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1 Introduction

The Boston accent is among the most notorious in America. Its most frequently mentioned features are "dropped R's" and the fronted vowel in words like *park* and *car*. "R-dropping," which we will refer to as the sociolinguistic variable (R) is, more technically, the vocalization of an /r/ in a syllable coda. (R) has been studied in many dialects (e.g. Feagin 1990, Foulkes and Docherty 2000, Hay and Sudbury 2005, Yaeger-Dror 2005), but no quantitative analysis of (R) in Boston has been published. This paper begins to fill this gap by presenting a sample of the careful speech of white Bostonians.

2 A Brief History of (R)

British English dialects were rhotic from Anglo-Saxon times until the 17th century, when /r/ began to "soften." Variable (R) in New England came about via migration from England at that time (Crystal 2005:467).

We know of no published quantitative analyses of (R) in Boston. Indeed, aside from *The Linguistic Atlas of New England (LANE)* and *The Atlas of North American English (ANAE),* previous studies of Boston English present it as exhibiting categorical (R) behavior. Laferriere (1979), in her study of the *or*C vowel, assumed categorical /r/-vocalization as the context of the vowel she was studying.[1] McCarthy (1991, 1993) and Halle and Idsardi (1997) present analyses that account for categorical r-deletion, r-intrusion, and linking-r in different contexts. Anttila and Cho (1998) present an OT model that allows for variation in the production of post-vocalic /r/, but they do not identify the factors that condition this variation.

LANE shows variation for (R) in many maps. *ANAE* Map 16.1 shows that (R) constitutes a major difference between Eastern New England (ENE)

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[1]Although both variants that Laferriere looked at were apparently pronounced with r-vocalization, subjects heard the standard variant of the vowel as "putting the r in" (Laferriere 1979:605).

and Western New England (WNE) speech, with WNE producing consonantal post-vocalic /r/'s nearly categorically. The vocalization of /r/ in ENE is not categorical, as discussed in Wells (1982:520–522). *ANAE*, Wells (1982) and Parslow (1967)—on which Wells based his work—conclude that ENE speech is "undergoing a return to rhoticity" (Wells 1982:520). *ANAE* also reports that Boston speakers are more r-ful in formal speech styles.

Two other large-scale studies of (R) in the U.S. contribute to our analysis: Feagin's (1990) study of the return of /r/ to the previously r-less dialect of Anniston, AL, and Labov's (1972) NYC department store study.

Feagin (1990) found that post-vocalic [r] was reappearing in the Anniston dialect one phonological environment at a time. Table 1 summarizes the contexts by which Feagin organized her data, from the environments in which [r] was being re-introduced the most, to the environments which were slowest to become r-ful (Feagin 1990:132). One of our questions was whether Boston [r] shows the same pattern of reintroduction as Feagin (1990) found. Within the Environment III words, Feagin found an effect of vowel quality: the order of reintroduction is illustrated by the order of the words listed in Environment III in Table 1.

	Most [r]	Variably r-ful		Least [r]
Environment	I	II	III	IV
	ŕC	ŕ	V́r(C)	Unstressed r
Vowel	NURSE	FUR[2]	NEAR [i], SQUARE [æ], START [ɑ], NORTH [ɔ], FORCE [o]	LETTER

Table 1: Contexts for the analysis of (R) in Feagin (1990)

Labov (1972) found that speakers pronounced word-final /r/ (in *floor*) more than they did in word-internal (but morpheme-final) *fourth,* suggesting that the morphological environment influences the rate of /r/ deletion. He also showed that (R) is conditioned by social factors.

Recently (R) has been studied in Philadelphia, a city generally considered to be rhotic. In Miller (1998), an implicational scale similar to Feagin's (1990) emerged. Both Miller (1998) and Ellis, Groff and Mead (2006) uncovered a new effect: dissimilation. Speakers, especially AAVE speakers, were more likely to vocalize /r/ in words containing another /r/.

[2]FUR is given to illustrate Group II; it is not in Wells's (1982) lexical set.

