

Figure 3: Rhoticity perception by token type and frame.

Overall, /ɹ/ is perceived more often for more r-full tokens. Context type (word or phrase) also affects /ɹ/ perception. For fully rhotic tokens, /ɹ/ is perceived slightly *more* often in nonce words than in phrases. For partially rhotic tokens, /ɹ/ is perceived slightly *less* often in nonce words than in phrases. For nonrhotic tokens, participants perceive /ɹ/ roughly equally in phrases and in nonce words.

The distribution of /ɹ/ perception with respect to token type (full, partial, none) and context type is examined for the Eastern listeners and the Western listeners, respectively (Figures 4 and 5).

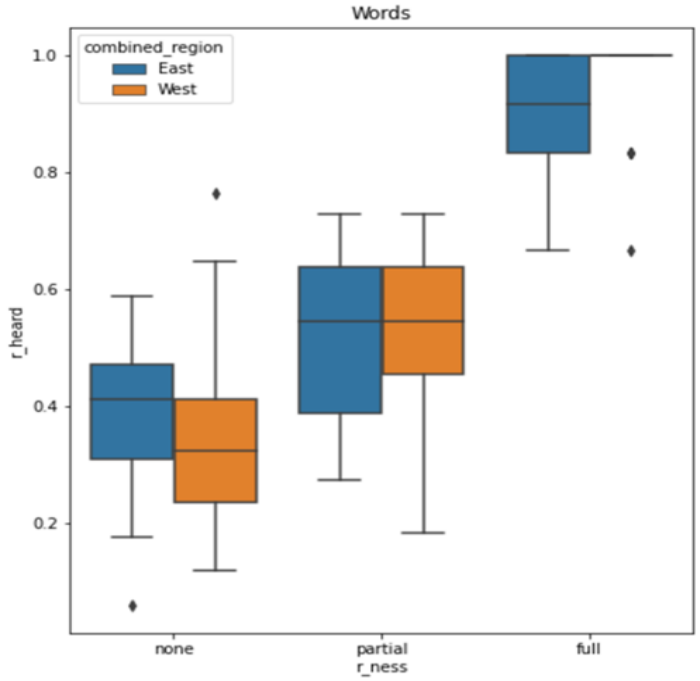

Figure 4: Rhoticity perception by region: Nonce words.

Figure 4 shows the spread of the mean values by token type for nonce words. One notices that the range of the first and third quartiles is similar between the two geographic regions for the nonrhotic nonce words, with the median for the Eastern listeners' perceptions higher than the median for Western listeners' perception. The Western region's median aligns with the first quartile value of the Eastern group on the box plot. This distribution suggests that while both groups consisted of a range of response, more participants from the east overall heard /ɹ/ in nonce words. In the partially rhotic category, the median and range of the two groups is identical, suggesting a similar distribution of answers between the two groups, but the Eastern listeners have a larger range of responses. In the fully rhotic category, the Eastern listeners have multiple values of /ɹ/ perceived, with visible first and third quartiles, while the Western listener group simply hears all the tokens as fully rhotic. This distribution requires closer study into why some Eastern listeners heard less /ɹ/ in this category than any Western listener.

Figure 5 shows the spread of mean values for the phrasal stimuli. Overall, there is a wider range of responses for the nonrhotic and partially rhotic stimuli than for the fully rhotic stimuli. As with the word tokens, the median value for the nonrhotic category is higher in the Eastern listener group, showing that the Eastern group has a higher number of participants that heard more /ɹ/. The partially rhotic tokens do not show a median for the Eastern listeners in the boxplot. The Western listeners have a median which aligns with the first quartile of the Eastern listeners. This result indicates that, again, the Eastern listener group had a higher number of individuals who heard more /ɹ/ in the category, overall. Fully rhotic stimuli in phrases show no difference between regional listener groups.

