SOUND CHANGE AND ARTICULATORY RELEASE: WHERE AND WHY ARE HIGH VOWELS DEVOICED IN PARISIAN FRENCH ?

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ABSTRACT

It has been claimed that in Parisian French high and mid front vowels in utterance-final open syllables are often devoiced and pronounced with a fricative-like noise. We investigated this phenomenon in spontaneous and read speech samples recorded from three generations of Parisian French speakers. Acoustic measurements indicate that the majority of vowels in read speech samples are at least partially devoiced, and show noise between 2-4 kHz. Devoicing and closure occur only in vowels that are in Intonation Phrase final position, and carry a low IP boundary tone. Male speakers in conversation showed the least devoicing. In reading and in conversation, 61 to 87 year-old speakers devoiced the target vowels as often as younger speakers did. We interpret the devoicing and closure of the vowel as the effect of an increased articulatory release before pause.

1. INTRODUCTION

It is in the nature of phonetic changes to remain largely unnoticed by native speakers. However, foreign learners of the language often notice and unconsciously reproduce such phenomena. One of the most noticeable characteristics of present-day Parisian French pronunciation for American students is a fricative-like noise at the end of sentences such as in (1):

(1) Merci_ch. Oui_ch. Allez_ch!

Fónagy [4], a non-native speaker of French himself, observed that high-front vowels [i], [y], mid vowels [e], [oe] and the high-back vowel [u] at the end of utterances before pause tend to get devoiced and sound similar to the voiceless palatal fricative [ç]. He called the phenomenon *devoicing of final vowels*.

In this paper we will show in what prosodic positions, age groups and sex this phenomenon is most likely to occur in conversation and in reading of a short text. We will investigate the amount of devoicing within the vowel, and the co-occurrence of devoicing and fricative closure. Finally we will suggest an articulatory phonetic explanation.

2. CORPUS

Ten Parisian French speakers were recorded reading a text, and carrying out an informal dinner conversation with their friends and one of the authors. The speakers were divided into three age groups: (1) first generation: one male and one female speaker of 61-85 years, (2) second generation: two male and two female speakers of 55-60 years, (3) third generation: three female and one male speakers of 16-35 years.

The text read by the speakers contained six target words of one to three syllables, ending on the vowel [y]: *vu*, *lu*, *vaincu*, *venu*, *entendu*, *devenu*. Within the utterance these past participles were placed in three different prosodic positions: Accentual Phrase (AP) final, Intonation Phrase (IP) final with an expected H% tone, and IP-final with an expected L% tone [1, 2]. The utterances were connected in a meaningful text shown in (2). The speakers were presented with the text in two paragraphs without special characters.

(2)
Nous avons tous *entendu* parler de l'empereur Jules César, et certains d'entre nous ont **lu**, **entendu** ou *vu* mentionner la célèbre phrase qu'il avait prononcée lors de sa *venue* à Rome: **venu**, **vu**, VAINCU. Je suis sure que tu l'as déjà ENTENDUE. Ou tu l'as peut-être LUE. J'ai *lu* cette histoire dans un recueil de phrases célèbres. D'autres ne l'ont peut-être jamais VUE.

Ce que cette phrase est **devenue** est tout à fait exemplaire. Elle est *devenue* un symbole suggérant, par la simplicité de sa syntaxe, la facilité avec laquelle César a *vaincu* ses adversaires. Elle exprime désormais que l'on a non seulement **vaincu**, mais que l'on n'a rencontré aucune opposition. Cette phrase honore la détermination de César et de sa VENUE. Il a voulu devenir empereur, et il l'est bel et bien DEVENU.

For better readability, AP-final target words here appear in italic, IP-final words with H% in bold, and IP-final words with L% in upper case.

With the exception of three speakers who read the text on the telephone, speakers in both speech situations were recorded with a clip-on microphone and a Marantz tape recorder in Paris. All speakers were volunteers, and gave the authors permission to record their speech.

3. CONVERSATION

3. 1. The end of main discourse units

Approximately 5 hours of conversation (a half an hour with each speaker) were transcribed and perceptually tagged for pitch movements and intonation phrase boundaries, following Jun and Fougeron's model [1, 2]). Words ending on [i], [y], [u], [e], [oe] and the semi-vowel [ɥ] were marked as belonging to one of the following four prosodic positions: AP-medial, AP-final, IP-final with H% tone, and IP-final with L% tone. Words in AP-medial positions corresponded to non-content words (*les*, *ses*, *tu*, *et*, *mais*... etc.). For criteria of segmentation into APs and IPs, see [2]. Occurrences of these vowels in the corpus were computed based on the age and the sex of the speaker, as well as the prosodic position of the word.

