

PHONETIC AND SOCIOPHONETIC CONDITIONING OF VOICING PATTERNS IN THE STOP CONSONANTS OF FRENCH.

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ABSTRACT

This paper presents a study of variability in the realisation of voicing timing in phonologically voiced (European) French stop consonants. Data derived from an acoustic analysis of recordings of read speech by male and female speakers from northeastern and southwestern France are compared. The results reveal sex-specific patterning consistent with findings elsewhere that female speakers tend to devoice more than males. The regional patterning of devoicing is, however, unexpected in the light of its historical distribution, and interactions between the independent variables of region and speaker-sex are explored. In the interpretation of the results attention is also drawn to the paradoxes inherent in the desirable goal of trying to marry experimental phonetic and variationist insights and methodology.

1. INTRODUCTION

This paper presents a subset of data from a study of patterns of devoicing in French stop consonants [1]. These data compare male and female speakers from Lille in northeastern France, and Bordeaux in the south west in the light of evidence from the literature which is presented in section 2.

2. VARIABLE VOICING IN FRENCH

There is evidence to suggest that female speakers of some languages tend to devoice stops more frequently than male speakers [2,3,4,5]. It has been suggested [2] that this may be due to aerodynamic constraints: since females have smaller vocal tracts, then all other things being equal, transglottal pressure will be equalised more quickly in female speakers, which predisposes them to more frequent cessation of vocal-fold vibration. However, the subjects in [3,4] were pre-pubescent children whose vocal tracts would not be sufficiently different for the physiological-aerodynamic explanation to hold in their case. Moreover, it has long been evident that speakers have a variety of mechanisms under their control to sustain vocal-fold vibration, for example passive and active enlargement of the vocal tract [6,7,8,9], and that this allows the maintenance of voicing for periods longer than could be expected from simple calculations of vocal tract volume.

Given the degree of control exercisable by speakers over voicing, it is reasonable to expect that voicing could function as a sociolinguistic variable. French initial (phonologically) voiced stops are phonetically prevoiced, so it is possible that in French devoicing could occur here as well as in other positions. It is well-known that non-standard voicing patterns have been characteristic of certain regional varieties of French, notably in eastern and northeastern France as a result of the influence of patterns in neighbouring Germanic dialects [5, 10]. Devoicing is not normally given as a feature of southern varieties of French. Goudailler comments [3] that the devoicing of phonologically voiced stops by his child subjects is only permissible because they are northern speakers who have at their disposal cues to the voicing contrast which are not available to southerners. As well

as regional variation, there is evidence of socially-stratified voicing patterns in French, notably in Roubaix, in northeastern France, where it was found to be a feature of the speech of older, poorly educated speakers, particularly women [5].

When data from the linguistic atlas of France [11] were subjected to statistical analysis [1], they confirmed the dominance of eastern and northeastern France as areas where devoicing was common at the beginning of the twentieth century, but showed that it also occurred to a lesser extent all over northern France, as well as in a limited number of southern areas. The data also frequently revealed a significant tendency for female informants, particularly in northern areas, to devoice more than males¹.

3. METHODOLOGY

Two sets of speakers were recorded, one from Lille (eight male speakers and ten females), where devoicing, particularly of final consonants has historically been a feature of the regional variety of French, and the other from Bordeaux (five male speakers and seven females) where this is not the case. All speakers were in middle-class occupations, and were aged between 23 and 42. The methodology used was designed to elicit naturalistic data. The speakers were all middle class and were selected as "friends of friends". They were recorded onto DAT either in homes or at their place of work. A prolonged interview/ conversation was recorded, during the course of which they read a short text chosen to yield voiced stops in a range of contexts. At the end of the session, they read a series of sentences designed for the same purpose.

The data were transferred onto a Macintosh computer and durational measures were taken using the waveform and spectral displays in Signalyze[12]. The present paper reports results for word-initial and word-final stops in the read data only, which were extrapolated from the waveform measurements: tokens with any break in prevoicing were counted as devoiced. These extrapolated data were analysed using Goldvarb [13], a multivariate analysis package designed to handle uneven data sets, as the numbers of tokens in some of the cells were small.

