

**Final devoicing in the “pool of variation”:  
A large-scale corpora approach with automatic alignment**

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**Research problem.** “Final devoicing” (FD) is the process whereby (contrastively) voiced consonants are devoiced in domain-final position (ex. rus. *Youtu[p]*). It is cross-linguistically well attested both as a phonological rule and as a sound change, progressing from larger to smaller domains (phrase to word) [1]. If “sound change is drawn from a pool of synchronic variation” [2], we should then be able to find FD as a variant in languages where it has not been phonologised. The goal of this paper is to investigate this hypothesis in Standard French. French has a voice contrast for obstruents which is maintained in word-final position (e.g. *cage* [kaʒ] “cage” vs. *cache* [kaʃ] “hides”). FD has been reported in French as a regional variant, especially in northern and eastern varieties, in small scale studies of conversational and read speech [3-4]. The present study aims at enlarging the scope of the investigation by quantifying FD in large corpora of Standard French. In this paper we focus on fricatives, which are less likely than stops to undergo contextual variation in general and FD in particular [5-6], and more specifically on /z/, /ʒ/ and their voiceless counterparts /s/ and /ʃ/. /z/ and /ʒ/ have been reported to be respectively the most and least variable fricative with respect to laryngeal feature variation in word-final position in French [7].

**Data.** Two manually transcribed corpora were used: ESTER [8], containing 80 hours of semi-prepared speech (radio broadcast news), and the Nijmegen Corpus of Casual French (NCCFr) [9], comprised of 31 hours of face-to-face conversations between friends. These corpora allow us to investigate FD across two different speech styles and several hours of speech.

**Methodology.** The data was segmented using an automatic speech recognition (ASR) system in forced alignment mode with pronunciation variants [10]. The fricative-final words were extracted, representing 7 330 tokens for /z/, 4 484 for /ʒ/, 20 150 for /s/ and 3 000 for /ʃ/ in ESTER, and 1 738 for /z/, 1 037 for /ʒ/, 4 964 for /s/ and 738 for /ʃ/ in NCCFr. The ASR system selected for each fricative among the canonical or (de)voiced variant; for instance /z/ was tagged either [z] or [s]. These data were sorted in 5 classes depending on the following context: whether the next word begins with a voiceless obstruent, voiced obstruent, sonorant, vowel, or if the fricative-final word is followed by a pause (breath or silence).

**Results.** The results are summarised in Figure 1 and Table 1 below. Two tendencies emerge. The first is laryngeal assimilation: before obstruents, the laryngeal feature of the word-final fricative is sensitive to the laryngeal feature of the following consonant (*mobilise pour* => *mobilis* [s]). This tendency is seen for both the voiced fricatives (with a devoicing rate of 66% before voiceless obstruents) and the voiceless ones (voiced in 58% of the cases). These results therefore confirm earlier studies on laryngeal assimilation in French, found in laboratory experiments [6] and in large-scale corpora investigations [7]. The second tendency is FD: /z/ and /ʒ/ are devoiced 24% of the time before a pause, compared to 8% before a vowel and 9% before a sonorant. We can therefore report the presence of FD in Standard French, both in controlled and uncontrolled speech, at a preliminary stage (not in all word-final positions but only before pause). There is no equivalent for /s/ and /ʃ/ (which are voiced 6% of the time before sonorant, 8% before vowel and 6% before pause): as expected from both the typology and the phonetics, there is no “final voicing” in variation in French. The FD effect is reinforced in spontaneous speech: 31% of the final fricatives are devoiced in NCCFr against 22% in ESTER. Finally, we find no effect of place of articulation: in ESTER the devoicing rate for /z/ is 22% vs. 21% for /ʒ/; in NCCFr it is 32% for /z/ vs. 28% for /ʒ/ (not significant). These results

are preliminary; before June 2019 we plan to manually check a representative sample of the data to evaluate the accuracy of the automatic segmentation and refine the statistical analyses accordingly.

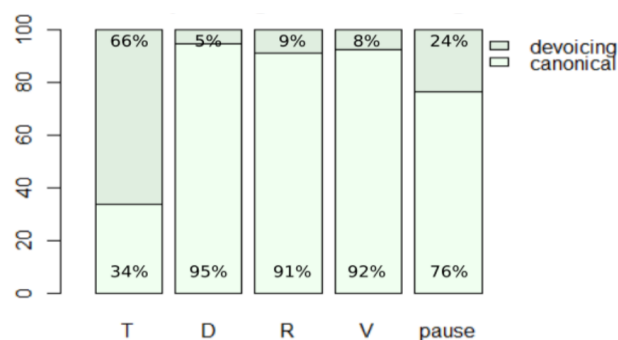


Fig. 1. Voicing and devoicing of word-final /z/ and /z/ (%) in ESTER and NCCFr as a function of the following context. T = voiceless obstruent; D = voiced obstruent; R = sonorant; V = vowel.

		Voiceless obstruent	Voiced obstruent	Sonorant	Vowel	Pause	Sum
ESTER	Canonical	876	3 057	1 392	3 170	970	9 465
	Devoiced	1 601	137	102	237	272	2 349
	Sum	2 477	3 194	1494	3 407	1242	11 814
	Canonical %	35	96	93	93	78	80
	Devoiced %	65	4	7	7	22	20
NCCFr	Canonical	275	426	273	662	211	1 847
	Devoiced	649	49	59	78	93	928
	Sum	924	475	332	740	304	2 775
	Canonical %	30	90	82	89	69	67
	Devoiced %	70	10	18	11	31	33

Table 1. Number of occurrences of devoiced /z/ + /z/ across following contexts and corpora.

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