Despite the large number of high and mid vowels in the corpus, only a few of them showed devoicing with fricative

noise in each conversation. No occurrences were observed in AP-medial, AP-final or IP-final H% positions. Table 1 shows cases recorded in IP-final position. The frequency of devoicing in this position varied greatly between the speakers. Some speakers devoiced six times more often than others, but no more than 6.1% of all high or mid vowels observed in IP-final position were devoiced at all.

All cases of devoicing with fricative noise occurred at the end of turns (3) or at the end of main logico-semantic units within a turn (4). (Words with devoiced final vowel appear in bold). The most frequently devoiced vowels were the high vowels [i] in 80%, [y] in 8% and [u] in 2% of all cases. The vowel [e] and the semi-vowel appeared respectively in 5% of all cases. We did not find occurrences of devoicing and fricative closure with the mid vowel [oe] or [ø].

(3) PC: ..... de tout l'esprit américain c(e) qui est génial (L%) # (il) faut lire ces ces trucs-là hein (H%) # Toqueville i(l) faut le lire (L%) # tu t(e) régal(e)ra (L%) # c'est vrai hein (H%)
MTV: Ben j(e) sais pas moi (L%) # j(e) l'ai jamais **lu_ch** (L%)
PC: T'en a jamais lu (H%)

(4) PC: Et alors euh # en fait c(e) qui est idiot (H%) # c'est que c'est un poste qui qui intéresse vachement ceux qui vivent à **Paris_ch** (L%) # Parce que en une heure et d(e)mie de bagnole t(u) y es quoi (L%)

As for the age of the speaker, we did not observe important differences between the three generations. Individual variations between the speakers seemed more important than age. In conversation, the oldest female speaker, AM, devoiced high vowels as often as youngest female speakers (CM, SB) did. One of the women in the parents' generation (MTV) devoiced these vowels as often as some of the younger speakers did, while the other female speaker's speech (MND) showed fewer occurrences. Gender seems to have more influence: male speakers in all three generations rarely devoiced any of the target vowels. Inferential statistics were not drawn at this point of our study, since more speakers per group are needed to assess the importance of these variables.

	vowels devoiced / total number of vowels **IP-final position with L%**			
Speakers (age) - sex	dinner conversation with a group of friends	% of devoicing	reading of a short text	% of devoicing
first generation				
GM (62) - M	1/59	1.7	5/6	83
AM (87) - F	4/66	6.1	5/6	83
second generation				
MTV (57) - F	3/49	6.1	3/6	50
MND (55) - F	2/58	3.5	2/6	33
PC (56) - M	2/58	3.4	2/6	33
JCC (58) - M	1/73	1.4	1/6	11
third generation				
CM (35) - F	5/85	5.9	4/6	66
JPR (34) - M	1/77	1.3	2/6	33
LP (16) - F	4/69	5.8	2/6	33
SB (26) - F	3/55	5.4	5/6	83

Table 1. Devoicing and/or fricative closures in conversation and reading.

4. READING

4.1. IP-final position and low boundary tone

In reading—as in conversation—vowels were devoiced and followed by a fricative closure only when they were in IP-final position, carrying a low IP boundary tone. However, we observed much more cases of devoicing in reading than in conversation. We interpret this difference by the nature of the two speech situations. Reading of a short text corresponds to a read-aloud monologue situation. Small group conversations, however, are characterized by fast turn-taking and few opportunities to speak in full, elaborated sentences. Thus, in speech samples were unfinished sentences, self-corrections and interruptions are dominant, we could not find a great number of target vowels in paragraph or turn-final prosodic positions.

Despite the larger number of devoicing in reading, out of the six target words placed in IP-final L% position only three showed systematic (≥50%) devoicing and closure: *devenu* (90%), *lu* (60%) and *vaincu* (50%). These words were not only in IP-final, but also in "paragraph-final" position. Paragraphs in texts, just like turns in conversation, are considered macro-prosodic constituents larger than the Intonation Phrase, and characterized by various prosodic features (see [5, 6, 8]).

The two older speakers devoiced five out of six target words in IP-final L% position, more than almost anyone (with the exception of the 26 year-old female speaker SB) in the younger generations. Younger speakers were less unanimous

in this respect: they show important individual variations. However, slightly less devoicing and closure can be observed in the parents' generation (8/24) than in their children's generation (13/24). First and second generation men devoiced the least frequently.

5. ACOUSTIC ANALYSIS

5.1. Measurements

All cases perceived as devoicing with fricative-like noises in read speech samples were submitted to acoustic analysis, in order to determine the degree of devoicing of each target vowel, and the extent to which devoicing and fricative closures co-occur. Because of background noise and frequent overlapping of voices, the acoustic analysis of the conversation speech samples was not considered. A total of 31 occurrences were submitted to acoustic analysis, but four occurrences recorded over the telephone were discarded because of poor acoustic quality.

