

# SOCIOPHONETICS OF PHONOTACTIC PHENOMENA IN FRENCH

Sandrine Brognaux<sup>1</sup>, Mathieu Avanzi<sup>2</sup>

<sup>1</sup>CENTAL and ICTEAM - Université catholique de Louvain, TCTS Lab - Université de Mons, Belgium

<sup>2</sup>Phonetics Laboratory, Department of Theoretical and Applied Linguistics, University of Cambridge, U.K.  
[sandrine.brognaux@uclouvain.be](mailto:sandrine.brognaux@uclouvain.be), [ma674@cam.ac.uk](mailto:ma674@cam.ac.uk)

## ABSTRACT

The aim of this paper is to shed new light on the behaviour of 5 phonotactic phenomena in French, which have been shown to be rather sensitive to regional and/or stylistic variation: schwa deletion at the initial of polysyllabic words and in monosyllabic grammatical words, liaison, deletion of final post-obstruent /l/ and /R/ and of /l/ in the 3<sup>rd</sup> personal clitic subject pronoun ‘il’. The analysis is performed on a 13-hour speech corpus, labelled at different levels and including productions of 120 speakers originated from 3 French-speaking countries (Belgium, France and Switzerland) and recorded in two different tasks (reading and conversation). Beside the regional and stylistic variables, parameters such as speakers’ age and socioeconomic status are also taken into account. The results of the analysis show that the 5 phenomena are mostly dependent on the speaking style, but that the effects of the other variables is less relevant than expected.

**Keywords:** schwa elision, liaison, liquid deletion, regional variation, stylistic variation, corpus, French.

## 1. INTRODUCTION

This paper deals with 5 phonotactic phenomena in French: schwa deletion in monosyllabic grammatical words (such as in *j(e) pense*) and at the initial syllable of polysyllabic words (such as in *il lui a d(e)mandé*); optional liaison, *i.e.* the phenomenon whereby a latent final consonant in a word (Word-1) may or may not be pronounced as the onset of a following vowel-initial word (Word-2), such as in *ils vont-(t)-au cinéma*; deletion of /l/ and /R/ in word-final obstruent-liquid clusters, such as in *pénib(le)* or in the singular personal clitic subject pronouns, such as in *i(l) va*. The modalities of appearance of these phenomena have been challenging issues for decades in the French phonological field, because the reasons that motivate their behavior (realization or deletion) are multiple and related to different levels of the linguistic analysis, as well as to extra-linguistic factors. All these phenomena have been claimed to behave similarly regarding speaking style, and speakers’ socio-economic status. Formal speaking situations (such as reading) would favor a

more controlled speech, and, consequently, a higher rate of liaisons and of realized schwas and liquids in the contexts mentioned above (for studies on the effect of speaking style on schwa, see [1], for liaison see [2], for liquid deletion see [3]). Speakers with a lower socioeconomic status would tend to realize fewer schwas [4], less liaisons [5] and allow in a greater extent liquids deletion [6]. As for the region of origin of the speaker, studies indicate that it would play a role on the behavior of only schwa and liquid deletion. As it has been shown in a wealth of previous studies [7], Swiss French tends to realize fewer schwas in initial position than the speakers from other French-speaking areas of Europe. Regarding liquid deletions, they have been said to be more common in Belgium than in France according to [8]. Liaison realization rate has not been claimed to vary according to the variety of French [9]. Finally, factors such as age have also been discussed regarding their role on liaison [10], schwa [11][12] and liquid deletion [13].