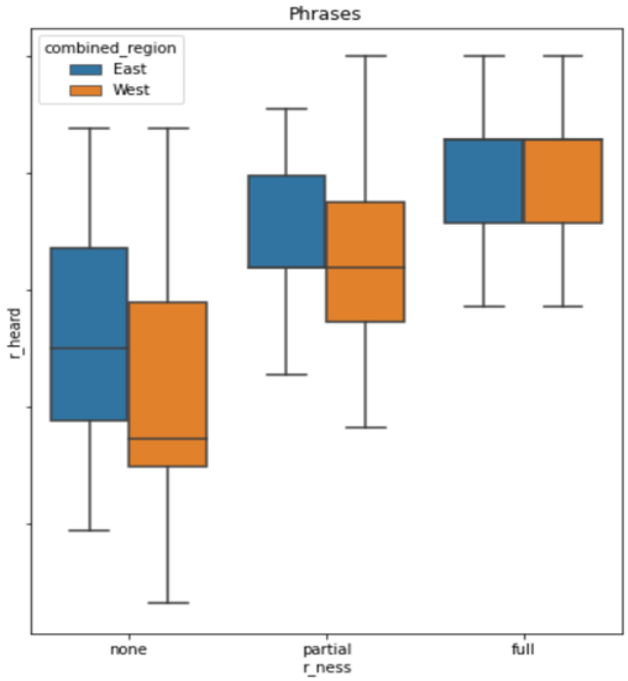

Figure 5: Rhoticity perception by region: Phrases.

Examination of raw data revealed that some tokens elicited a greater difference in perception than others (see Appendix B). Table 3 shows the six nonce word tokens with the greatest difference in perception and transcriptions, whereas Table 4 shows the five phrasal context tokens with the greatest difference in perception, and their transcriptions. I phonetically transcribed these words impressionistically.

Table 3: Tokens with the greatest perception differences across regional groups: Nonce words

Token (/ɹ/ spelling)	Token Type	/ɹ/ heard Western	/ɹ/ heard Eastern	Transcription	Rhotic Syllable in Question
Anmisterthee	Nonrhotic	3/20 (0.15)	9/19 (0.47)	ænmɪstəθi	[ə]
Reehar	Nonrhotic	3/20 (0.15)	9/19 (0.47)	ɹihɑ̰	[ɑ]
Nundernee	Partially rhotic	5/20 (0.25)	11/19 (0.59)	nʊndəni	[ə]
Thairfa	Nonrhotic	15/20 (0.75)	8/19 (0.42)	θeəfə	[eə]
Forlunt	Nonrhotic	6/20 (0.75)	11/19 (0.59)	fɔlʊnt	[ɔ]
Starsit	Nonrhotic	10/20 (0.50)	15/19 (0.79)	stɑ̰sɪt	[ɑ]

Table 4: Tokens with the greatest perception differences across regional groups: Phrasal contexts

Token	Token Type	/ɹ/ heard Western	/ɹ/ heard Eastern	Transcription	Rhotic Syllable in Question
Hardigan[1]	Nonrhotic	5/20 (0.25)	12/19 (0.63)	hɑdɪgɪn	[ɑ]
Regular	Nonrhotic	7/20 (0.35)	13/19 (0.68)	ɹɛgjulə	[ə]
Before	Nonrhotic	4/20 (0.20)	10/19 (0.52)	bifɔ	[ɔ]
Courthouse	Nonrhotic	10/20 (0.50)	15/19 (0.79)	kɔthoʊs	[ɔ]
Other	Nonrhotic	12/20 (0.60)	7/19 (0.37)	æθəfeɪv	[ə]

This data shows that most of the stimuli with the greatest perceptual differences between groups were nonrhotic. Lastly, consider that the nonce words in Table 3 include only one word-final rhotic. The phrasal words in Table 4 include only two word-medial rhotic words but were all phrase-medial. Overall, the effects of rhotic placement in the words and utterances may have had an effect on perception. Table 5 shows the distribution of tokens in the study depending on the vowel that preceded the rhoticity testing syllable, for context.

Table 5: Token distribution vowel preceding rhotic syllable in question

	[iə]	[æ]	[eɪə]	[ə]	[ɔ]	[ɑ]	[ɛ]
Word	2	3	1	17	4	6	1
Phrase	2	3	1	18	4	6	1

5 Discussion

This study examined if significant exposure to nonrhotic English affects a listener's perception of /ɹ/, especially in syllables that lack a strong acoustic correlate for /ɹ/, with data from a force-choiced task survey. It sought to determine if there was evidence that listeners who grew up in communities with nonrhotic English perceived [ɹ] in these instances more frequently than listeners who did not grow up in regions where nonrhotic speech is prevelant. Lexical context, and its effect on /ɹ/ perception, was also considered, specifically the effects of word-hood and context. The study ultimately found certain trends in listener responses overall, between listener groups and between token context type.