4. RESULTS

4.1 Distribution of word-initial stops

Figure 1 shows percentages of word-initial stops fully voiced and devoiced for male and female speakers in the two regions, across place of articulation. The figure shows that there is devoicing at all places of articulation, but that the patterning varies across speaker groups. There is evidently more devoicing by female speakers than by males, but this again varies across region and place of articulation: only Lille female speakers devoice at all places of articulation; Bordeaux females do not devoice any word-initial /b/, but devoice /d/ at about the same rate as the Lille females, and devoice a far higher proportion of /g/. Bordeaux males, on the other hand, never devoice word-initially,² whereas

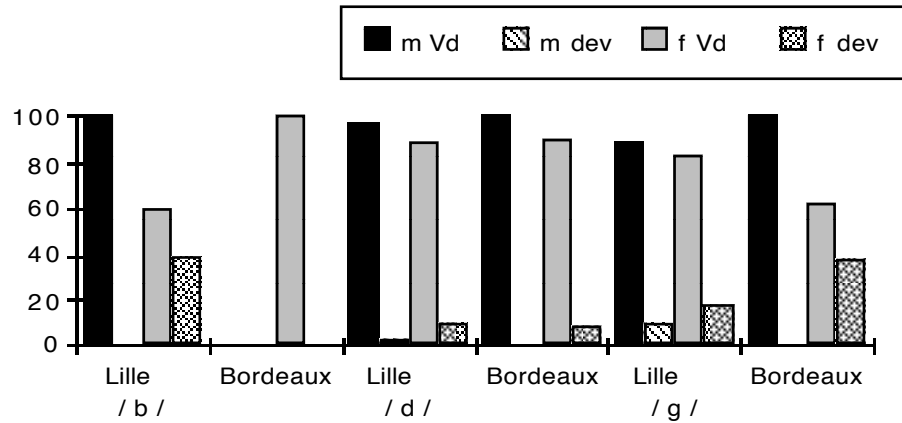


Figure 1. Percentages of tokens devoiced in word-initial /b/, /d/ and /g/.

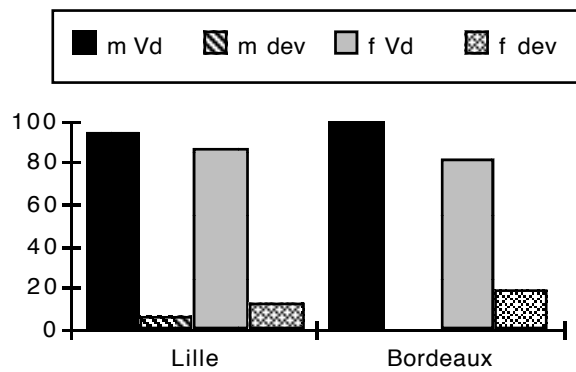


Figure 2. Percentages of tokens devoiced pooled across word-initial /b,d,g/.

the Lille males devoice small proportions of /d/ and /g/ but not /b/. In each case, female speakers devoice more than males, but the regional effect is less clear, with Lille females devoicing more than Bordeaux females in /b/ and marginally more in /d/, but Bordeaux females devoicing considerably more /g/. In fact,

when the data are pooled across place of articulation, as shown in Figure 2, the Bordeaux females are seen to produce marginally more devoicing overall. Figure 2 also confirms the clear sex-specific trend.

4.2 Distribution of word-final stops

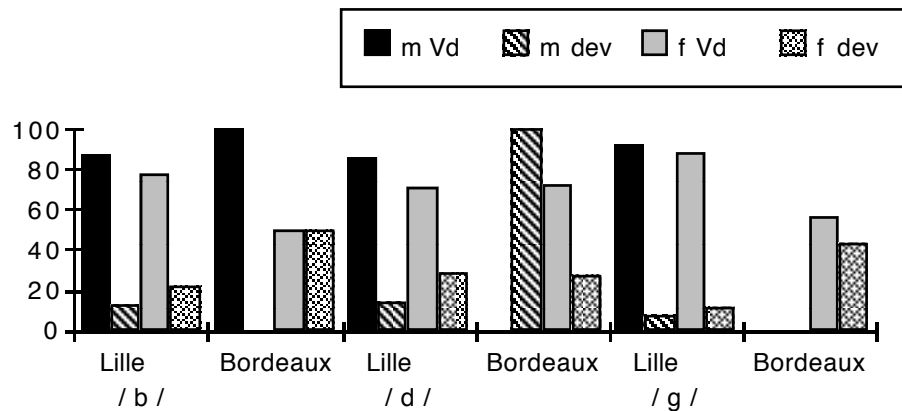


Figure 3. Percentages of tokens devoiced in word-final /b/, /d/ and /g/.