In our opinion, the drawback of existing studies dealing with phonotactic phenomena variation in French is that they rarely consider all these variables simultaneously. Besides, they usually rely on manually-annotated low-size corpora, tailored for a specific analysis, which prevents from analyzing possible interactions between the various phenomena and diverse extra-linguistic factors. This precludes the possibility of grasping whether these phenomena are influenced by the same factors in the system of a given speaker. In this context, this study aims at shedding new light on phonotactic phenomena in French, by testing simultaneously the role of 4 sociolinguistic factors (speaking style, speakers’ age, socioeconomic status and origin) on the behaviour of the five aforementioned phonotactic phenomena. It has the advantage of relying on a very large corpus of more than 13 hours, balanced in terms of speaking style, region of origin and sex. The analysis relies on both manual and automatic annotation, based on a strategy making use of natural language processing (NLP) techniques.

## 2. MATERIAL

Our corpus consists in a subpart of the material recorded within the Phonologie du Français Contemporain framework [14]. It includes 15 regional varieties of French, recorded in 3 different countries of Europe: 5 varieties spoken in the Northern part of metropolitan France (Béthune, Brécey, Lyon, Paris and Ogéviller); 5 varieties spoken in Switzerland (Fribourg, Geneva, Martigny, Neuchâtel and Nyon) and 5 varieties spoken in Belgium (Brussels, Gembloux, Liège, Marche-en-Famenne and Tournai). For each of the 15 locales, 4 female and 4 male speakers were selected; they were born and raised in the city in which they were recorded. Participants were broadly categorised as belonging to the working class (WC) or a higher class (HC) according to whether their occupation was manual or non-manual [15]. We are conscious that the factors that may determine socioeconomic class are numerous, but we followed [13] and [16] by considering that occupation is a good indicator of social class. As for the age of the speakers, it ranges from 19 to 82 years, and is controlled for each of the 15 groups. Each of the 120 speakers was recorded in a reading text task (the text is 398 words-long) and in semi-directed sociolinguistic interviews, in which the informant had minimal interaction with the interviewer. The entire reading text and a stretch of 3 minutes of spontaneous speech for each speaker were orthographically transcribed and automatically aligned within Praat [17] with the EasyAlign script, which provides a 3-layer annotation in phones, syllables and words (see [18] for a detailed description of the tool; and [19] for the implementation of the syllabification rules). The phonetic transcription and its alignment were manually verified and corrected when necessary by inspecting both spectrogram and waveforms (e.g. boundary adjustments, segments deletion or addition especially in the case of schwas, liaisons and liquid consonants). The orthographic transcription was then annotated in part-of-speech (PoS) tags using the DisMo software [20]. A dedicated tier (“delivery”) was manually added, in order to identify overlapping speech and short non-audible or unusable segments (e.g. due to the presence of external noises in the recording). In total, the corpus is more than 13 hours long, and includes approximately 123k tokens.

## 3. ANALYSIS

### 3.1. Phenomena extraction

Automatic scripts, relying on natural language processing (NLP) techniques allowed for the

extraction of the different sites studied in this research.

In order to extract all the sites of potential schwa deletion, the orthographic transcription of the entire dataset was exploited to automatically produce a phonetic transcription with the eLite tool [21] relying on the BruLex French phonetic dictionary [22]. Regarding phonological variants, BruLex adopted a specific strategy which consists in selecting the form which is considered as the most frequent in isolated presentation. For the schwa variation, the adopted representation always includes the schwa. The main advantage of using NLP-produced phonetization is that it allows for an easy comparison of the pronunciation of the corpus with a so-called ‘standard’ pronunciation, which should correspond to neutral read speech. For comparison purposes, this transcription was automatically aligned with the genuine phonetic transcription as pronounced by the speaker, using a slightly modified version of Levenshtein’s edit distance [23] (see Figure 1).

**Figure 1:** Automatic alignment of NLP and real phonetization of a sentence.

	Je	pense	pas	que	c'	était	prévu
Elite	Z @	p a~ s	p a	k @	s	e t E	p R e v y
Corpus	Z /	p a~ s	p a	k /	s	e t E	p R e v y

All monosyllabic function words (i.e. *ce, de, je, le, me, ne, que, se* and *te*) and polysyllabic words containing an initial schwa in their standard pronunciation were extracted. Based on the automatic alignment, elision phenomena were automatically identified.