Recall that listeners heard more /ɹ/ in nonce words for both nonrhotic and partially rhotic tokens. Possibly, this result is due to listeners' reliance on context when an acoustic signal is ambiguous. If an individual knows that a word is pronounced rhotically in Standard American English, then they expect an /ɹ/ to be in the word. Therefore, in these phrasal contexts, they are more likely to perceive an /ɹ/ even if the presence of [ɹ] is ambiguous or missing. The nonce word tokens eliminate all lexical context that could allow a listener to predict the word.

There is little difference between the two regional groups in the fully rhotic phrasal stimuli: participants in both groups heard [ɹ] *more* often in nonce word tokens than in phrasal tokens. Johnson (2018) describes how talker differences modify listener expectations: a listener may change their expectations of what they hear depending on how they contextualize the manner in which a person speaks. The phrases in the survey are from speakers who speak with a Boston dialect. This accent includes not only nonrhotic pronunciations of words with /ɹ/ in coda but other features of the dialect. For example, Clopper and Pisoni (2003) describe how a backed [æ] is another salient feature of dialects in New England. Additionally, the Boston accent is known across the United States. Popular movies present the accent to viewers outside of New England. Thus, while a listener from the Western region of the United States may not have had the same level of exposure to Boston English as individuals from the Eastern region, they most likely could recognize the dialect's accent. In the nonce words, because context was eliminated, listeners had less acoustic stimuli which allowed them to recognize and discern the accent. For this reason, in the study, the context the accent provided may have prompted all individuals to hear less [ɹ] in the phrasal tokens in the fully rhotic category. That said, in the fully rhotic word category, there is a spread of responses in the Eastern group and almost no spread in the Western group. This difference requires closer study with more stimuli.

In contrast, the results from the partially rhotic and nonrhotic tokens in both categories suggest that there may be a minor perception difference between the Eastern listener group and the Western listener group. In these categories, sentence context was possibly more significant than the effect of the Boston accent on /ɹ/ perception. Future work would examine the extent to which context as well as expectation generated by knowledge of a dialect's features affect rhotic perception.

[1] This word, in context, was clearly a surname and was said in a phrase with real words.

Coarticulatory effects may provide evidence to explain why /ɹ/ was heard in the first place in nonrhotic tokens — both in nonce words and in phrases. All tokens are from natural speech. Due to the physiological complexity of producing an [ɹ], surrounding sounds are often affected by its articulation. Boyce and Espy-Wilson (1997:3741) state that "/ɹ/ has been described as coarticulating with adjacent segments [...]. The best known of these effects involve vowels". Notably, Key (2012) found that listeners with significant exposure to nonrhotic dialects perceived more /ɹ/ in the categorization task he gave them. He suggests that this outcome may be explained by the fact that stimuli were taken from nonrhotic speech and re-combined. This process presents multiple phonetic qualities that are unfamiliar to rhotic listeners. Thus, potentially, the coarticulatory qualities of a nonrhotic accent — the additional articulations occurring simultaneously with the pronunciation of the [ɹ], or lack thereof — may affect the extent to which an individual hears /ɹ/, depending on their familiarity with the accent. A new hypothesis is that this acoustic difference in the vowel may prompt one to percieve an /ɹ/ where there is none.

Why did Eastern listeners hear more [ɹ] in nonce words and/or in phrases for some tokens and not in other tokens? Recall Tables 3 and 4 that show the five tokens with the greatest differences in /ɹ/-positive responses, as well as transcriptions of these tokens. Noticeably, [ɑ] and [ɔ] are found in several of these tokens in the syllable in question. Possibly, the low back vowel articulations in the nonrhotic English-speaking Northeast differ in quality from their counterparts spoken in other parts of the region. These differences in quality may affect how one perceives the coarticulatory effects of a dropped /ɹ/. Easterners are used to hearing these nonrhotic syllables with these vowels. This result complements Key's (2012) categorization task findings. Future work involving the quality of surrounding vowels in nonrhotic syllables in the Northeast is required to make any definitive claim.

This study has raised many questions. First, a future experiment might use higher quality audio recordings and an even distribution of tokens per rhoticity category, as it is not clear what effect these issues had on the results. Secondly, interpretation of results from this experiment depends on the assumption that an individual raised in a region of the United States with nonrhotic dialects has more exposure to said dialects than an individual raised in a region of the United States without said dialects. While this assumption is sound logic, it does not ensure that all of the nonrhotic listeners actually grew up hearing nonrhotic English with semi-regularity. Further, this line of inquiry does not take into account speakers of or those with significant exposure to African American English, which is nonrhotic. A future experiment may ask about an individual's exposure to nonrhotic English overall.

