ON THE ROLE OF GLOTTAL STOP: FROM BOUNDARY MARKER TO CORRELATE OF FOCUS. A STUDY ON ITALIAN AND FRENCH

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ABSTRACT

Cross-linguistically, word-initial or word-final glottalisation is commonly used to mark prosodic boundaries. In Italian and French glottal stops can occur in the presence of boundaries or pauses, and some authors have also stated that they are common before prosodically prominent words. This latter observation suggests a link between informative prominence (linguistic focus) and glottalisation: the aim of our study is to test this hypothesis, by systematically comparing utterances produced in two situations, focus vs background.

The analysis is conducted on a corpus of task-elicited speech produced by two groups, Italian and French (15+15 speakers and 2069 observations in total). We identified the presence of word-initial and word-final glottalisation, and then counted its occurrence in two different informative contexts, focus vs. background. Our data confirmed that glottalisation is much more likely to happen when the phrase is under narrow focus, both in Italian and French.

Keywords: glottalisation, glottal stops, focus, Italian, French

1. INTRODUCTION

Glottalisation of word-initial or word-final segments has been documented as a common marker of prosodic boundaries in several languages across the world [1]. Even though glottal consonants are not part of the phonological inventory of our languages of interest, several acoustic analyses have been conducted on the presence of glottalisation and glottal stops in Romance languages as well [2,3]. In Italian, glottalisation has been observed to occur predominantly at phrase boundaries, and with target vowels bearing stress. In this sense, the phenomenon can be interpreted as a marker of constituent edges, blocking cohesion processes such as *raddoppiamento fonosintattico* and vowel coalescence [4, 5]. In French, similarly, processes like liaison or *enchaînement* reduce the likelihood of a word-initial vowel being glottalised. Nevertheless, [6] found that vowels are more frequently glottalised on boundaries of higher prosodic constituents. In addition to that, some authors have observed that vowels glottalise to a greater degree if the word is pitch-accented (see [7, 8] for English, [9] for French). Pitch accent being the most commonly cited prosodic cue for linguistic focus [10, 11], these observations seem to suggest a link between the three phenomena: focalisation, pitch accent and glottalisation. To our knowledge, though, no study has tested this hypothesis by systematically comparing the two situations, focus *vs* non-focus, and their respective co-occurrence with word-final or word-initial glottalisation, without necessarily taking the presence of pitch accents into consideration. The aim of the present study is therefore to disentangle these interactions, and answer to the following research question: is there a correlation between the occurrence of glottal stops (here also intended as non-canonical realisations, in the form of laryngealisation) and the expression of focus in Italian and French?

2. METHODOLOGY

The analysis is conducted on a corpus of task-elicited speech, containing a total of 870 utterances, produced by 15 French and 15 Italian speakers. The choice to use semi-spontaneous speech is motivated by the fact that focus is a phenomenon that strictly belongs to communicative interaction, and no real communication between speakers can take place in fully controlled speech. The lack of a precise script certainly implies a less than perfect balance between the occurrences of the target structures; despite this, the number of observations that can be made from our data corpus is largely sufficient to enable precise statistics.

2.1. Participants

Participants were 15 native speakers of Italian and 15 native speakers of French. Both groups are mixed, with a majority of female speakers. Italian speakers were recorded in the city of Turin or adjacent area, where they were raised and were currently working or studying. French speakers were recorded in Paris, and they were raised and were living in the region of Paris and Île-de-France.

Group	L1	M	F	Total	Age
FRL1	French	2	13	15	19-32
ITL1	Italian	2	13	15	22-30

Table 1: Profile of participants.

2.2 Procedures and stimuli

The task is taken from [12] and adapted to the needs of our research. Participants are shown a PPT slide containing a picture story and a caption, serving as baseline. After that, they are shown other slides containing the same picture story, accompanied by different questions, which participants are asked to answer aloud. The questions are worded as to elicit three types of focalisation: broad focus (henceforth BF), narrow identification focus (ID), narrow corrective focus (CF). BF is elicited through a broad *wh*-question of the type "What's going on here?". ID is elicited through a *wh*-question targeting each time a different syntactic constituent (subject, object, verb…), e.g. "Who's buying the newspaper?". Finally, CF is elicited through an assertive statement accompanied by a tag-question, aiming at obtaining a corrective answer, e.g. "Mary is buying a book, isn't she?". Stimuli were created in two versions; Italian speakers performed the task in Italian and French speakers in French. The recordings were conducted in a soundproof booth, with a Focusrite Scarlett interface and Shure SM58 microphones.

Figure 1: Examples of stimuli used for the task.

As already mentioned, the corpus contains non-scripted speech: this implies that the number of phonosyntactic vowel clusters (and consequently possible glottal stops) realised by each participant is not identical. On the other hand, utterances are balanced from the informative point of view: the focus type of participants' utterances is controlled through the question asked.

2.3. Identifying glottal stops

Identification of glottal stops and glottalisation is not a straightforward task; several studies have reported huge variability in their acoustic realisation. Having observed the same variation in the realisations described by [3], in this study we follow the coding of glottalisation described by [13], and take into account every realisation of glottal stop presenting at least two of these acoustic cues:

- aperiodicity;
- diplophonia;
- creak;
- silent gap (full glottal closure).

