The relationship between schwa insertion and consonant cluster simplification in French: An Analysis of Covariance

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Abstract

This research in concerned with predicting rates of schwa insertion following consonant clusters at word boundaries in French. We are interested in knowing whether there are differences in rates of schwa insertion following a word-final consonant cluster predicted to simplify as compared with clusters predicted to remain stable in two dialects of French. Our data is drawn from a corpus of political debates from the national assemblies of Que´bec and France. It contains approximately 126 hours of speech data from more than 200 speakers. We use an analysis of covariance to investigate the effects of dialect and cluster on rates of schwa insertion after taking into account differences in rates of reduction. Since differences in rates of schwa insertion due to rates of reduction can be predicted, then the differences in rates of schwa insertion between dialects that would be expected due to differences in rates of reduction can also be predicted. Any differences beyond these pre- dictions cannot be put down to differences in rates of reduction and can therefore be attributed to differences between the groups. The data contain rates of both reduction and schwa insertion for word final consonant clusters in each dialect. The data is further grouped according to whether the cluster is predicted to simplify or remain stable. We consider four variables: a response variable of rates of Schwa insertion, two categorical explanatory variables of Dialect and Cluster, and one covariate variable of rates of Reduction. Initial examination of a portion of the data suggest that the best model to fit the data contains three intercepts (a common intercept for all clusters in the France dialect, and one for each level of the explanatory variable Cluster for Que´bec) and the regression line of Schwa against Reduction will be the same for all four. This suggests that, after controlling for differences in rates of reduction, there is a significant difference in rates of schwa insertion in the Que´bec dialect between clusters predicted to simplify and clusters predicted to remain stable. There is no significant difference in rates of schwa insertion in the France dialect between these two groups of clusters. However, the relationship between cluster reduction and schwa insertion is the same in both dialects.

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1 Introduction

This research is concerned with the relationship between consonant cluster simplification and schwa insertion in French. In the French language, there are two well known phonological operations that target consonant clusters at word boundaries: cluster simplification and schwa insertion. Both are understood to alter a sequence of consonants in order to either facilitate articulation or enhance perception of the sequence. For example, word-final consonant clusters will often be either simplified, as in (1a) and (2a), or have schwa inserted, as in (1b) and (2b).

(1) *"titres de gloire"*
   a. [tit də glwaʁ]
   b. [titʁə də glwaʁ]

(2) *"manifestent leur colère"*
   a. [manifɛs lœʁ kɔlɛʁ]
   b. [manifɛstə lœʁ kɔlɛʁ]

The insertion of schwa at word-boundaries in French has been extensively studied (Grammont, 1961; Dell, 1985; Tranel, 1987; Picard, 1991; Dell, 1995; Ayres-Bennett and Carruthers, 2001; Côté, 2000, 2007; Eychenne, 2005). Côté (2004a,b) has presented an account of the simplified productions where consonant clusters that contain either a rising sonority contour, or lack crucial featural contrasts, are susceptible to deletion. Laks (1977), has examined /r/ deletion patterns in word-final consonant clusters according to social, stylistic, and phonetic factors. What emerges from this literature is the observation that neither consonant cluster simplification nor schwa insertion are absolute, in the sense of a given speaker, or community of speakers, utilizing one to the exclusion of the other. There is often both intra- and inter-speaker variation. Referring to examples (1) and (2) above, a speaker from Northern France more commonly produces (1b), (2b); while a speaker from Québec more commonly produces (1a), (2a), though in both dialects the opposite may also occur. Tranel (1987) and Goad (2002), noting the overt release of word-final stops in Continental French, offered a possible explanation for the lower incidence of simplification in the French spoken in Northern France. Both Eychenne (2003) and Kemp et al. (1980), while examining schwa at word boundaries in speakers from Québec, found that schwa at word boundaries in the vernacular does not exist, though for a small subset of four speakers who displayed a speaking style favoring high overall rates of cluster conservation, schwa surfaced principally following liquids (/r/, /l/) and variably following stops and nasals. While some attempts have been made to accommodate sociolinguistic variation within phonological grammars (Lyche, 1979; van Oostendorp, 1997; Hayes, 1997), and the researchers noted above have studied either consonant cluster simplification alone or schwa insertion alone, none have investigated both processes together.

