

A Case of Foreign Accent Syndrome: an Acoustic Description for a French-Speaking Subject

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Abstract

The aim of this study is to describe acoustic-phonetic productions of a Quebec French-speaking foreign accent syndrome (FAS) subject. This syndrome is described as an acquired accent change following a stroke or a brain injury. Vowel formant frequencies, vowel durations and stop consonant VOT were analyzed with sentence-level intonation, global F0 and general characteristics of the accent. Results match other studies regarding increased variability of vowel duration and token to token formant frequencies and regarding modification of prosodic patterns. However, they cannot completely support current interpretations on whether FAS is related to apraxia of speech, is a prosodic only deficit or an overall posture of vocal tract deviancy.

1 Introduction

This study presents an acoustic-phonetic description of a Quebec French-speaking subject with foreign accent syndrome (FAS). This syndrome is an acquired speech disorder in which the speaker's accent is perceived as foreign by acquaintances and by the subject himself [14]. It generally follows stroke or brain injury, affecting the speech output motor system. Also, the acquired accent should differ from the original accent of the speaker, who should not be used to speak the foreign language.

Even though some phonetic features found in the new accent lead listeners to identify a source language or region, the acquired accent shares only a few characteristics with the real foreign accent [4]:

many accents having those characteristics may thus be associated with the FAS subject's accent [1]. For example, the accent of a FAS British English subject could be identified as one of a Scottish, Irish or a German speaker [4].

Many common phonetic features have been found in FAS subjects, such as modification of vowel lengthening and tensing, increase of average F0, modification of rhythmic patterns (syllable timing and stress assignment) and atypical intonation curve in some cases. Consonant production relating to manner, place and voicing would also be modified, but to a lesser extent than for vowels (except for [6]). Nevertheless, determining the underlying mechanism responsible for FAS is still difficult, first of all because of the rareness of patients (only single-case studies may be conducted, even if an effort of comparison using the same corpus among case studies is in progress [9]). FAS would originate either from a segmental and prosodic deficit [3, 8, 10] or a prosodic-only deficit [1, 2, 7], the changes observed on the segmental level being a direct consequence of suprasegmental modifications of speech. FAS is considered by some authors as a mild form or a subtype of apraxia of speech [10] whereas some others claim that it is a syndrome by itself: the main difference between this syndrome and related speech disorders (aphasia, dysarthria and apraxia of speech) would be that the speaker's productions are not regarded as being pathological by listeners [2]. Modifications in the subject's production are observed, but these exist within the range of natural languages possibilities.

Most of the studies dealing with phonetic aspects of FAS were carried out with stress-timed languages,

most of the time with English-speaking subjects. In English, the place of the word stress affects vowel quality. The prosodic structure is different in French, where stress usually falls on the last syllable of a prosodic unit. This study is, to our knowledge, the first acoustic/phonetic one conducted with a subject speaking a fixed-stress language.

2 Method

2.1 Speakers

The foreign accent syndrome subject (FG) is a 75 year-old man, who has Quebec French as his first language. A neuropsychological and language evaluation as well as neuroimaging results are available in [11].

He suddenly presented with a FAS in January 2003. Because of the focal deficit seen on the brain imaging, involving the left insular and anterior temporal cortex, two brain regions frequently involved in aphasic syndrome but also in FAS, a cerebrovascular origin was considered the best explanation to account for FG's language deficits. His acquired accent is generally considered Acadian (i.e. of the French-speaking people from the easternmost Canadian provinces). FG also reported that his accent was sometimes identified as European French, British or Scottish by people he met. Although we do not have, unfortunately, any recording of his prior accent, the spontaneous appearance of the foreign characteristics was confirmed by one of his close relation. For the sake of comparison, two control male speakers were included. They are native Quebec French speakers, age-matched and they do not show any speech or hearing disorder.

2.2 Recordings and analysis

The FG and control subjects corpus was obtained from a French adaptation of stimuli developed by [1], also used in other acoustic-phonetic studies conducted with FAS subjects [7, 8, 9]. The first part of the corpus provides data for vowel duration and formant frequencies. The ten French oral vowels were included in non-word, embedded in a carrier phrase, e.g., '*V comme pVpa*' ('*V as in pVpa*'). The second part, devised to collect data for voice onset

time, comprises non-words containing initial stops /p, t, k, b, d, g/ followed by /a/, inserted in a carrier phrase, e.g., '*C'est /Ca/ que je dis.*' ('*It's /Ca/ that I say*'). All tokens were randomly presented in written form on a computer screen and were repeated ten times each. Fundamental frequency and pitch contours analysis were based on the recording of a text-reading task. Subjects were requested to read a text called *La bise et le soleil*, commonly used in French phonetic experiments. All recordings were made in a quiet room, using a high quality digital recorder.

Finally, a prior recording obtained during a consultation with the second author has been added for the FAS subject corpus. This recording included, inter alia, spontaneous speech, reading, counting and signing tasks.

3 Results

3.1 Descriptive characteristics of the FAS speaker

Transcriptions show that two characteristics of the Quebec French variety are missing in the subject's speech: tense vowels becoming lax in closed syllables, and [t] or [d] becoming [t^s] or [d^z] before high front vowels [5]. These two characteristics do not appear in Acadian French. This may, in part, contribute to the perception of a foreign accent. When he has to read isolated words, FG's stress assignment is not consistent. In French, the last syllable of a prosodic unit usually bears the accent; FG puts stress sometimes on the penultimate syllable, [dis'tɾaksjõ] instead of [distɾa'ksjõ] for example. It does not seem to happen in spontaneous speech. As already reported, his speech rate is slow, but not enough to be considered pathological.