The total of identified glottal stops (henceforth GS) with this method is 376.

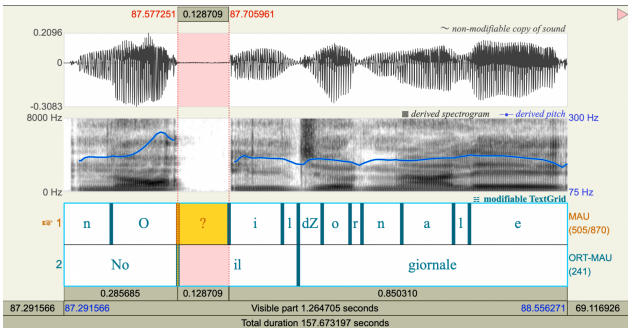

Figure 2: Example of GS between the vowels [ɔ] and [i] in the phrase "No, il giornale" ("*No*, *the newspaper*").

3. PREDICTIONS

As expected from the literature, the presence of a prosodic boundary is a relevant parameter in determining a higher occurrence of glottalisation. For this study, we predict that the informative role of the constituent phrase (focus vs background) is also a relevant parameter: in fact, glottalisation will be more likely to occur on a phrase boundary when the constituent forming the phrase is under narrow (identification or correction) focus. This hypothesised relation could be expressed in the following way:

(1) occurrence of glottal stop:
phrase level < phrase level + focus

4. ANALYSIS

The recorded corpus is composed of 890 utterances, 445 for the French group and 445 for the Italian. We

left out of this analysis 36 ill-formed utterances, namely those presenting main verb elision or internal pauses exceeding 0.2 s. Within this final set of 864 utterances, we identified a total of 2069 vowel clusters situated at possible phrase boundaries, thus potentially leading to the insertion of a GS. Starting from these potential glottalisation points, we have identified the segments where the speakers actually produced a GS. A total of 376 GS were identified and analysed. Vowels located at the beginning of the utterance were excluded from the analysis as well, because their position implied an almost systematic initial glottalisation, regardless of their prosodic position and the informative role they had in the utterance.

We will briefly show the results obtained for each group, Italian and French, and then move to a short comparison between the two languages.

4.1 Italian

The Italian dataset is made up of 434 utterances, within which 1228 vowel clusters at phrase boundaries were observed and 167 GS were detected. Out of these 167, 95 were produced in correspondence of boundaries of focussed constituents. The remaining 72 were produced at the boundaries of all other constituents of the utterance. The raw number and the proportion of GS produced by the speakers in the two contexts (focus vs. non-focus) are shown in the table and graph below.

	Non-focus	Focus
No GS	941	120
GS	72	95

Table 2: Number of occurrences of GS in the two contexts, focus vs non-focus, for the Italian group.

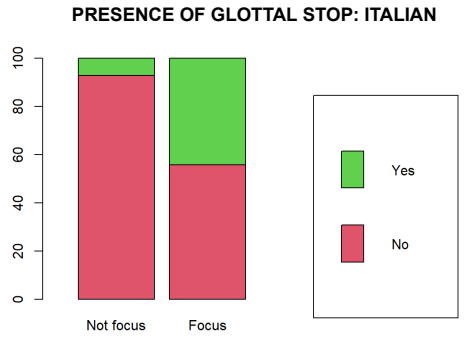

Figure 3: Proportion of occurrences of GS in the two contexts, non-focus vs focus, for the Italian group.

We performed a Pearson's Chi-squared test with Yates' continuity correction to compare the two situations, focus vs non-focus, and the resulting value is $p < 2.2e\text{-}16$. In addition, Bayes' Theorem was applied to calculate prior odds, likelihood ratio and a posteriori probability. The results show a likelihood ratio of 6.28, meaning that we are approximately 6 times more likely to get a GS in a focused environment than a non-focused one. The a posteriori probability is therefore 89%.

4.2 French

The French dataset is made up of 430 utterances, within which 841 vowel clusters at phrase boundaries were observed and 209 GS were detected. Out of these 209, 96 were produced in correspondence of boundaries of focussed constituents. The remaining 113 were produced at the boundaries of all other constituents (background) of the utterance. The raw number and the proportion of GS produced by the speakers in the two contexts (focus vs. non-focus) are shown in the table and graph below.

	Non-focus	Focus
No GS	517	115
GS	113	96

Table 3: Number of occurrences of GS in the two contexts, focus vs non-focus, for the French group.

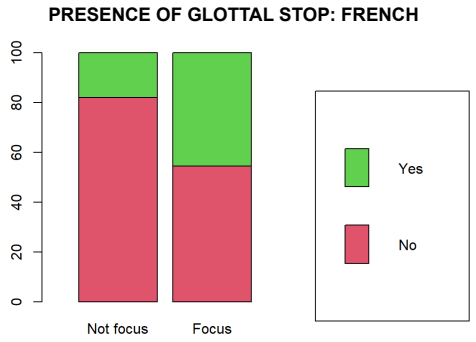

Figure 4: Proportion of occurrences of GS in the two contexts, non-focus vs focus, for the French group.

