Rhotic variation and schwa epenthesis in Windsor French

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Abstract

This study investigates two idiosyncratic phenomena found in the French dialect of the Windsor area in SW Ontario. (1) Rhotics in this dialect are pronounced in three phonetic varieties: the dorsal fricative, the alveolar approximant, and the alveolar tap. (2) An epenthetic schwa is also found in the phonetic realization in certain phonemic contexts. Through phonetic analysis of recorded speech and statistical data analyses, we explore whether the phonological context is a good predictor of the phonetic realization of rhotics and schwa epenthesis. Amongst the independent factors, the manner and place of articulation of the phonemes preceding and following the rhotics are best predictors for the type of rhotics, the presence/absence of schwa epenthesis, as well as for the duration of the epenthetic schwa. The type of rhotic realization is a pre-condition for schwa epenthesis. Finally, duration of phonological schwas is also significantly longer than that of epenthetic schwas in schwa-rhotic sequences.

Index Terms: dialectology, phonetic variation, phonology-phonetics interface, rhotics, schwa epenthesis

1. Introduction

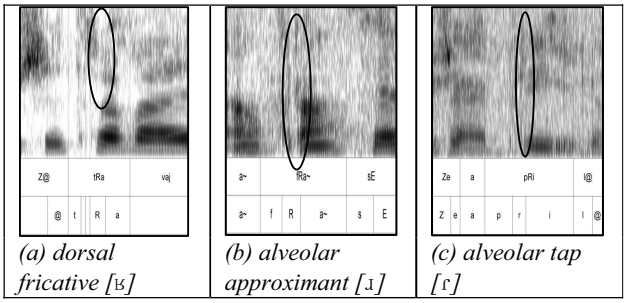
As a part of the *Phonologie du français contemporain* (PFC) project [1], this study investigates the phonetic variation of rhotics and schwa epenthesis in the variety of French spoken in the Windsor area of Southwestern Ontario. Past research indicates that the pronunciation of Canadian French dialects is often subject to the influence of English ([2], [3], [4]). As a result, certain phonetic patterns typically found in these dialects are different from those of Standard French. In previous studies of consonant-rhotic (CR) clusters, Chow & Poiré [5] and Kelly [6] found that Windsor French speakers alternate between [ʁ], the dorsal fricative commonly found in Standard and Laurentian French ([7], [8]); [ɹ], the alveolar approximant commonly found in North American English; and [ɾ], the alveolar tap, which is absent in both Standard French and North American English. An epenthetic schwa [ə] was also found in a number of CR clusters, a phenomenon previously attested in Laurentian French ([9], [10], [11]). This study looks at the phonetic variation of rhotics and schwa epenthesis in all phonological contexts. By way of phonetic analysis of recorded speech and statistical data analysis, we seek to answer several questions. Can the phonological context surrounding the rhotics (i.e. the manner and place of articulation of the surrounding phonemes, as well as the type of surrounding phonological boundaries) predict the type of rhotics in the phonetic realization? Does schwa epenthesis co-occur with a specific type of rhotics? Is the duration of a rhotic related to its type? For the epenthetic schwa occurring within CR-clusters, we are especially interested in the presence of schwa epenthesis: is it a pre-condition for the phonetic realization of a particular type of rhotics (or vice versa)? We also explore whether the duration of phonological (naturally occurring) schwas is significantly different from that of epenthetic schwas. Finally, we analyze all schwa-rhotic (SR) sequences and investigate whether phonological schwas are longer than epenthetic schwas in these sequences, and whether phonological schwas occupy a larger portion of the SR sequence than epenthetic schwas.

We begin with detailed descriptions of rhotic variation and schwa epenthesis in section 2. Research methodology is found in section 3. Statistical results are presented and discussed in section 4. Conclusions are given in section 5.

2. Rhotic variation and schwa epenthesis

2.1. Rhotic variation

In the recordings of four native speakers of Windsor French, three different phonetic realizations for the rhotic are found. These rhotic varieties can be distinguished by their respective spectrographic patterns.