3.2 Vowel analysis

For acoustic analysis, the vowels comprised between stop consonants were considered. Figure 2 is a plot of the F1/F2 distribution for FG (dashed line) compared to the average value of both control speakers (plain line). Even though all vowel productions have been considered to be intelligible by the transcriber, acoustic analysis of vowels shows that the FG's vowels are more opened and slightly

more fronted than controls, especially for high and mid vowels. This suggests that even though vowels are produced with a restricted F1 range, contrary to [1, 8], formant frequency values suggest that vowels are produced with a more open vocal tract position.

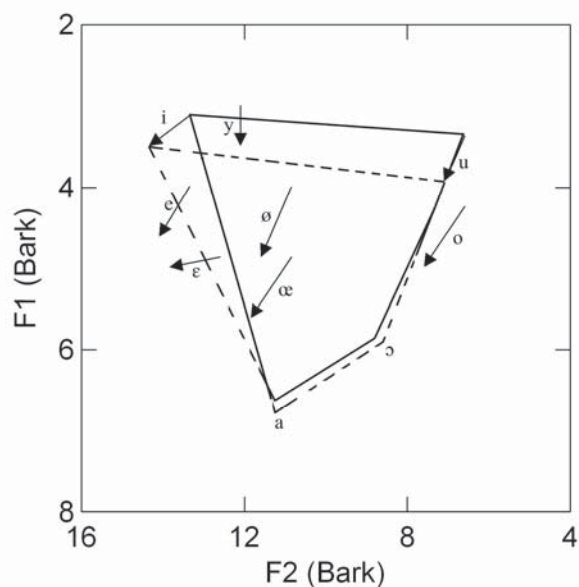


Figure 1: Mean formant frequency for FG (arrowhead) and for controls (beginning of arrow).

Vowel dispersion is also higher in FG's productions. Table 1 lists mean values of F1 and F2 for controls and FG. A higher variability is also observed in F2 in comparison with F1 values, maybe because F1 range is already restricted. Control of FG's articulatory/acoustic targets seems not as accurate as that of controls.

Table 1: Mean dispersion in F1 and F2

	F1 (Hz)	F2 (Hz)
Control 1	13	27
Control 2	16	33
FG	30	81

Table 2 presents mean vowel durations and standard deviation for pVp vowels. Overall vowel length is more than twice higher for FG in similar speaking conditions. However, as mentioned before, this does not lead to a perception of a pathological speech. Moreover, these results may be explained in part by the fact that FG was very careful in accentuating each /Ca/ syllable.

Vowel duration is also more variable for FG, as are formant frequency values. These results have already been observed in other subjects [8, 12], but not in all studies [7].

Table 2: Mean vowel duration for /pVp/

	duration (ms)	SD
Control 1	71	5
Control 2	66	9
FG	185	36

3.3 VOT analysis

French voiced stops have a negative-lag VOT while voiceless stops have a short-lag one. As shown in table 3, FG consonant production keeps these VOT values, suggesting a normal control of voiced/voiceless opposition. These results are consistent with control data and with [1, 7, 8] regarding voicing contrast.

Table 3: VOT values for labial, velar and stop consonants.

	voiceless	voiced
labial	19	-73
alveolar	19	-60
velar	50	-53

3.4 Analysis of suprasegmentals

Mean F0 across read sentences is higher for FG (140 Hz) compared to controls (116 Hz and 119 Hz), though this value is classically considered to be in the normal range for male voices. FG reported to have always had this high-pitch voice. Pitch range, even if slightly restricted, is consistent with control values.

Global intonation patterns show that pitch contours fall abruptly at the end of many prosodic units. Inappropriate terminal contours were already observed in [1].

4 Discussion and conclusion

Acoustic analysis of speech produced by a subject with foreign accent syndrome has been conducted. The most striking characteristics of his speech were the absence of lax vowels and affrication, two features that are descriptive of French from the

Quebec variety. These two characteristics, [ɪ] becoming [i] or [tʰ] becoming [t], can be viewed as a consequence of vocal tract tensing, an interpretation already provided by some authors to explain phonetic characteristics of FAS [8, 12]. This could also be supported by the subject's high vowel durations and mean fundamental frequency, even if, as previously mentioned, these parameters may not be a direct consequence of the syndrome. However, formant frequency values do not support this explanation, showing a centralization of vowel space in F1 and suggesting more open vocal tract configurations.

FAS is sometimes classified as a mild form or a subtype of apraxia of speech, high token to token variation suggesting a deficit of motor control programming. Even if, with regard to vowel duration and dispersion and with regard to inaccurate stress assignments or intonation patterns, a higher than controls variation is observed, stop VOT values show an accurate control of tongue-glottis coordination, matching patterns of the subject's specific language.

The variability of observations between studied subject and the rareness of available patients for study make difficult any generalization. A deeper analysis of prosodic patterns in various speaking styles would allow understanding whether the disappearance of regional characteristics observed in FG speech is a consequence of a simplification of segmental system, ruled or not by modifications of prosodic system, or a consequence of another motor control deficit.

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