For liaisons, an automatic script considered the orthographic and phonetic transcription of the corpus. Potential liaisons sites were defined as words ending in a latent consonant /t,n,z,R,p/, i.e. ending in a {t,d,n,s,x,r,p} consonant, and followed by a vowel, a {h} or a semi-vowel. The latent status of the final consonant was determined on the basis of a phonetic dictionary look-up relying on an enriched version of BruLex containing all derived and inflexed forms [24]. For rare cases for which two pronunciations were proposed (i.e. with or without the final consonant) such as the word ‘plus’, a manual check was performed. For all other cases, the realization of the liaison was automatically determined by analyzing the last pronounced phoneme of the word in the corpus. All sites were then manually checked, and liaisons were categorized by one of the authors as obligatory, optional or forbidden, based on [2] and [25] previous works, relying on the PoS annotation.

As for deletion of /l/ and /R/ in word-final obstruent-liquid clusters, they were automatically extracted from the orthographic transcription. Their phonetic transcription was analyzed to assess the pronunciation of their final liquid. The singular personal clitic subject pronoun “il” (meaning “he” or “it”), was also analyzed, in terms of pronunciation of the liquid. The plural form was here not considered due to its very low frequency in the reading task.

Note that all items in context of disfluency were not taken into account in the analysis.

### 3.2. Statistics

Due to the nature of the dependent variable (presence or absence of a given phenomenon), data were analysed by means of Generalized Estimated Equations with repeated measures [26]. Participants were entered as random variables, and speaking style (read vs conversational speech), speakers’ age, speakers’ regional origin (Belgium, France, Switzerland), speakers’ socioeconomic level (WC vs HC) and all the double interactions were entered as independent variables in the model. For conciseness matters, only the significant effects are mentioned in the report of the results. Bonferroni corrections were applied when examining pairwise comparisons between levels of a given predictor.

## 4. RESULTS

### 4.1. Schwas in initial polysyllabic word position

In total, 2427 sites of initial schwas in polysyllabic words were extracted from the corpus. The analysis revealed that only the speaking style has a significant effect on the realization of schwa in this position (Wald  $\chi^2$  (2) = 54.009,  $p < .001$ ): in conversational speech, initial schwas are maintained in 45.3% of the cases of the cases, against 98.52% of the cases in read speech.

### 4.1. Schwas in monosyllabic grammatical words

In total, 11537 sites of schwas in monosyllabic grammatical words were extracted from the corpus. The analysis revealed that the speaking style plays a significant role on the presence of schwa in this position (Wald  $\chi^2$  (2) = 418.173,  $p < .001$ ): in conversational speech, the vowel is maintained in 48.23% of the cases of the cases, while it is maintained in 94.76% of the cases in read speech. An effect of age was also found (Wald  $\chi^2$  (1) = 22.390,  $p < .001$ ): the older the speaker, the more schwas are realized in this context.

### 3.3. Liaison

In total, 5705 sites of potential liaison were extracted from the database. Table 1 shows their distribution. The nature of the consonant was included in the model as an independent variable. The results revealed an effect of category of liaison (Wald  $\chi^2$  (1) = 1151.502,  $p < .001$ ), i.e. the fact that a liaison is obligatory, facultative or forbidden. The three categories differ significantly from each other ( $< 0.001$ ). Results also indicate an influence of the nature of the consonant (Wald  $\chi^2$  (4) = 131.946,  $p < .001$ ): liaisons occur more often when the latent consonant at the end of the first word is a /z/ or a /n/ rather than when it ends with /t/. /R/ and /p/ are the least preferred consonants for liaison. Finally an effect of age was also found (Wald  $\chi^2$  (1) = 3.692,  $p < .05$ ): it reveals that the older the speaker, the more liaisons tend to be realized.