(a) dorsal fricative [ʁ] *(b) alveolar approximant [ɹ]* *(c) alveolar tap [ɾ]*

Figure 1: *Spectrographic patterns of the three varieties of rhotics in Windsor French.*

Figure 1(a) is a spectrographic display of the dorsal fricative [ʁ], most commonly found in Standard and Laurentian French ([7], [10]), and is characterized by a patch of low-intensity energy across the higher frequencies. The alveolar approximant [ɹ] is common in North American English. As shown in (b), this type of rhotic is recognized in the spectrogram by multiple striations. The third rhotic variety, the alveolar tap [ɾ] (shown in (c)) is found neither in English, Laurentian nor Standard French. However, it is described by Léon [12] as a feature of rural French dialects. The alveolar tap is similar to the middle consonant of the North American pronunciation for the word "butter", and can be recognized in the spectrogram by a single visible striation across all frequencies.

2.2. Schwa epenthesis

In Figure 2, the short vowel [ə] (encoded as "@"; see section 3.2 for details on speech encoding) between [g] and [ʁ] (encoded as "R") can be recognized by the presence of three

formants, the frequencies of which correspond to those of the schwa.

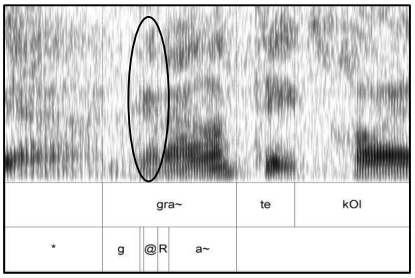


Figure 2: *Spectrographic pattern of an Epenthetic Schwa.*

In Windsor French, epenthetic schwas can be found in consonant-rhotic clusters. Chow & Poiré [5] determine that rhotic variation and schwa epenthesis are phonologically related: the type of rhotic is a pre-condition for the occurrence of schwa epenthesis.

3. Research methodology

3.1. Subjects and the recordings

We use the recordings of four female native speakers of Windsor French [13] within the *Phonologie du français contemporain* (PFC) corpus in our speech analysis. Subjects' ages range from 16 to 88. Although French is the first language for all subjects, the two younger speakers (16 and 41 years) show audible English influence, whereas the two older speakers (60 and 88 years) do not show such influence. They are divided into two groups according to the presence/absence of English influence. Thirty-two minutes of recorded speech are collected in two different speech styles: read passage (three minutes) and directed conversation (five minutes).

3.2. Speech Analysis

Using Praat [14], we create tiers to encode the recorded speech. We organize these tiers according to the size of the discourse units: sentence, intonational phrase, prosodic word, lexical word, syllable and phoneme. Phonetic annotation is done using SAMPA (http://www.phon.ucl.ac.uk/home/sampa/index.html), a machine-readable phonetic alphabet. In total, 962 instances of rhotics and 613 instances of schwas are encoded. Special tiers are created to record the variety of rhotic and whether epenthetic schwas are found in the clusters. Phonological properties of the phonemes preceding and following the rhotic are used to determine the influence of phonological context on the phonetic realization of the rhotics and schwa epenthesis. The encoded ensembles of tiers are then transferred onto spreadsheets and prepared for statistical analyses.

3.3. Statistical Analyses

We conduct four series of statistical analyses, one for each of the dependent variables listed in Table 1. For the discreet dependent variables ("Type of rhotic in the phonetic realization" and "Presence/absence of schwa epenthesis"), we carry out a Variable Rule analysis to determine the significance of the independent variables. For the duration of rhotic and schwas (which are continuous dependent variables) two series of Analyses of Variance (ANOVA) are conducted using SPSS (http://www.spss.com).

Dependent Variables	Independent Variables
Type of rhotic in the phonetic realization	*Place of articulation and manner of the preceding phoneme*
Presence/absence of schwa epenthesis	*Place of articulation and manner of the following phoneme*
Duration of rhotics	*Syllabic position of the rhotic/schwa within a word (initial, medial, final, or monosyllabic)*
Duration of schwa	*Type of boundary before and after the phoneme (word/syllable)*
	Position of the phoneme within the syllable (attack/coda)
	Type of attack/coda (non-cluster, cluster: Consonant-rhotic (CR), CCR, or RC)
	Type of rhotic in the phonetic realization
	Presence/absence of schwa epenthesis
	Speaker identity
	Presence/absence of English influence
	Speech style

Table 1: *Variables used in the present study*

Rhotic variation (fricative, alveolar approximant and alveolar tap) and the presence/absence of schwa epenthesis are treated as dependant variables in two separate analyses. In one analysis, rhotic variation is treated as the dependent variable, while the presence/absence of schwa epenthesis is treated as an independent variable, and vice versa for the other analysis.