Figure 3 shows percentages of word-final stops fully voiced and devoiced across place of articulation. Again there is devoicing at all places of articulation, but the patterning across speaker groups is more consistent than in the case of the initial stops. Female speakers consistently devoice more frequently than males in either region, except apparently for the Bordeaux /d/ tokens. However, the 100% devoicing rate for Bordeaux males can be discounted as anomalous, since there is only a single token. Whereas Lille males devoice more than Bordeaux males in /b/, the regional effect is reversed for the female speakers, with Bordeaux female speakers devoicing more frequently than the Lille females. They also devoice more /g/, and the rate is the same in /d/ (27% and 29%). This is not the distribution which would have been expected from historical patterns of word-final voicing observed for the respective regions. The pooled data shown in Figure 4 (from which data for the Bordeaux males has been excluded) shows similar overall trends to those in Figure 2, but with a greater difference between the two groups of females, and a smaller difference between the Lille males and Lille females.

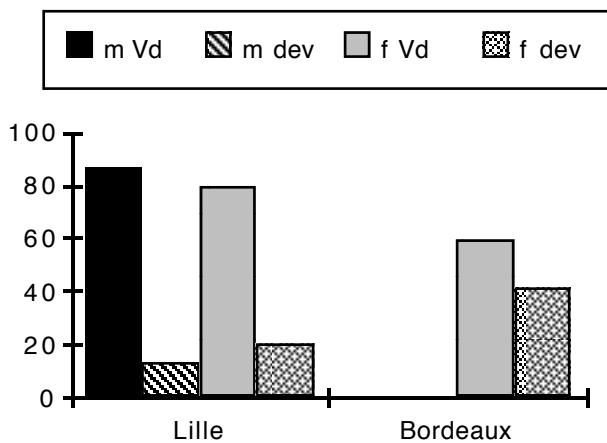


Figure 4. Percentages of tokens devoiced pooled across word-final /b,d,g/.

4.3 Statistical analysis.

The statistical significance of the results for both the word-initial and word-final stops was tested using Goldvarb, which performs binomial Varbrul (multivariate) analysis to test the significance of competing independent variables in accounting for the patterning of variation in the dependent variable. Table 1 shows results from two separate binomial analyses of the data described in the previous two sections. The dependent variable is stop voicing, and the independent variables are place of articulation, speaker sex and region. The application value is full voicing, so in the two rightmost columns, a factor weighting closer to 1 indicates that the factor in question favours full voicing relative to the other factors in the group, and a factor weighting closer to zero indicates that the factor favours devoicing. Starred factor weightings indicate that the factor group was selected as significant in the binomial run, that is it plays a significant role in accounting for the patterns of variation in the data. The figures in square brackets after each set of weighting scores give the range

of variability for that factor group: the greater the range, the greater the significance of the group in accounting for the data.

Factor Group	Factor	Word-initial	Word-final
		Input: .913	Input: .786
SEX	male	.689*	.570
	female	.386* [.30]	.461 [.10]
REGION	Lille	.510	.566*
	Bord.	.467 [.04]	.276* [.29]
PLACE	/b/	.396*	.474
	/d/	.596*	.472
	/g/	.321* [.28]	.587 [.11]

Table 1. Results of binomial Goldvarb analyses for word-initial and word-final stops by speaker sex, region and place of articulation. * indicates Factor Group selected as significant.

4.3.1 Speaker sex. Speaker sex was selected as significant for word-initial stops but not for word-finals, although the direction of the effect is the same in the latter case, with females tending to favour devoicing. Separate binomial analyses were carried out for each place of articulation and for each word position as well as for the combined word positions, and without exception the tendency was the same, with females favouring devoicing.

4.3.2 Region. By contrast, region was selected as significant in word-final position but not for the word-initial stops. The results confirm the unexpected picture portrayed by the distributions, that it is in Bordeaux that devoicing is favoured more than in Lille. Again, when subsets of the data were analysed, this tendency was confirmed in all cases except for word-initial /d/.