The remaining 27 cases were divided into three categories: fully, partially or not devoiced. The extent of devoicing was determined as a ratio between the duration of the voiceless portion and the total length of the vowel. The duration of the vowel was measured from the onset to the offset of the formants. Absence or presence of noise was noted. Since most of the read speech samples were recorded with a clip-on microphone, we obtained good quality data on voicing. However, formant frequencies in sentence final position were sometimes wiped out. In such cases, the segmentation of the vowel was based on our perception.

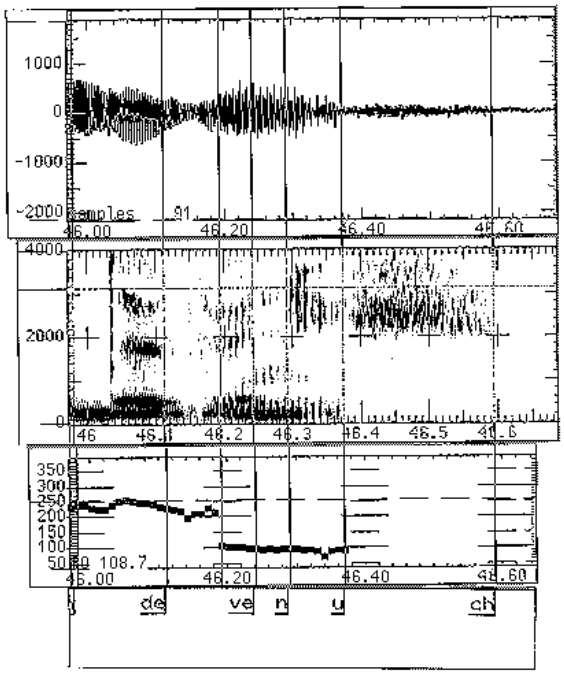

Figure 1. The vowel [y] in the word *devenu* pronounced by the female speaker CM.

5.2. Partial devoicing and closure. Figure 1 shows the vowel [y] of the word *devenu* pronounced by the female speaker CM. The word is the last word in the text, which we called the absolute paragraph-final position.

The vowel [y] is 300 ms long, but the length of the voice bar is only 78 ms. Approximately 3/4 of the vowel (ratio of devoicing 0.74/1) is devoiced. The devoiced section is characterized by an intense, fricative-like noise between 2 and 4 kHz. All but one absolute paragraph-final target words (all speakers considered) show the same structure. Strikingly, they also show similar amount of devoicing (70-75%). Non paragraph-final target words, such as *vu*, *entendu* and *venu* tend to be shorter, and have a shorter devoiced portion (average ratio of devoicing: 0.48/1).

5.3. Total devoicing and closure. The only exception to this tendency was the oldest female speaker who tends to entirely devoice the vowel [y], regardless of the position of the word within the paragraph. As shown in Figure 2, the vowel [y] in the word *entendue* is devoiced from the release of the occlusive [d], and it remains devoiced throughout the entire length (235 ms) of the vowel. The spectrogram also shows a somewhat less intense fricative noise within the vowel.

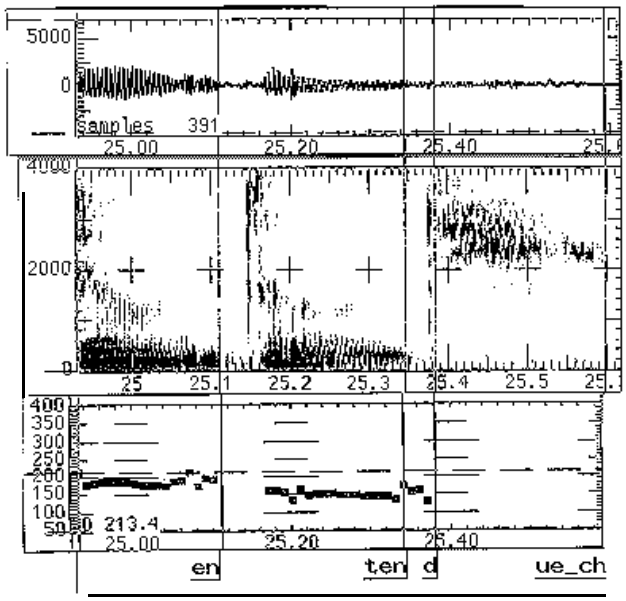

Figure 2. The vowel [y] in the word *entendue* pronounced by the female speaker AM.