3.3.1. Variable rule analysis

Variable Rule (VarbRule) analyses are conducted using GoldVarb [15]. In order to see the full picture in the rhotic variation analysis – since VarbRule can only yield viable data in binomial analyses –, we conduct three separate analyses, grouping two variables together at a time.

3.3.2. Analysis of variance

Four series of Analyses of Variance (ANOVA) are conducted to determine the influence of the phonological context on the duration of rhotics and schwas. In the first series, we treat rhotic duration as the dependent variable, and add the type of rhotic in the phonetic realization and the presence/absence of schwa epenthesis to the list of independent variables. For the analysis of schwa duration, since all epenthetic schwas are found in CR clusters (for example, *vrai* /vRɛ/ → [və̲Rɛ]), the type of rhotic in the phonetic realization is added to the list of independent factors. In the third series, we compare the duration of epenthetic schwas and phonological schwas (e.g. *fenêtre* /fənɛtR/). In the last analysis, we examine all schwa-rhotic (SR) sequences and investigate whether the duration and percentage of phonological schwas in SR sequences are significantly different from those of epenthetic schwas. We conduct two series of one-way ANOVA, using schwa duration and percentage (duration of schwa / duration of SR sequence) as dependent variables.

4. Results and Discussions

4.1. VarbRule Analyses

4.1.1. Rhotic variation

We conduct three binomial analyses, grouping two varieties together at a time. All three analyses yield significant results (significance > 0.05). However, since the dorsal fricative type is the most commonly found rhotic in our corpus (498 fricatives, 155 alveolar flaps, 399 alveolar approximants), the comparison of fricatives and non-fricatives turns out to be most indicative.

	Non-Fricative	Fricative	% for each factor	Factor Weight
Presence of English influence				
Absence	314	150	48	0.617
Presence	248	250	51	0.390
Range: 23				
Speech style				
Text	311	245	57	0.427
Conversation	251	155	42	0.598
Range: 17				
Position of the phoneme within the syllable (attack/coda)				
Attack	108	264	61	0.662
Coda	454	136	38	0.257
Range: 40				
Type of branching				
Non-branching	329	279	63	0.671
CR	223	107	34	0.243
CCR	5	7	1	0.005
RC	5	7	1	0.005
Range: 67				
Phonological context of the preceding phoneme				
Front Vowel	194	169	38	0.484
Central Vowel	52	41	9	0.439
Back Vowel	43	40	8	0.582
Bilabial	117	23	14	0.648
Dental	43	80	12	0.150
Velar	32	3	3	0.510
Fricative	37	8	4	0.960
Pause	36	35	7	0.507
Range: 81				
Phonological context of the following phoneme				
Front Vowel	305	67	38	0.696
Central Vowel	85	38	12	0.598
Back Vowel	61	28	9	0.667
Bilabial	25	25	5	0.505
Dental	28	71	10	0.228
Velar	7	20	2	0.209
Fricative	15	47	6	0.228
Lateral	6	30	3	0.131
Pause	27	74	10	0.234
Range: 57				
Presence of schwa epenthesis				
Absence	466	398	90	0.419
Presence	93	2	9	0.952
Range: 53				

Table 2: *VarbRule results for rhotic variation: non-fricative vs. fricative*

In table 2, the numbers in the "non-fricative" and "fricative" columns represent the number of tokens for each type. The numbers in the "% for each factor" column indicate the percentage of each variable within an independent factor. For example, under the factor "Presence of English influence", 51% of rhotic tokens are produced by speakers with English influence, 49% of them by speakers with no English influence.

4.1.2. Schwa epenthesis

In this analysis, the type of rhotic is added to the list of independent variables. Since we need to analyze the factors that determine the presence and absence of schwa epenthesis, we analyze all 1057 encoded rhotic tokens, which include those that co-occur with epenthetic schwas. However, 468 tokens are eliminated due to "knock-outs"— a total absence of tokens for certain variables. For example, for the factor "Phonological context of the preceding phoneme", knock-outs are found for certain phonological contexts, including back and central vowels as well as laterals; this means that it is highly unlikely for schwa epenthesis to occur after these phonemes.