4.3.3 Place of articulation. There is a significant place of articulation effect in the word-initial but not the word-final data. In contrast with the sociolinguistic factor groups, this one does not show consistency across the data sets, and when they are pooled (see 4.3.4) it is, unsurprisingly, not selected as significant.

4.3.4 Position in word. A further binomial analysis was run on the pooled word-initial and word-final data, testing position in the word against the three other factors. Position was selected as significant, with final position favouring devoicing (Factor weights: final, .345; initial, .560).

5. DISCUSSION

The results presented above are particularly interesting in the context of historical patterns of voicing in French. There is no reflection of the high rates of word-final devoicing observed in the *Atlas linguistique de la France* [11], a tendency already apparent in [5], where the age-grading found in the data showed clear indication of change in progress towards the elimination of the non-prestige, devoiced variant. Consistent with this, the present data show that although there is still some devoicing by

Lille speakers, this is no more than might be expected in any other region of France.

The sex-specific effects appear, however, to run contrary to Pooley's findings: they are of roughly the same order as those of his older (45+) speakers. In his data, the difference between the sexes is reversed in both the age-groups below 45yrs. This is particularly surprising given that the present speakers are from "middle class" backgrounds, and it might therefore be expected that they would more advanced in terms of the spread of a linguistic "change from above" [14] towards the prestige variety than Pooley's mainly working class subjects. It is possible, in the light of this, to speculate that his younger female subjects were hypercorrecting.

There are thus interesting sociolinguistic issues raised by the findings presented in this paper, but findings such as the significant /d/ > /b/ >/g/ place-of-articulation effect in word-initial position, for which there is no obvious explanation, are more important for the questions they raise than for what they in themselves might be able to reveal about constraints on devoicing (which is, in effect, not a great deal). A number of the questions could be incorporated at some level into a study of this type, which counts the incidence of voice-breaks; for example, the influence of the preceding and following segmental context, the influence of prosodic structure, or the role of lexical conditioning. But others (arguably the most interesting) require detailed phonetic study. The definition of devoicing used here is somewhat crude; obvious detailed issues to investigate would include the timing relationship between glottal and supraglottal gestures, articulatory and acoustic comparisons with phonologically voiceless stops, as well as the precise articulatory effects of the other independent variables cited.

Even the sociophonetic effects cannot be fully explained without more detailed experimental analysis: it may be the case, for example, that physiological differences between male and female speakers do predispose female speakers to devoice more frequently; possibly, then, the higher rates of devoicing by Bordeaux females than by Lille females is because in Bordeaux, female speakers are not compensating for a natural tendency to devoice, whereas in Lille, where devoicing has historically been a sociolinguistically stigmatised variant, they are compensating to avoid it. One can speculate on this, but not draw firm conclusions without taking a number of articulatory factors into account, such as precise vocal-tract volumes, compliance of the vocal tract walls, glottal configuration, airflow rate. The problem that then arises is that these and other related factors cannot be investigated without using invasive techniques for measuring them. In addition to the undesirability of the latter from the point of view of the sociolinguist (whose aim is to access the speech produced by the speaker when s/he is paying the least attention to it), these techniques are also likely to hinder the phonetician's attempts to discover what is happening when devoicing occurs because by their nature they introduce additional variables and hinder, to varying degrees, the articulation of "natural" stop tokens.

6. CONCLUSIONS

The data analysed in this paper are consistent with findings in the literature that female speakers tend to devoice stops more than males. They also clearly indicate that the at least in the main city in the northeasternmost *département* of France, devoicing, and particularly final devoicing, is no longer a prominent characteristic of the local variety of French. There is an

indication of interaction between devoicing as a regional variant and as a sex-specific one, in the partial confirmation of Pooley's evidence of a reduction over time in male-female differences in the area in this respect.

There are serious methodological conflicts involved in trying to find a satisfactory phonetic account of these findings, but this should not deter phoneticians from continuing to seek ways to take on board the methodological and theoretical implications of sociolinguistic studies; nor should it deter sociolinguists from incorporating more detailed, and sometimes better informed insights from experimental phonetics, and indeed phonology, into their analyses.

NOTES

1. "Devoicing" is here used as a term of convenience: it is impossible to know what the underlying system of these informants was.
2. N.B. numbers of tokens for Bordeaux male speakers were very small.

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