**Table 1:** Distribution of the liaisons in the corpus, according to the category of liaison (OBLigatory, FACultative and FORbidden) and the nature of the consonant. On the left, the total number of sites, on the right, the % of realized liaisons.

	OBL		FAC		FOR	
/n/	714	<b>98.45</b>	24	<b>62.5</b>	413	<b>0.72</b>
/p/	0	-	8	<b>12.5</b>	2	<b>0</b>
/R/	0	-	194	<b>3.6</b>	24	<b>0</b>
/t/	35	<b>94.28</b>	1169	<b>49.35</b>	465	<b>3.42</b>
/z/	1230	<b>97.31</b>	905	<b>28.28</b>	522	<b>2.49</b>
<b>total</b>	<b>1979</b>	<b>97.67</b>	<b>2300</b>	<b>37.21</b>	<b>1426</b>	<b>2.247</b>

### 3.4. Post-obstruent /l/ and /R/ in word-final obstruent-liquid clusters

In total, 2622 words ending with a post-obstruent /l/ and /R/ in word-final obstruent-liquid clusters were extracted from the corpus. Table 2 reveals their distribution. The nature of the element on the right side of the liquid (consonant [C], vowel [V] or pause [#]) was included as an independent variable. Results first revealed an effect of context (Wald  $\chi^2$  (2) = 86.072,  $p < .001$ ): the liquid is more often maintained before V and # than before C. An effect of style was also found (Wald  $\chi^2$  (1) = 143.409,  $p < .001$ ): in conversational speech, the liquid is maintained in only 53.22% of the cases, while it is maintained in 87.84% of the cases in read speech. Finally, an effect of variety was found (Wald  $\chi^2$  (2) = 6.994,  $p < .05$ ): French speakers (72.78%) maintain the liquid in a smaller proportion than Swiss speakers (81.96%), while Belgian speakers do not differ from both of them (75.69%).

**Table 2:** Distribution of words ending with a post-obstruent /l/ and /R/ in the corpus, according to the

segment to the right of the cluster (followed by a consonant, C; vowel, V, or pause, #).

	+C	+V	+#
L/R deleted	460	64	84
L/R maintained	1025	419	570
<b>% maintained</b>	<b>69.02</b>	<b>86.74</b>	<b>87.15</b>

#### 4.5. /l/ in 3<sup>rd</sup> personal clitic subjects pronouns

In total, 982 “il” were extracted from the database. It appeared that the liquid was always realized before a vowel. Conversely, it was deleted in front of a consonant in 240 cases, against 254 cases of /l/ realization in that context. In the analysis, only the cases for which “il” is followed by a consonant were considered (N=494). The statistical analysis revealed only a significant effect of style (Wald  $\chi^2$  (1) = 174.584,  $p < .001$ ): in conversational speech, the liquid is maintained in only 5.76% of the cases, against 96.15% of the cases in read speech

## 5. DISCUSSION

The results we obtained can be summarized as follows. First, the deletion rate we observe for schwas in polysyllabic words and monosyllabic grammatical words is very similar in the two contexts (slightly more than 45% in conversation, around 95% and more in reading). As for conversation, the rate is comparable to [11]’s calculations for Parisian speech and [8]’s calculations for Belgian speech, but slightly higher than what was found by [7] for Swiss speech. The fact that no effect of origin was found might be a consequence of the heterogeneity of the speakers’ origin within the country. As it has been shown for Switzerland, speakers behave differently depending on the canton they are originated [7]. The fact that we observe an effect of age on schwa distribution in grammatical words might be due to the articulation rate: it has indeed been shown that older speakers articulate slower than younger speakers [27]. Further work should include this parameter in the analysis. As regards liaison, our results confirm what has been shown in many previous studies (see [2], [9] and references therein): liaison is more frequent with /z/, /n/ and in a lesser extent /t/ than /R/ and /p/. The rate of realized facultative liaison is close to the one reported in the literature ([2][9]). As for the effect of age, it also confirms results of previous studies [10], and can be explained by the fact that older speakers are more conservative than younger speakers. The fact that age does not interact with the category of liaison (i.e. obligatory, facultative or forbidden) does not claim in favour of the hypothesis that the contexts of liaison tend to disappear. On the other

