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DO FRENCH-SPEAKING LEARNERS SIMPLY OMIT THE ENGLISH /h/?

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ABSTRACT

It is commonly considered that French-speaking learners of English tend to drop /h/. In such cases, a hard vowel onset is often observed, suggesting the presence of a glottal stop preceding the vowel, whereas [h] is characterised by an open glottis.

First, a set of recordings of the nursery rhyme “Humpty Dumpty” pronounced by 37 French students was acoustically analysed. The H2/H1 ratio (relative amplitude of the first two harmonics) at the onset of the first vowel in words beginning with /h/ was measured as an indication of voice quality. A comparison between cases where [h] was present and where it was not indicated that out of the 14 students who dropped /h/ at least once, 11 showed a higher H2/H1 ratio on average when /h/ was not pronounced, as expected.

Second, glottal opening measurements were conducted on 9 test words beginning with /h/ or null consonant pronounced by a native speaker of French, using ePGG (external lighting and sensing photo-glottography). The results suggest more clearly than the H2/H1 ratio data that the glottis is closed when /h/ is dropped.

A comparison of the two data sets shows the advantage of articulatory measurements such as ePGG when acoustic data alone do not provide sufficiently clear information on certain articulatory phenomena such as glottal aperture.

Keywords: English /h/, French-speaking learners, H2/H1 ratio, glottal aperture, ePGG

1. INTRODUCTION

It is widely observed and described in the literature that native French speakers learning English as a foreign or second language tend to omit the English /h/. Most descriptions imply that /h/ is simply not intended by the speaker ([9], among others). But is /h/ simply omitted, or are there some other articulatory gestures involved instead of the articulation of [h]? The present study will focus on glottal opening patterns to examine the phenomenon.

2. BACKGROUND

2.1. Articulation of the consonant [h]

The consonant [h] is classified as a voiceless glottal fricative in the IPA chart. However, according to Ladefoged [8], “most forms of [h] have very little friction at the glottis”. He then goes on to state, “the vocal cords are apart and any turbulent airflow that there might be is due to what Pike [11] calls ‘cavity friction’ rather than local friction at a particular point. [h] has no more friction at the glottis than [f] or any other voiceless sound with a comparable airflow. [...] [h] is best described as the voiceless approximant without any particular place of articulation. It has been defined as the voiceless counterpart of the following sound”. The articulation of [h] is thus characterised by i) a constriction in the vocal tract corresponding to the following sound, and ii) an open glottis. The latter point is reflected in the distinctive feature representation of the glottal state of consonants proposed by Halle and Stevens [3]: /h/ is characterised by [+ spread glottis].

In English, /h/ may occur word-initially as in *heat* and *hair/hare*, as opposed to *eat* and *air* (these monosyllabic words with a vocalic onset may be accompanied by a glottal stop [ʔ], as Wells [15] notes, or by glottalisation, but not necessarily, unlike German). It may appear intervocalically before a stressed vowel as in *ahead*, *to hear*, and in that case, it is sometimes realised as a voiced glottal fricative [ɦ], “more accurately described as comprising a range of breathy-voiced vocoids” [15]. However, in English /h/ is never found in word-final position.

2.2. H-dropping observed in native speakers’ production

In the two varieties of English that are generally considered as “reference” pronunciations, namely, Received Pronunciation (RP), or Southern Standard British English (SBE), on the one hand,

and General American (GA), on the other, /h/ has a full phonemic status in their consonant inventories in spite of its limited distribution.

However, in some varieties of English spoken by native speakers, /h/ may be omitted in any lexical item [15], [5]. According to Wells [15], h-dropping in this sense is an innovation started in London. Then it has “spread from London to Norwich and then from Norwich to other East Anglian towns, while the Norfolk countryside remains /h/-pronouncing”. H-dropping is also observed in some other English-speaking communities outside of England. [5], [15]

Another important factor concerning h-dropping is the socio-economic variation. It has been shown that h-dropping and the social scale are closely related [12], [10], [14]. H-dropping is commonly associated with the working-class population, along with other pronunciation characteristics of Cockney, such as diphthong shift, /t/ glottaling, and /l/ vocalisation. With the exception of Newfoundland, h-dropping is therefore usually considered stigmatising.

Considering this sociolinguistic factor, h-dropping is usually not recommended to non-native speakers learning English as a foreign language, even though it is observed in the speech of some native speakers.

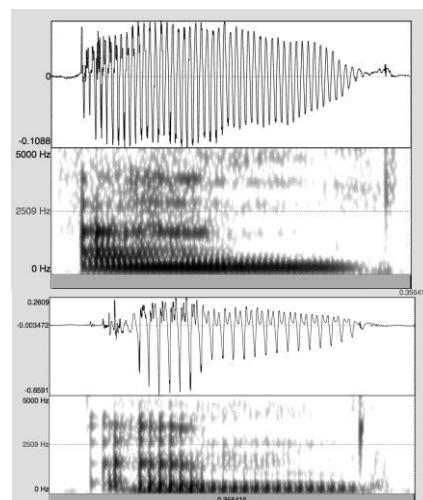
What, then, happens when French-speaking learners of English drop /h/? Three methods were used to approach this issue: spectrographic analysis, H2/H1 ratio (relative amplitude of the first two harmonics), and glottal aperture measurement using ePGG (external lighting and sensing photo-glottography).