	Absence	Presence	%	Factor Weight
Speaker identity				
DE1	228	16	23	0.764
HF1	202	62	24	0.295
MF2	184	94	26	0.193
RE2	253	18	25	0.831
Range: 64				
Phonological context of the preceding phoneme				
Front vowel	161	2	27	0.961
Bilabial	88	66	25	0.367
Dental	114	40	23	0.326
Fricative	40	20	10	0.321
Velar	8	57	10	0.018
Pause	2	8	1	0.013
Range: 95				
Type of rhotic in the phonetic realization				
Fricative	183	181	61	0.305
Alveolar tap	127	3	22	0.485
Alveolar Approximant	6	89	16	0.913
Range: 61				

Table 3: *VarbRule results for schwa epenthesis*

We now turn to the question as to whether rhotic variation is a pre-condition for schwa epenthesis or vice versa. If we look at the bottom part of Table 3 (Type of rhotic in the phonetic realization vs. Alveolar approximant), in all but 6 cases, schwa epenthesis co-occurs with the alveolar approximant (factor weight = 0.913). However, not all instances of alveolar approximants (495 instances in total) co-occur with schwa epenthesis (only 95 instances). Since the number of instances of alveolar approximants far exceeds that of the schwa epenthesis, we can deduce that the alveolar approximant is a pre-conditioning factor for schwa epenthesis, but not vice versa.

4.2. Analysis of variance

4.2.1. Rhotic duration

In the analysis of rhotic duration, none of the independent factors turn out to be significant; only one factor, the type of rhotic in the phonetic realization, came close to being statistically significant (df = 961, F = 2.592, sig. = 0.075).

4.2.2. Schwa duration

We only analyze the duration of epenthetic schwas in the second series. The type of rhotic, the type of attack/coda, and the Phonological context of the preceding phoneme are significant factors (sig. > 0.005); the Phonological context of the following phoneme is close to significant (sig. = 0.079).

4.2.3. Phonological vs. epenthetic schwa

In the third series, the duration of 94 instances of epenthetic schwas is compared to that of 518 tokens of naturally occurring schwas. Results indicate that the duration of phonological schwas is significantly larger than that of epenthetic schwas (df = 104, F = 123.198, sig. = 0.000). In addition, speaker identity, the presence vs. absence of word boundary after the schwa, the phonological context of the preceding and following phoneme all play a significant role in determining the duration of schwas (sig. > 0.05).

4.2.4. Schwa-rhotic sequences

The comparison between phonological and epenthetic schwas within SR sequences yields 41 epenthetic schwas and 13 phonological schwas in SR sequences in the recording of read-aloud text, and 37 epenthetic and 14 phonological schwas in the directed conversations.

	Read-aloud text			
	Epenthetic		Phonological	
	schwa	R	schwa	R
Dur	0,0341	0,0221	0,1052	0,0305
%	61,84%	38,16%	76,59%	23,41%
	Directed Conversation			
	Epenthetic		Phonological	
	schwa	R	schwa	R
Dur	0,0326	0,019	0,0837	0,0396
%	62,62%	37,38%	69,66%	30,34%

Table 5: *Distribution of schwa and rhotic duration (in ms and percentage) between 2 styles and 4 speakers*

As expected, the duration of phonological schwas is significantly greater (df = 104, F = 98.575, sig. = 0.000) than that of epenthetic schwas. Phonological schwas also occupy a larger percentage of an SR sequence (df =104, F = 15.187, sig. = 0.000). In addition, the type of rhotic plays a significant role in both the schwa duration and percentage within SR sequences (sig. = 0.000).

5. Conclusions

In this study, we investigate the interaction between phonology and phonetics in the context of two phonetic variations in Windsor French: rhotic variation and schwa epenthesis. We analyze and encode the recorded speech of four female native speakers of the dialect for statistical analyses. The phonological context turns out to be a good predictor of the type of rhotic as well as the presence/absence of schwa epenthesis in the phonetic realization. In addition to phonological factors, the presence/absence of English influence, speaker identity and speech style are also significant. In the analysis of rhotic duration, although not quite statistically significant, the type of rhotic is the best predictor of rhotic duration. For the duration of schwas, the type of rhotic, the type of attack/coda, and the phonological context of the preceding phoneme are significant factors, with the phonological context of the following phoneme coming close to being statistically significant. Finally, our results indicate that naturally occurring schwas are significantly longer than epenthetic schwas. Within SR sequences, phonological schwas are also significantly longer and occupy a larger percentage of the duration of the SR sequence than epenthetic schwas.

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