hand, more surprisingly, no effect of speaking style was found on the liaison distribution. This might indicate that the differences between read speech and conversational speech are not that different regarding liaison realization, after all. An even more formal situation would be necessary to assess that speaking style does not have any effect on liaison realization. With respect to liquid deletion, the comparison between different varieties of French has never been done: this study brings empirical evidence to the fact that the non-realization of liquids in word-final obstruent-liquid clusters varies according to the origin of the speakers, Swiss speakers being more conservative than Hexagonal speakers. Finally, none of our variables appeared to be affected by the speakers’ socioeconomic status. This may be due to the fact that the categories we created (WC vs HC) are not clearly differentiated enough, and that a better sampling of the speakers regarding this criterion is needed to examine the effect of this variable.

## 6. CONCLUSION

The aim of this paper was to shed new light on the impact of 4 sociological variables (speaking style, speaker’s age, socioeconomic status and geographic origin) on the behaviour of 5 phonotactic phenomena, which have been said to be very sensitive to variation. This study relied on a large corpus of 13-hours, containing 120 speakers of various regional and sociological origin and age, and containing both read and spontaneous speech. The whole corpus was manually annotated and enriched in terms of phonotactic annotation by automatic annotation tools. Results have shown an important effect of speaking style on schwa distribution at the initial of polysyllabic words and in grammatical items, as well as on liquid deletion in word-final obstruent-liquid and in 3<sup>rd</sup> personal clitic subjects pronouns. Only an effect of age was found on liaison distribution. Interestingly, an effect of variety was also observed on deletion of /l/ and /R/ in word-final obstruent-liquid clusters. Future work should include other predictors such as articulation rate, phonemic context, position within the host prosodic unit, etc. (for an influence of these factors on schwa realization, see [28]).

## 8. ACKNOWLEDGMENTS

Sandrine Brognaux is supported by the “Fonds National de la Recherche Scientifique” (FNRS). Mathieu Avanzi’s work was financed by the Swiss National Science Foundation (SNF grant Advanced Postdoc.Mobility n°P300P1-147781).