3 Methodology

Our methodology was designed to answer three questions:

(1) What internal constraints affect variation in coda /r/ in Boston?
(2) How does (R) vary with social factors?
(3) Is the Boston r-less pronunciation receding?

To this end, we conducted a quantitative analysis of the production of (R) among 24 lifetime residents of Boston who vary in age, sex, occupation, and level of education. Recordings were conducted in 2006. We began by approaching strangers in a variety of public spaces including parks, streets, small businesses and a school and asking them to help with a school research project. Upon confirming that the speaker was a Boston native and gaining permission to record, we asked speakers to read a three-page story about the Blizzard of '78. Some speakers also shared reminiscences of this blizzard, but we do not include that data in this report. The story contains 224 words with post-vocalic /r/ and is composed of two texts found online and slightly edited (Urbanek 2003, Spina 2005). An Olympus DS-330 digital recorder with a Shure SM58 microphone was used, and an uncompressed *.wav* file was transferred to either a Mac or PC for acoustic and auditory analysis using Praat. Speakers also filled out a brief demographic questionnaire.

Speakers ranged in age from 19 to 81. We analyze 12 females, whose average age is 52, and 12 males, whose average age is 58. They all lived within the I-495 belt that we chose to define the Boston border, half of them live in the working class neighborhoods of South Boston and Dorchester, where nearly all of them were recorded. Speakers told us their occupation, but we did not ask directly about income or social class. We organized them into three groups by occupation, using the average annual income for their occupation type for the Boston metropolitan area for 2006, as reported in the U.S. Department of Labor's Bureau of Labor Statistics (*http://www.bls.gov/oes/current/oes_71650.htm*). Table 2 shows their distribution by income and Table 3 by highest level of education.

	<$40K/year	$40-50K/year	>$50K/year
Female	**6**	2	4
Male	3	3	**6**

Table 2: Distribution of speakers by estimated income

	High School	College	Post-College
Female	5	3	4
Male	5	6	**1**

Table 3: Distribution of speakers by education

While the females are, overall, more highly educated, they earn less than the males. The skewed distributions for both income and education with respect to sex should be kept in mind in interpreting the results.

Both authors participated in coding the data. For the dependent variable, a binary choice between presence/absence of constricted [r] was made. In future studies, we plan to see whether coding for degree of rhotic constriction better correlates to independent variables (Hay and Maclagan, forthcoming). All tokens that were ambiguous to one coder were coded by the other. Inter-coder reliability checks were conducted on a subsample of 400 tokens and ~90% agreement was attained.

Spectrograms were examined with the hope that convergence of the second (F2) and third formant (F3) would provide a useful cue to physiological constriction, but we found inconsistent support for that concept: some tokens where we clearly hear constricted [r] show non-convergent F2 and F3. Conversely, some clear cases of vocalization show convergence of the two formants. Further acoustic analysis is planned to better understand this issue.

In addition to these readings, the speech of two well-known Bostonians, Tom and Ray Magliozzi ("The *Car Talk* guys") was also examined, using all 801 tokens from a fifty-minute broadcast of their NPR show *Car Talk* (*www.cartalk.com/Radio/Show/*).

For all of these recordings, environments were categorized according to factors previously shown or expected to affect the production of /r/. Independent variables include preceding vowel, following segment, stress, morphological position of /r/, word type, lexical frequency, word length, and dissimilation.

4 Independent Variables Analyzed

Our coding represents surface phonetic forms rather than phonemes. Because of variation in the pronunciation of pre-rhotic vowels, we listened to each speaker's production of, for example, words like *warm* and *north* to determine whether the pre-rhotic vowel should be coded as [a] or [o]. We grouped the three variables preceding vowel, following segment and stress, to facilitate comparison to Feagin (1990), as shown in Table 4.