Milne and Côté (2009) investigated both consonant cluster simplification and schwa insertion at word boundaries in two dialects of French: a variety spoken in and around Paris and Northern France (FR), and a variety spoken in Québec (QF). The data they presented confirmed the expectation that these two phonological operations pattern differently in each dialect. Rates of consonant cluster simplification were higher in the QF variety than the FR variety (51% vs. 18% overall simplification rate) and rates of schwa insertion were lower in the QF variety than the FR variety (20% vs. 40% overall schwa insertion rate). However, they determined that the distribution of occurences of consonant cluster simplification and schwa insertion were not the same in each dialect. For the FR variety, even as rates of consonant cluster simplification increased (rates of simplification were highest for those clusters ending with /r,l/), rates of schwa insertion remained constant (50% of occurences of schwa insertion with clusters ending in /r,l/, 50% with others). Whereas for the QF variety, as rates

of consonant cluster simplification increased (rates of simplification were highest in clusters ending in /r,l/ as well as in clusters ending in a stop consonant), rates of schwa insertion also increased (95% of occurences of schwa insertion with clusters ending in /r,l/ or a stop consonant, 5% with others). They hypothesized a possible relationship between consonant cluster simplification and schwa insertion, at least for the QF variety: in contexts where consonant cluster simplification did not occur (for whatever reason), schwa insertion was an alternative. However, their results were based data drawn from different speech styles. The data for the QF dialect, being drawn from the political debates in the Assemblée nationale du Québec, was most likely representative of a more formal speech style than the data for the FR dialect, which was drawn from a less formal conversational speech style. Therefore it is difficult to say whether the differences they observed were due solely to dialectal differences between the two varieties, or whether the differences might also be attributable to differences in speech style. We wonder whether, after controlling for differences in speech style, the observation of schwa insertion as an alternative to cluster simplification will remain.

This project uses data evenly balanced from both dialects of French (Québec and Northern France) drawn from a uniform style of speech (political debates from the national assemblies of both countries). We use an analysis of covariance to examine to what extent the regression relationships of schwa insertion on consonant cluster simplification differ between the dialects. In particular, whether or not they differ at all. Of concern is whether the relationship between consonant cluster simplifiction and schwa insertion is exactly the same in the data from both France and Québec (the hypothesis of coincidence) or whether the two slopes are equal, even if the intercepts are different (the hypothesis of parallelism).

2 Data and Methods

Our data is drawn from a corpus of political debates from the national assemblies of Québec and France that occurred in the month of May 2011. It contains approximately 17.5 hours of speech data: 9 hours from Québec ('QF'), 8.5 hours from France ('FR'). Every instance of a word final consonant cluster was identified and coded for the presence or absence of both consonant cluster simplification or schwa insertion. After excluding clusters that only occured in one dialect or were represented by fewer than five tokens, our total data set contained 5428 tokens (QF = 2840, FR = 2588) and consisted of 21 unique word final consonant clusters.

Rates for consonant cluster simplification ('Simplification') and schwa insertion ('Schwa') were calculated for each cluster in each dialect. The Simplification rate was calculated simply as the number of occurences of cluster simplification divided by the total number of occurences of that cluster (see 3). Since we are exploring the question of schwa insertion as an alternative to consonant cluster simplification, we calculated a rate of Schwa as the number of occurences of schwa insertion divided by the total number of occurences per cluster less the number of occurences of cluster simplification (see 4). That is, of all the times a cluster did not simplify, how frequently was schwa inserted instead. Calculated this way, a test of the regression coefficient in our regression equation (that the slope of the line is significantly different from 0) can be interpreted as a test of the hypothesis that schwa insertion is an alternative to consonant cluster simplification: where consonant cluster simplification did not occur (for whatever reason), schwa insertion occured instead. An example of how these rates were calculated is shown below:

$$\begin{aligned} (3)\quad \textit{Simplification} &= n_{simplification} \div (n_{simplification} + n_{schwa} + n_{full}) \\ &= 80 \div (80 + 15 + 5) \\ &= 0.80 \end{aligned}$$

$$\begin{aligned} (4)\quad \textit{Schwa} &= n_{schwa} \div (n_{schwa} + n_{full}) \\ &= 15 \div (15 + 5) \\ &= 0.75 \end{aligned}$$