## 7. REFERENCES

- [1] Lucci, V. 1983. *Etude phonétique du français contemporain à travers la variation situationnelle*. Grenoble: Publications de l'Université de Grenoble.
- [2] Durand, J., & Lyche, C. 2008. French liaison in the light of corpus data. *Journal of French Language Studies*, 18, 33-66.
- [3] Brognaux, S., Picart, B., & Drugman, T. 2014. Speech synthesis in various communicative situations: Impact of pronunciation variations. *Proc. Interspeech* Singapore, 1524-1528.
- [4] Léon, P. 1992. *Phonétisme et prononciation du français*. Paris: Nathan.
- [5] Encrevé, P. 1988. *La liaison avec et sans enchaînement : phonologie tridimensionnelle et usage du français*. Paris: Seuil.
- [6] Armstrong, N. 1996. Variable deletion of French /l/: Linguistic, social and stylistic factors. *Journal of French Language Studies* 6, 1-22.
- [7] Racine, I., & Andreassen, H. 2012. A phonological study of a Swiss French variety: Data from the canton of Neuchâtel. In: R. Gess, C. Lyche, & T. Meisenburg (eds), *Phonological Variation in French: Illustrations from Three Continents*. Amsterdam: John Benjamins, 173-207.
- [8] Hambye, P., & Simon, A. C. 2012. The variation of pronunciation in Belgian French: from segmental phonology to prosody. In: R. Gess, C. Lyche, & T. Meisenburg (eds), *Phonological Variation in French: Illustrations from Three Continents*. Amsterdam: John Benjamins, 129-149.
- [9] Durand, J., Laks, B., Calderone, B., & Tchobanov, A. 2011. Que savons-nous de la liaison aujourd'hui ? *Langue Française* 169, 103-135.
- [10] Aschby, W. (1981). French liaison as a sociolinguistic phenomenon. In W. W. Cressey & D. J. Napoli (Eds.), *Linguistic Symposium on Romance Languages*. Washington (D.C.): Georgetown University Press, 46-57.
- [11] Hansen, A. B. 1994. Etude du E caduc - stabilisation en cours et variations lexicales. *Journal of French Language Studies* 4, 25-54.
- [12] Hansen, A. B. 2000. Le E caduc interconsonantique en tant que variable sociolinguistique. Une enquête en région parisienne. *Linx* 42/1, 45-58.
- [13] Boughton, Z. 2014. Social class, cluster simplification and following context: Sociolinguistic variation in word-final post-obstruent liquid deletion in French. *Journal of French Language Studies*, 1-21.
- [14] Durand, J., Laks, B., & Lyche, C. 2009. *Phonologie, variation et accents du français*. Paris: Hermes.
- [15] Chambers, J. K., & Trudgill, P. 1998. *Dialectology*. Cambridge: Cambridge University Press.
- [16] Chambers, J. K. 2009. *Sociolinguistic Theory: Linguistic Variation and its Social Significance*. Oxford: Wiley-Blackwell.
- [17] Boersma, P., & Weenink, D. 2015. Praat Version 5.3. Retrieved from <http://www.fon.hum.uva.nl/praat/>
- [18] Goldman, J.-P. 2011. EasyAlign: an Automatic Phonetic Alignment Tool under Praat. *Proc. Interspeech* Firenze, 3233-3236.
- [19] Goslin, J., Content, A., Goldman, J.-P., & Frauenfelder, U. 1999. *Syllable boundary placement in French. Man and machine. A comparison*. Proc. JEL Nantes.
- [20] Christodoulides, G., Avanzi, M., & Goldman, J.-P. 2014. DisMo: A Morphosyntactic, Disfluency and Multi-Word Unit Annotator. An Evaluation on a Corpus of French Spontaneous and Read Speech. *Proc. LREC* Rejkjavic, 3902-3907.
- [21] Roekhaut, S., Brognaux, S., Beaufort, R., & Dutoit, T. 2014. eLite-HTS: a NLP tool for French HMM-based speech synthesis. *Proc. Interspeech* Singapore, 2136-2137.
- [22] Content, A., Mousty, P., & Radeau, M. 1990. BRULEX. Une base de données lexicales informatisée pour le français écrit et parlé. *L'année Psychologique* 90, 551-566.
- [23] Brognaux, S., & Drugman, T. 2014. *Phonetic variations: Impact of the communicative situation*. Proc. *Speech Prosody* Dublin, 428-432.
- [24] Pagel, V., Lenzo, K., & Black, A. 1998. *Letter to sound rules for accented lexicon compression*. Proc. 5<sup>th</sup> ICSP Pittsburgh, 2115-2120.
- [25] Delattre, P. 1947. La liaison en français. Tendances et classifications. *The French Review* 122, 148-157.
- [26] Ghisletta, P., & Spini, D. 2004. An Introduction to Generalized Estimating Equations and an Application to Assess Selectivity Effects in a Longitudinal Study on Very Old Individuals. *Journal of Educational and Behavioral Statistics* 294, 421-437.
- [27] Schwab, S., & Avanzi, M. 2015. Regional Variation and Articulation Rate in French. *Journal of Phonetics* 48, 96-105.
- [28] Bürki, A., Ernestus, M., Gendrot, C., Fougeron, C., & Frauenfelder, U. 2011. What affects the presence versus absence of schwa and its duration: a corpus analysis of French connected speech. *Journal of Acoustical Society of America* 130, 3980-3991.