Phonetic description	IPA	Wells Lexical Set	Reading example
Schwar in closed syllable	[ɚ]C	NURSE	*worst*
Schwar in open syllable	[ɚ]	FUR	*worthy*
Stressed vowel in open or closed syllable:			
High front	[i]	NEAR	*fear, fierce*
Mid front	[e]	SQUARE	*there*
Low central	[a]	START	*part*
Low/Mid back[3]	[o]/ [ɑ]	NORTH	*north*
High back[4]	[u]	CURE	*allure*
Unstressed schwar	[ɚ]	LETTER	*blizzard*

Table 4: Grouping of preceding vowel with following segment

Following Labov (1972), we coded for the morphological position of (R). We checked the frequency of each token in the American National Corpus (ANC) of spoken texts. The values below indicate how frequently words appear in the ANC First Release, containing 3,298,467 words (*http://americannationalcorpus.org/frequency.html*). We also consider word length, counted in syllables.

Position	Example
word-final	*pair*
morpheme-final, but word internal	*pairs*
morpheme-internal	*blizzard*

Word type	Example
function word	*are*
lexical word	*car*

[3]The 495 tokens of words such as *stormy* or *warmth*, which may be pronounced with either a low [a] (FORCE) or mid [o] (NORTH) vowel in the Boston dialect were compared. There was no correlation between whether we heard a low or mid vowel and whether we heard a constricted or vocalized /r/

[4]Feagin (1990) does not include words with this vowel, but does list the [o] in *core* and [ɔ] in *corn* as separate categories, which we combine.

Frequency		Example
0	(rare)	*snow-covered*
<100	(fairly rare)	*fierce*
<1,000		*appear*
<10,000		*warm*
<100,000		*our*
>100,000	(most common)	*there*

Number of syllables	Example
Monosyllabic	*fear*
Disyllabic	*winter*
Three or more syllables	*fortunate, entertainment*

Based on the findings by Miller (1998) and Ellis, Groff, and Mead (2006), who showed that another /r/ in the word increased the likelihood of r-deletion, we looked for a dissimilation effect as follows:

Dissimilation	Example
no other /r/ in word	*other*
another /r/ earlier in word	*remember*
another /r/ later in word	*larger*

5 Data

Twenty-four speakers read the text containing 224 *r*-words, producing 4,951 analyzed tokens. (~350 tokens were omitted due to reading errors, background noise, etc.) Deletion rates were calculated for each of the 224 words so that any lexical effects could be isolated. However, none of the 224 words exhibited categorical r-presence or r-absence. Thus these 4,951 tokens were submitted to multivariate analysis using Goldvarb X for Macintosh. Overall, (R) was produced as [r] 38% of the time: the input value for the analysis presented below is 0.35 (application value = [r]).

6 Results: Linguistic Factors

The most significant internal factor was the phonological context. Table 5 shows the results for the effect of preceding vowel. Higher factor weights indicate a greater likelihood of [r] production.

Category, following Feagin (1990)	Vowel (Wells 1982)	N	%	Factor Weight
I: stressed schwar + C	*NURSE*	253/393	*64*	.85
II: stressed schwar	*FUR*	65/171	*38*	.48
III: high back round	*CURE*	101/196	*52*	.62
low central	*START*	460/1035	*44*	.64
high front tense	*NEAR*	132/391	*34*	.42
mid front	*SQUARE*	138/440	*31*	.37
mid back round	*NORTH/FORCE*	251/788	*32*	.43
IV: unstressed mid-central	*LETTER*	475/1537	*31*	.38

Table 5: Effect of preceding vowel

Our speakers were most likely to pronounce [r] in NURSE words with a tautosyllabic following consonant, the same environment that Feagin (1990) found was the first to re-introduce [r] in Anniston. Unlike the Anniston results, however, the Boston pattern does not show a clear stair-step pattern in Environments I through IV. In the Boston data, the environments other than NURSE have similar weights (Table 5 and Figure 1).