3. H-DROPPING BY FRENCH-SPEAKING LEARNERS OF ENGLISH: SPECTROGRAPHIC ANALYSIS

First, spectrograms representing cases of h-dropping by French-speaking learners were examined. The nursery rhyme “Humpty Dumpty” was recited by 37 first-year English-major university students studying in a French university in the Parisian region as part of the task required in a mid-term oral examination. The production of the students was recorded through a headset microphone at 16 kHz, 16 bits on a digital recorder. The presence or absence of [h] was determined auditorily and visually (on oscillogram and spectrogram). Out of the 37 students, 14 of them dropped /h/ at least once in ‘Humpty’ /hʌmpti/

(appearing 3 times), ‘had’ /hæd/ (as a lexical verb; once), ‘horses’ (once) /hɔːsɪz/. Fig. 1 shows examples of h-dropping in the word ‘Humpty’: a hard vowel onset (top) and irregular pitch periods (bottom) are observed in these cases, which suggest that the glottis is closed before the articulation of the vowel.

Figure 1: Oscillogram and spectrogram (Praat [1]; window length is 5 milliseconds) of the beginning of the word ‘Humpty’ (/hʌmp/) pronounced by two French-speaking learners without the onset [h].



4. SPECTRAL ANALYSIS: H2/H1 RATIO

Second, a further acoustic analysis was conducted. Ladefoged [7] suggested a continuum of phonation types, defined in terms of glottal aperture, ranging from voiceless (most open) to glottal closure (most closed). Based on the assumption that the glottal aperture during the consonant influences the voice quality at the onset of the following vowel, the H2/H1 ratio was measured as an indication of voice quality [6] at the onset of the vowel after the target /h/.

4.1. Methods

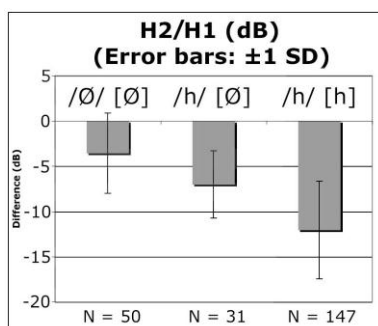
The same set of recordings used in the previous study was used for this analysis. The first 30 milliseconds of the first vowel in the words ‘Humpty’, ‘had’, ‘horses’, as well as ‘all’ /ɔːl/ (appearing 2 times) were spectrally analysed. Then the H2/H1 ratio was measured using Praat [1].

4.2. Results

The results obtained in this experiment are illustrated in Figure 2. Out of 185 occurrences of target /h/, a null phonetic realisation was observed in 31 cases (along with 147 cases of [h] as well as

other realisations such as liaison with the preceding consonant). The mean values of 4 different cases (2 different phonemic targets – null consonant / $\emptyset$ / and /h/– x 2 different acoustic realisations – [$\emptyset$] and [h]–, “/h/ [$\emptyset$]” being the case of h-dropping) were calculated. Out of the 14 students who dropped /h/ at least once, 11 showed a higher H2/H1 ratio on average when they dropped /h/ than when they did not. Although not statistically significant due to the high intra-speaker variability, there was a clear trend toward a higher ratio in the cases of h-dropping.

Figure 2: H2/H1 ratio represented in terms of difference in intensity (dB) and classified by the target phoneme (null consonant / $\emptyset$ / or /h/) and the acoustic realisation (null consonant [$\emptyset$] or [h]).



5. ARTICULATORY MEASUREMENT ON THE GLOTTAL APERTURE

In a third step, a pilot experiment of glottal aperture measurements was conducted using ePGG. The external lighting and sensing photoglottography (ePGG) was developed by K. Honda and S. Maeda [4], [13]. This non-invasive technique makes it possible to monitor glottal aperture by placing a light source on the surface of the side neck to illuminate the hypopharynx. The glottal aperture is measured in terms of the intensity of the light that is detected, after passing through the glottis, by a high-sensitivity photo-sensor unit placed on the front neck.

5.1. Methods

The corpus used in the experiment included 7 test words beginning with either /h/ or a vowel onset ('heed' /hi:d/, 'had' /hæd/, 'hot' /hɒt/, 'who'd' /hu:d/, 'eat' /i:t/, 'add' /æd/, 'odd' /ɒd/), 2 others including /h/ word-medially ('ahead' /ə'hed/, 'behind' /br'hænd/) as well as distractors ('sat' /sæt/, 'pool' /pu:l/, 'top' /tɒp/, 'keep' /ki:p/). They were read 3 times in the carrier sentence "I say _____ eight times".

Three types of data sets were recorded simultaneously on Astro-Med Dash8 multi-channel recorder (sampled at 20 kHz) in a recording studio: 1) audio signal; 2) ePGG; 3) oral airflow.