Our assumption that Simplification is the proper explanatory variable, and not Schwa, stems from three observations. First, in our data, consonant cluster simplification and schwa insertion never co-occur. There are no instances in this data of a token being both simplified and having

schwa inserted at the same time. Second, our data suggests that for both the Québec and France data, the group of clusters we consider can be divided into two groups: those that do simplify, and those that don't. In this data, all /ʁ/ initial clusters (/ʁl, ʁm, ʁn, ʁt/) have simplification rates of 0.02 or less. The same division does not apply with respect to schwa insertion. Finally, the observation from Milne and Côté (2009) that, at least in their data from Québec, schwa insertion happened only in those clusters that also simplified, and rarely in clusters that didn't.

Viewed this way, we can describe four possible functions for the relationship between consonant cluster simplification and schwa insertion, as shown in Figure 1. In the figure, the x axis displays rates of cluster simplification, the y axis rates of schwa insertion. Data points $\{a,b,c\}$ denote clusters that do not participate in cluster simplification while data points $\{x,y,z\}$ represent clusters that do (or at least could) participate in cluster simplification.

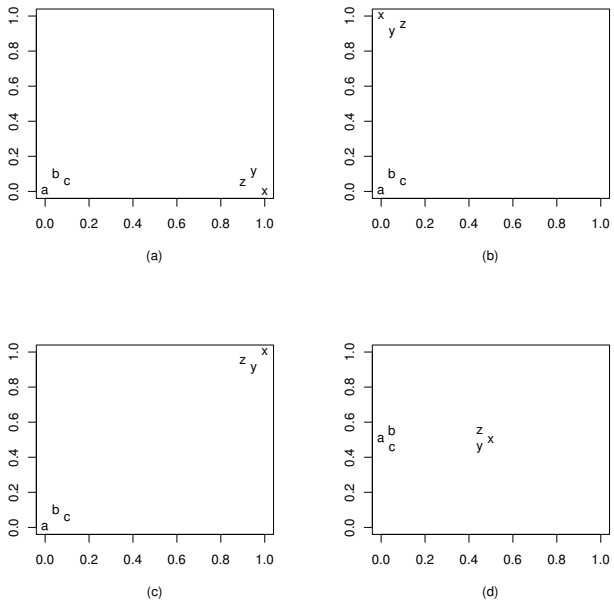

Figure 1: Typology of relationships between cluster simplification and schwa insertion

In Figure 1, the top left panel (a) demonstrates the situation where only cluster simplification is available and it is strictly observed in all cases. The top right panel (b) demonstrates the reverse situation where only and always schwa insertion occurs. In both of these situations, no relationship between cluster simplification and schwa insertion could be determined, since one always occurs to the exclusion of the other. The bottom left panel (c) illustrates the situation where both cluster simplification and schwa insertion are available and always either one or the other occurs. It is in this situation where a relationship can be determined. The bottom right panel (d) shows the situation where cluster simplification and schwa insertion appear to be independent of each other.

3 Analysis

The overall rates of Simplification and Schwa by Dialect are given in Table 1. t–tests on these data reveal a significant difference between the dialects in rates of Simplification ($t(40) = 3.268, p = 0.002$), but no significant difference in rates of Schwa ($t(40) = -0.672, p = 0.51$). This indicates that overall rates of Simplification are higher in the data from Québec than in the data from France.

Our analysis of covariance examines to what extent the regression relationships of schwa insertion on consonant cluster simplification differ between the dialects. In particular, whether or not they differ at all. Of concern is whether the relationship between consonant cluster simplifiction

		mean	standard deviation
Schwa	QF	0.544	0.325
	FR	0.604	0.255
Simplification	QF	0.430	0.313
	FR	0.177	0.166

Table 1: Summary statistics for rates of Schwa and Simplification by Dialect

and schwa insertion is exactly the same in the data from both France and Québec (the hypothesis of coincidence) or whether the two slopes are equal, even if the intercepts are different (the hypothesis of parallelism). If we accept coincidence, then we can fit a single overall regression line to both relationships. If the regression lines are parallel, then the effect of consonant cluster simplification on schwa insertion is the same in each dialect, but the 'base-line' values for schwa insertion are different for the two dialects.