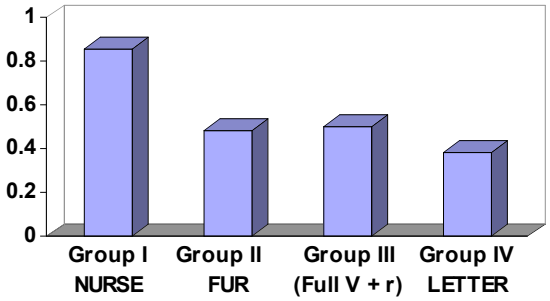

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Figure 1: Phonological Effects: Weights for Groups I-IV

Back vowels favor an *r*-ful pronunciation in Boston. This finding differs sharply from the pattern that Feagin found in Anniston, in which front vowels favored [r], and back vowels disfavored [r]. The difference may be partially due to the different vowel qualities in Boston and Anniston.

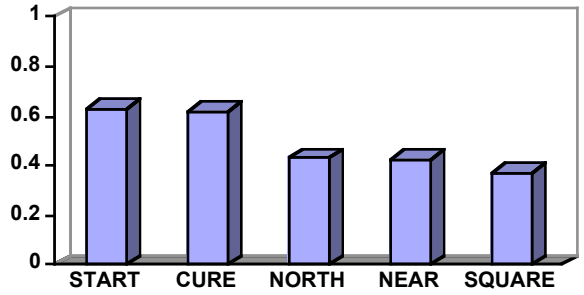

Figure 2: Phonological Effects: Weights for each full vowel in Group III

Of the other linguistic factors, the position of /r/ with respect to word boundaries matters most: speakers were more likely to pronounce word-final [r] and more likely to delete non-final /r/. (Table 6). Despite Hay and Warren's (2002) and Hay and Maclagan's (forthcoming) research into the effects of morpheme boundaries, our speakers showed no difference in /r/ deletion between morpheme-final word-internal (e.g. *pairs*) and morpheme-internal (e.g. *blizzard*) contexts. These results echo those of Labov's (1972) NYC study, in which speakers pronounced word-final /r/'s (in *floor*) more than they did in word-internal *fourth*. Labov (1972:66) suggests that this is due to a "phonological constraint" that differently affects preconsonantal and word-final /r/, which may also be the right explanation for Boston speakers.

Morpheme position	**N**	**%**	**Weight**
word-final	878/2214	*40*	0.60
word-internal	997/2737	*36*	0.42

Table 6: Effect of morpheme position

Word type	**N**	**%**	**Weight**
functional	257/678	*38*	.44
lexical	1618/4273	*38*	.51

Table 7: Effect of lexical category of the word

The functional/lexical distinction proved significant: lexical words favor [r] slightly more than function words. This supports Selkirk's (1995) argument that monosyllabic function words differ from lexical words in not forming prosodic words when they appear in their weak form, as evidenced

in part by their sharing "properties of stressless syllables: vowel reduction, appearance of syllabic consonants… etc." (Selkirk 1995:447).

The one factor not selected as significant in the binomial step-up/step-down analysis was presence of another /r/ in the word. This result might suggest a difference in the underlying status of /r/ in predominantly non-rhotic vs. predominantly rhotic dialects (e.g. Boston vs. Philadelphia).

No multivariate analyses were conducted including more than one of the following factors: word length, word type, and frequency. This is important because of interactions among them: longer words are generally used less frequently and function words tend to be shorter and more common. This would have substantial impact on the integrity of the statistical method. The interactions can be seen by the significant correlation between two of the variables: Spearman's Rank Correlation for word length and frequency has $r = -0.39$ ($p < 0.0001$) overall and increases within the subgroup of function words to $r = -0.56$ ($p < 0.001$).

To circumvent this interaction, we ran analyses with the same set of factors, but substituting word length and then lexical frequency for word type. In the analysis with word length, that factor emerged significant: the greater the number of syllables, the more likely /r/ is deleted (Table 8). In the analysis with frequency, that factor proved non-significant.