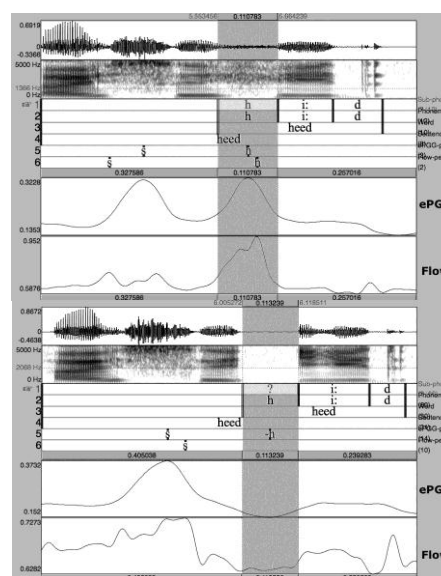
One female native speaker of French, who did not participate in the acoustic study reported above, read the list of carrier sentences 3 times. A dummy sentence was added at the end of the list so that all carrier sentences would be read with similar rhythmic and prosodic patterns.

The ePGG and airflow signals recorded were lowpass-filtered digitally (passband at 30 Hz, stopband at 100 Hz) in order to eliminate glottal pulses and other high-frequency components.

5.2. Results

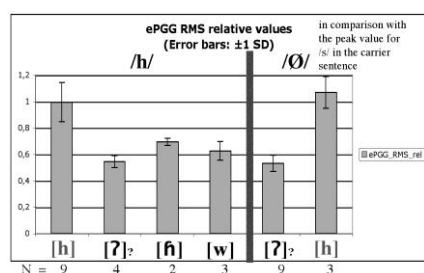
The ePGG curves thus obtained were first checked manually. In cases where [h] was pronounced, a peak was observed in the ePGG signal, just as for [s] in the word 'say' in the carrier sentence, which corresponds to a maximal glottal aperture during this consonant (Figure 3: left). On the other hand, when [h] was not pronounced, a valley was observed in the ePGG signal, which corresponds to a minimal glottal aperture (Figure 3: right). A similar tendency is found in the airflow signal as well: a peak (or several peaks) when [h] is pronounced and a valley (or several valleys) when it is not pronounced. A valley was also observed in the ePGG signal when an intervocalic /h/ was pronounced as a glottalisation between vowels.

Figure 3: Oscillogram, spectrogram, ePGG signal and airflow signal of the word 'heed' /hi:d/ pronounced with [h] (top) and without (bottom) by a native speaker of French.



In order to quantify this tendency, the root mean square (RMS) of the ePGG values was calculated for each occurrence of target /h/ and null onset in the test words. Then, it was compared with that of [s] in the word ‘say’ in the carrier sentence. Each RMS value is thus represented in terms of relative value compared to that of [s] in the carrier sentence. Figure 4 shows relative RMS values classified by the target phoneme (/h/ or null consonant) and its phonetic realisation. Regardless of the target phoneme, the relative RMS value is around 1 (i.e. similar to that of [s]) when [h] was pronounced, whereas it varies around 0.5 to 0.7 when the phonetic realisation was acoustically null or glottalisation (glottal stop [ʔ]), voiced [ɦ], and [w] (the speaker pronounced [w] in ‘who’ /hu:/, probably due to a confusion with other “wh-” words beginning with /w/). These figures indicate that the glottis was as open as in [s] when [h] was pronounced, but was closed when [h] was absent.

Figure 4: Mean RMS relative values of the ePGG signal classified by the target phoneme (/h/ or /Ø/: null consonant) and its phonetic realisation (1 native speaker of French x 9 test words x 3 repetitions = 27 tokens: ‘ahead’ was measured word-initially and medially).



A spectral analysis (H2/H1) as shown in Section 4 was also conducted on the audio data, but no relevant tendency was found for this speaker.

6. DISCUSSION AND CONCLUSION

The measurements presented in this paper show the following: 1) a hard vowel onset or irregular pitch periods are often observed at the onset of the following vowel when French speakers drop /h/ in word-initial position in English; 2) 11 out of 14 French-speaking learners who dropped /h/ showed a higher H2/H1 ratio than when they did not; 3) glottal aperture measurements using ePGG show that the glottis tends to be closed when /h/ is dropped.

The H2/H1 ratio did not present an entirely straightforward tendency due to a high degree of

inter- and intra-speaker variability. It should be noted that the formant structure of each vowel influences the amplitude of harmonics. In addition, the acoustic measurements are only an indirect indication of glottal aperture during the presence or absence of [h], since what is measured is the voice quality of the following vowel, which may evolve rapidly. Instead, the ePGG articulatory measurement of the glottal aperture has the advantage of measuring the object of investigation more directly. It should also be noted that it is a non-invasive instrumentation.

The tendencies found in the present series of experiment hint the presence of a glottal stop or glottalisation. This phenomenon may be related to the French speakers' tendency to insert a glottal stop when they need to mark an initial boundary with an empty onset, as in the case of so-called “*h-aspiré*” (e.g. la hauteur [la ʔotœʁ] “the height”, where [ʔ] is optional: [2], among others).

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