Lastly, approximately 32% of the participants reported recognizing at least one voice in the study, and 18% of participants reported that they were unsure if they recognized an individual. This self-reporting is not accurate. Individuals approached me and said they recognized my voice in the survey, although my voice was not used for its audio. Regardless, there is a significant chance that familiarity with the speaker affected the results of the study. Specifically, 62% of those individuals who answered that they recognized a voice were from the Eastern region. A future study would ensure that no one knew the speakers whose audio was manipulated.

6 Conclusion

The results suggest that in the study of nonrhotic speech from Boston, Massachusetts, the amount of [ɹ] articulated affects the amount of /ɹ/ perceived — a somewhat intuitive statement. Possibly, the context of words, the difference between real and nonce words, and accent perception also had an effect. Additionally, the results of this study suggest that there is a correlation between exposure to particular articulation and perception of these articulations. The greatest differences between the Eastern and Western groups' perceptions of /ɹ/ were often in nonrhotic syllables with low back vowels. Possibly, the difference in quality in these vowels affected how one group perceived the syllable. Future studies should examine closely the quality of low back vowels from this region and examine how they relate to perception of rhoticity both overall and in different regional groups.

Acknowledgements

I would like to thank my project advisor, Professor Susan Lin, for her guidance in designing this experiment and her immense help in studying the data. I am indebted also to those individuals who kindly let me interview them, and then later use the audio material from these interviews. Many thanks also to all of my friends and family who took this detailed survey, and to my friends who read over my work and helped me work with my statistics. Lastly, I am grateful to Dr. Hall-Lew for this opportunity and her extensive help editing this paper.

References

Boersma, P., and David Weenink. 2016. Praat: Doing phonetics by computer [Computer software, Version 6.1.14]. Accessed 20 Feb 2019, http://www.praat.org/

Boyce, Susan, and Carol Epsy-Wilson. 1997. Coarticulatory stability in American English /ɹ/. *Acoustic Society of America*

101(6):3741–3753.
Clopper, Cynthia, and David Pisoni. 2003. Some acoustic cues for the perceptual categorization of American English regional dialects. *Journal of Phonetics* 32(1):111–140. https://doi.org/10.1016/S0095-4470(03)00009-3
Creel, Sarah, Dolly Rojo, and Nicolle Paullada. 2016. Effects of contextual support on preschoolers' accented speech comprehension. *Journal of Experimental Psychology* 146:156–180. https://doi.org/10.1016/j.jecp.2016.01.018
Demirezen, Mehmet. 2012. Which/r/are you using as an English teacher? Rhotic or nonrhotic? *Procedia - Social and Behavioral Sciences* 46:2659–2663. https://doi.org/10.1016/j.sbspro.2012.05.542
Irwin, Patricia, and Naomi Nagy. 2007. Bostonians /ɹ/ speaking: A quantitative look at (R) in Boston. *University of Pennsylvania*
Working Papers in Linguistics 13(2):135–145.
Johnson, Keith. 2018. Speech Perception Basics. Lecture on phonetics at University of California, Berkeley, CA, USA.
Key, Michael. 2012. Phonological and phonetic biases in speech perception. Doctoral dissertation, The University of Massachusetts, Amherst.
Labov, William. 1972. *Sociolinguistic Patterns*. Philadelphia, PA: University of Pennsylvania Press.
Mazzoni, Dominic. 2018. Audacity cross-platform sound editor [Software, Version 2.22). Accessed 15 March 2019, https://audacityteam.org/
McDermott, Christina, Rachel Thomas, and Thalia Cruzat. 2017. Examining style-shifting in speakers of Boston English. Unpublished coursework manuscript, University of California Berkeley.
Qualtrics. 2019. *Qualtrics XM* [Software]. Accessed 20 March 2019, https://www.qualtrics.com
Venezky, Richard. 1967. English orthography: Its graphical structure and its relation to sound. *Reading Research Quarterly* 2(3):75–105. https://doi.org/10.2307/747031
Walker, Abby. 2018. The effect of long-term second dialect exposure on sentence transcription in noise. *Journal of Phonetics* 71:162–176. https://doi.org/10.1016/j.wocn.2018.08.001