We found no cases of target vowels that were all-voiced and/or followed by a fricative-like noise. The presence of F2 and F3 throughout the fricative (co-articulation, figure 1), and the absence of gap between the voiced and the voiceless portions confirms Fónagy's [4] interpretation that the devoiced vowel is"*transformed* into a voiceless palatal constrictive" (p. 247).

6. TOWARD AN ARTICULATORY EXPLANATION

6.1. More or less energy?

It is another question whether, as Fónagy claims, the phenomenon is due to an "increased tension" of the articulators.

The prosodic position of the devoiced vowels seems, at first, to contradict this hypothesis. Our data show that

devoicing and closure only occur at the end of major prosodic constituents that are in final position within the utterance, and the turn (or the paragraph). Except for cases of emphasis, these positions in general are characterized by decreased, rather than increased articulatory energy: amplitude and F0 drop, deletion of entire syllables, devoicing of stop consonants… etc. While it is not difficult to imagine how the drop of voicing in final vowels would be consistent with less articulatory effort, it is more problematic to account for the closure requiring, a priori, more energy. The tendency for the articulators to relax before pause, and the effort to hold a closure seem to contradict each other.

An explanation comes from Straka [7] and his distinction between "articulatory energy" and "articulatory tension". The first term refers to the initial set up, the second to the maintain of the articulatory position. Straka claims that vowels and consonants behave differently in strong (stressed) and weak (unstressed) positions within the word. The strong position corresponds to more, the weak position to less articulatory energy (figure 3).

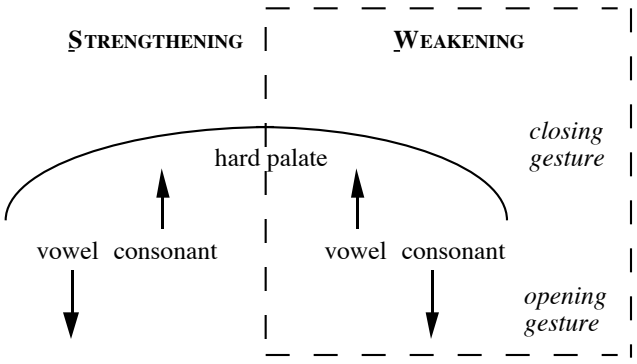

Figure 3. Vowels and consonants under the effect of articulatory energy (after Straka [7], p.79).

By applying this model to prosodic units above the word, the closure in IP-final vowels can be explained as follows. In weak positions, that are characterized by less articulatory energy, "the muscular contraction is the strongest at the set up of the articulation, but it starts diminishing before the final release of the articulation" (p. 108). As a consequence of this, consonants tend to open and vowels tends to close. To this decreasing articulatory energy corresponds an increasing tension, if the closure has to be held for longer duration. (Straka used this explanation for diphtongs.)

According to our interpretation, IP-final high vowels we observed at the end of major prosodic units undergo the same process. Throughout their articulation, the vowels gradually loose articulatory energy ("weakening"): they get devoiced and become less and less open. In the same time they also become more tense, because they undergo final lengthening at the major prosodic boundary (IP). Eventually, the closure becomes so tight that the outcoming air produces a fricative-like noise.

7. CONCLUSION

In this paper we showed that the high vowels [i], [y], [u], the semi-vowel [ɥ] and the mid front vowel [e] were devoiced only in Intonation Phrase-final open syllables, when carrying a low boundary tone. All occurrences appeared at the end of an Intonation Phrase that also corresponded to the end of a paragraph or a turn. These macro-prosodic units seem to be the chief prosodic domain involved in this phonetic change.

In read-aloud speech samples, acoustic measurements showed that the majority of the vowels were at least partially devoiced. In paragraph or turn-final positions they were considerably lengthened, and devoiced up to 75% of their total duration. Simultaneously to devoicing, a fricative-like noise appeared between 2 and 4 kHz.

Among the two sociolinguistic variables we examined, age did not seem to be an important factor. In reading, older speakers devoiced more vowels than most of the younger speakers. Their speech samples in conversation showed similar amount of devoicing and closure. Although we could only study two speakers in this age group, our results raise the question devoicing of high vowels is—as studies claim—a new, on-going phonetic change, or an already established, widespread phonetic feature of Parisian French pronunciation. Sex seemed to be a greater divider between the speakers: men produced less devoicing and closure in conversation than women did. The tendency was less clear in reading.

After Straka [7], we interpreted the devoicing and closure of high and mid front vowels as the simultaneous effect of decreasing articulatory energy and increasing articulatory tension before pause. The first leads to the drop of voicing and the closure of the vowel, the second to the emergence of a fricative-like noise.

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