Syllables	N	%	Weight
1	984/2293	*43*	.56
2	660/1875	*35*	.48
3+	231/783	*30*	.38

Table 8: Effect of word length

7 Results: Social Factors

While we were surprised to see virtually the same rate of r-deletion for males and females overall, there are important differences when age and sex are examined simultaneously (Table 9). For both sexes, there is a higher rate of [r]-production for the youngest group. The men show a stair-step correlation between age and rate, while there is little difference between the two older female generations. Women have a higher weight than men for the oldest generation, suggesting they began the change earlier.

Age & sex	N	%	Weight
Younger women (19-39)	700/1212	*59*	0.65
middle women (40-69)	229/820	*28*	0.38
older women (70-89)	86/421	*20*	0.39
Younger men (19-39)	450/818	*55*	0.66
middle men (40-69)	340/1044	*33*	0.54
older men (70-89)	70/636	*11*	0.21

Table 9: Effects of age and sex

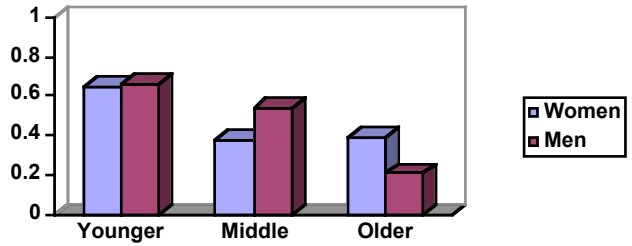

Figure 3: Effects of age and sex

Education	N	%	Weight
Post-college	689/1002	*69*	0.76
College	577/1683	*34*	0.47
High School	609/2266	*27*	0.40

Table 10: Effect of education

Income	N	%	Weight
>$60,000	1110/2273	*49*	0.59
<$40,000	547/1649	*33*	0.50
$40-60,000	218/1029	*21*	0.31

Table 11: Effect of estimated income (based on current occupation)

These data support assertions, stemming from Wells (1982), that r-vocalization is undergoing a change: younger speakers delete /r/ less frequently, even taking into account differing degrees of education and income. Speakers with post-graduate education produce [r] quite a bit more often than those with less education. This may be due both to greater contact with

speakers of other (rhotic) dialects and to greater contact with more formal speech.

8 Results: Car Talk

Finally we turn to our analysis of the speech of the Car Talk guys. Car Talk is a call-in show on National Public Radio, in which people get car advice from two hosts, the brothers Ray and Tom, both of whom are mechanics, Boston natives, and—importantly—graduates of MIT. It's a humorous show, and the hosts' Boston accents are seen as part of the entertainment value of the show. But the question is, do they speak like other Bostonians?

Using data from one episode of Car Talk containing 801 tokens of (R), we find first that the two hosts pronounced [r] at different rates. Ray pronounced [r] 73% of the time, and Tom 45%. Their combined rate was 66%, similar to that of other highly-educated speakers. Comparing them to our aggregate age and sex data, Tom's rate is like that of the youngest group of females and Ray's like the middle group of females. This raises some interesting questions about gender and performance that we do not investigate here. We also found that their rate of r-deletion did not vary with the sex or the geographic location of the person calling in to the show.

In linguistic variables, Tom and Ray do not pattern exactly like other Bostonians, but they follow other Bostonians in deleting /r/ the most in word-internal contexts. They show basically the same pattern with respect to preceding vowel, though at a slightly lower rate. Interestingly, for the context that includes unstressed schwa, the context shown by Feagin (1990) and others to be the last place to reintroduce [r], Ray and Tom are ahead of the game, using more [r] in this context than other Boston speakers do.

9 Next Steps

While we have answered the questions we posed in Section 3, showing the effects of several linguistic and social factors on this ongoing sound change in Boston, we anticipate further work to answer the following questions:

(1) How does (R) behave in conversational rather than read speech?
(2) Are there different (R) patterns in white and African-American English varieties? other ethnic varieties?
(3) Does Boston (R) pattern more clearly when coded as a scalar rather than a nominal variable?
(4) How does (R) pattern in other parts of Northern New England?

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