The complete model is given by (5):

$$Y = \beta_0 + \beta_1 x + \beta_2 z + \beta_3 x \times z + \varepsilon \tag{5}$$

Where Y is the rate of Schwa, x is the rate of Simplification, z is the dummy variable defined by

$$z = \begin{cases} 1 & \text{if Dialect is QF} \\ 0 & \text{if Dialect is FR} \end{cases}$$

and ε accounts for random variation.

The least squares line for the model for our data is given by

$$\hat{y} = 0.23431 + 0.71969x + 0.26673z - 0.13844x \times z$$

Testing for coincidence, that is, $H_0 : \beta_2 = \beta_3 = 0$, is simply testing significance of the terms z and $x \times z$, simultaneously. This can be done using the ANOVA tables for the data:

	Df	Sum Sq	Mean Sq	F value
Simplification	1	0.77249	0.77249	13.2756
Corpus	1	0.45575	0.45575	7.8324
Simplification:Corpus	1	0.00822	0.00822	0.1412
Residuals	38	2.21116	0.05819	

Table 2: ANOVA table

Thus, we get the following F-test statistic for coincidence

$$\begin{aligned} F &= \frac{(0.45575 + 0.00822)/2}{0.05819} \\ &= 3.98668 \end{aligned}$$

Comparing with an $F(2,38)$ distribution, we get the p-value $p = .03$. That is, the two lines are not coincident.

Testing for parallelism, that is $H_0 : \beta_3 = 0$, is testing significance of the term $x \times z$. Referring to the ANOVA table we get the following F-test statistic for parallelism

$$\begin{aligned} F &= \frac{0.00822}{0.05819} \\ &= 0.1412 \end{aligned}$$

Comparing with an $F(1,38)$ distribution, we get the p-value $p = .71$. Therefore, it seems the two lines are parallel. Since H_0 is true, the model for the data from France will be $Y = (\beta_0 + \beta_2) +$

$\beta_1 x + \varepsilon$, and the model for the data from Québec will be $Y = \beta_0 + \beta_1 x + \varepsilon$. The least squares lines for the model for our data will be

$$\hat{y}_{FR} = .50104 + .71969x$$

and

$$\hat{y}_{QF} = .23431 + .71969x$$

Plotted in Figure 2 are the data points for Schwa on Simplification by Dialect along with their regression functions.

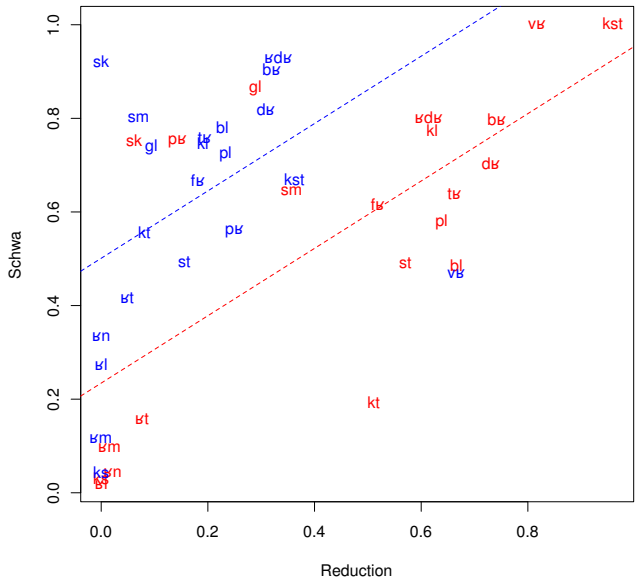

Figure 2: The parallel relationships between cluster simplification and schwa insertion by dialect

4 Conclusion

We began with the question of whether schwa insertion is an alternative to consonant cluster simplification. The results from the analysis of covariance appear to suggest this could be the case. The parallel regression functions that emerged from the model indicate that, although rates of cluster simplification were higher in the data from Québec, rates of schwa insertion following a cluster that did not simplify do not appear to be different between the two dialects. In fact, the identical positive slope coefficient in the model suggests that, in both dialects, the more frequently a consonant cluster simplifies, the more likely it is to have a schwa inserted instead. The situation we found in our data resembles the hypothetical relationship described in panel (c) of Figure 1. We believe that the strength of this relationship, and the fact that it exists in both dialects, indicate that schwa insertion is indeed an alternative to consonant cluster simplification in both of the dialects of French we considered.

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