christinammcdermott@outlook.com

Appendix A

Table A-1: Fully rhotic token words and corresponding phrases

Phrase	Nonce Word Extracted from surrounding syllables (r spelling)	Nonce Word Extracted from surrounding syllables (r-less spelling)
Does this individual pronounce the 'r' in worse?	Worsah	Wosah
Does this individual pronounce the 'r' in sweaters (1st time)?	Thursyu	Thrusyu
Does this individual pronounce the 'r' in October?	Touber	Toubel
Does this individual pronounce the 'r' in another?	Notherch	Nothelch
Does this individual pronounce the 'r' in hour?	Budower	Budowa
Does this individual pronounce the 'r' in years?	Upleeyers	Upleeyehs

Table A-2: Partially rhotic token words and corresponding phrases

Phrase	Nonce Word Extracted from surrounding syllables (r spelling)	Nonce Word Extracted from surrounding syllables (r-less spelling)
Does this individual pronounce the 'r' in other?	Thurthantha	Thuthentha
Does this individual pronounce the 'r' in years?	Retooyeers	Retooyeahs
Does this individual pronounce the 'r' in underneath?	Nundarnee	Nundenee
Does this individual pronounce the 'r' in car?	Ainkarka	Ainkaka
Does this individual pronounce the 'r' in mother?	Therast	Thehast
Does this individual pronounce the 'r' in mother?	Merlike	Mellike
Does this individual pronounce the 'r' in anywhere?	Whearfra	Wheafra
Does this individual pronounce the 'r' in father?	Fatharl	Fathal
Does this individual pronounce the 'r' in tour?	Tidtour	Tidtoh
Does this individual pronounce the 'r' in bar?	Baror	Baroh
Does this individual pronounce the 'r' in commuter?	Mutterrale	Muttarale

Table A-3: Nonrhotic token words and corresponding phrases

Phrase	Nonce Word Extracted from surrounding syllables (r spelling)	Nonce Word Extracted from surrounding syllables (r-less spelling)
Does this individual pronounce the 'r' in mister?	Anmisterthee	Anmistathee
Does this individual pronounce the 'r' in summer?	Marhousda	Mahousda
Does this individual pronounce the 'r' in other?	Atharfav	Athafav
Does this individual pronounce the 'r' in car?	Carso	Caso
Does this individual pronounce the second 'r' in regular?	Gulartee	Gulatee
Does this individual pronounce the 'r' in for?	Thairfa	Thaifa
Does this individual pronounce the 'r' in for?	Forlunt	Folunt
Does this individual pronounce the 'r' in theater?	Neerthuthear	Neerthuthea
Does this individual pronounce the 'r' in park?	Nulparkum	Nulpalkum
Does this individual pronounce the 'r' in air?	Eircondish	Ekondish
Does this individual pronounce the 'r' in disaster?	Fasterb	Fasteb
Does this individual pronounce the 'r' in starts?	Starsit	Stasit
Does this individual pronounce the 'r' in before?	Forin	Fohin
Does this individual pronounce the 'r' in Hardigan?	Reehar	Reeha
Does this individual pronounce the 'r' in courthouse?	Kwourthow	Kwoughthow
Does this individual pronounce the 'r' in Tyler?	Lergonin	Legonin

Appendix B

Table B-1: Raw data number of /ɹ/ responses by category: Nonce word

Region	Token Type	Number of Tokens	Number of Responses	Number of /ɹ/ Positive Reponses	Simple Average
West	Full /ɹ/ Word	6	120	115	0.958
East	Full /ɹ/ Word	6	114	101	0.886
West	Partial /ɹ/ Word	11	220	115	0.523
East	Partial /ɹ/ Word	11	209	111	0.531
West	No /ɹ/ Word	16	320	118	0.369
East	No /ɹ/ Word	16	303	127	0.421

Table B-2: Raw data number of /ɹ/ responses by category: Phrasal context

Region	Token Type	Number of Tokens	Number of Responses	Number of /ɹ/ Positive Reponses	Simple Average
West	Full /ɹ/ Phrase	6	119	103	0.866
East	Full /ɹ/ Phrase	6	112	102	0.91
West	Partial /ɹ/ Phrase	11	220	140	0.636
East	Partial /ɹ/ Phrase	11	209	139	0.665
West	No /ɹ/ Phrase	17	340	137	0.403
East	No /ɹ/ Phrase	17	323	162	0.502