The Pearson's Chi-squared test with Yates' continuity correction gives a resulting $p = 2.261e\text{-}15$ for the two situations compared, focus vs non-focus. Application of Bayes' Theorem gives in this case a likelihood ratio of 2.68. The a posteriori probability of getting a GS in a focus environment is therefore 69%.

4.3 Interlinguistic comparison

There is a slight difference between the two languages, in which French shows a higher proportion of GS in the non-focus condition than Italian. This is due to the fact that phenomena of vowel coalescence are generally rarer in French than Italian, and vowel clusters are often avoided through various forms of resyllabification like *enchaînement* or *liaison* [14]. Nonetheless, regarding our hypothesis, results are highly significant in both groups.

5. DISCUSSION

Our aim in this study was to test the hypothesis expressed in (1). The results we obtained are highly significant for both groups, so our predictions are confirmed: when a prosodic phrase is under linguistic focus, the probability of observing a GS in correspondence with its boundaries increases considerably. Namely, the increase of probability we could observe is 25% for both groups. This is the first time that the relationship between these two variables has been analysed without it being considered the consequence of other markers of prosodic prominence, e.g. pitch or nuclear accent. The reason why we found interest in the presence of GS in this particular context is that, in our data, it emerges quite strikingly that glottalisation does not necessarily occur in presence of pitch accents: on the contrary, it often surfaces as the only phonetic correlate of *in-situ* focalisation, in absence of major f_0 movements. In our data, GS often happens to be the only distinctive cue between focus and non-focus phrases in an identical environment. As shown in the examples (2) and (3) and their respective spectrograms, the only difference between the non-focus "in edicola" 'at the newsstand' and the contrastive focus "in edicola" is the presence of a GS before the vowel [i] in the second one.

(2) ITL1_sp03:
Che cosa succede qui?
What's going on here?
Maria compra il giornale in edicola.
Mary is buying the newspaper at the newsstand.

(3) ITL1_sp03:
Maria compra il giornale al supermercato, no?
Mary is buying the newspaper at the supermarket, right?
No, Maria compra il giornale [ʔ]in edicola.
No, Mary is buying the newspaper [ʔ]at the newsstand.

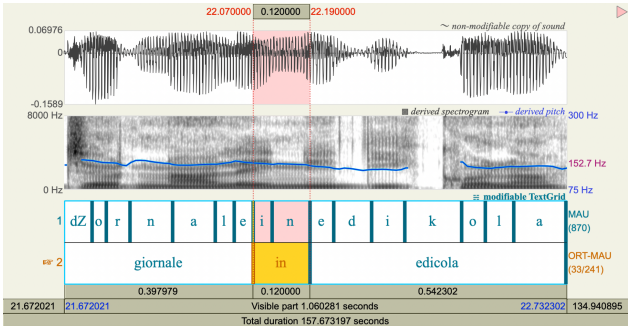

Figure 5: Spectrogram of the phrase "in edicola" ("*at the newsstand*") in a non-focus context as uttered by an Italian speaker (see example 2).

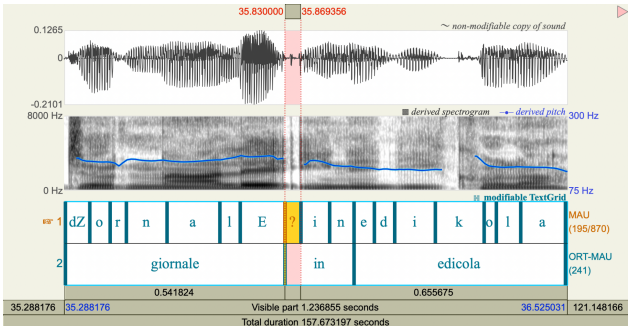

Figure 6: Spectrogram of the phrase "in edicola" ("*at the newsstand*") in a corrective focus context as uttered by an Italian speaker (see example 3).

This goes in the opposite direction than [5, 7, 10, 15]. Another hypothesis on the role of GS has then to be formulated: since it is not the consequence of pitch accent, its presence could be linked to other physiological reasons, see [16]. For example, GS could be functional to the maintenance of subglottal pressure, in order to keep a loud voice at the end of an utterance, or either as a "signal of hard work". Our data support this hypothesis, since the presence of GS is especially visible for focussed phrases in utterance-final position.

In any case, our findings go in the direction of [17] and her definition of "focus as prosodic alignment": in such perspective, the only feature shared by focussed constituents across languages is prosodic alignment to the edge of a prosodic domain, and not prominence intended as nuclear or pitch accent. Italian and French have already been described as "non-plastic" languages from the point of view of focus-induced variation on the intonation level. According to [17], another possible strategy for realising alignment (and then marking focus) is then the insertion or strengthening of a prosodic boundary, which is precisely what Italian and French speakers achieve through the use of GS. It could be the case that both word-initial and word-final GS are used by Italian and French speakers as boundary markers, separating the focused constituent from the rest of the utterance.

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