



Word and phrasal stress disentangled: Pitch peak alignment in Frisian and Dutch declarative structures

Amber Nota^{1,2}, Nanna Haug Hilton¹, Matt Coler^{2,1}

¹University of Groningen, the Netherlands

²INCAS³, the Netherlands

a.g.r.nota@rug.nl, n.h.hilton@rug.nl, mattcoler@incas3.eu

Abstract

This paper investigates intonational pitch variations and pitch peak alignment in declarative sentences and is part of a larger study of declarative, interrogative and imperative grammatical constructions in the Frisian-Dutch contact situation. Frisian is a minority language spoken in the province of Fryslân in the Netherlands. Following Jun [19], we devised a reading task in which phrasal intonation could be analysed while cancelling out focus effects.

The reading task contains nine sentences per language, each with three trisyllabic words (SVO): three with focus on the first word, three on the second, and three on the last. For each set of three sentences, lexical stress is equally divided across the syllables of the focused word.

A subset of 20 of the study's 40 bilingual Frisian-Dutch native speakers performed the task in Frisian and Dutch. Pitch measurements were conducted according to the Melodic Analysis of Speech method and adapted MAS+ method, allowing for fine-grained phonetic analysis. Results suggest both Frisian and the local Dutch variety show delays in pitch peak alignment when compared to previous research, with Frisian showing a stronger delay in focus realisation. Additionally, an age effect in Frisian pitch production suggests a possible change in the language.

Index Terms: Pitch peak alignment, phrasal intonation, minority language, reading task

1. Introduction

There are two officially-recognized languages spoken today in the Netherlands: the minority language Frisian – also called West-Frisian – and the majority language Dutch, both of which are West Germanic. While Dutch is well-described, comparatively little is known about Frisian, which is a mainly spoken language for some 450,000 people in the northern province of Fryslân [1]. Frisian is a minority language, and is therefore subject to intense cultural pressure. Claims of Frisian-to-Dutch convergence were voiced as early as 1996 [2] and De Haan claims that Frisian shares contact features from Dutch on all levels of its grammar [3]. All Frisian speakers are Frisian-Dutch multilinguals. Insights into the manners in which a majority and minority language influence one another can further our understanding of the processes involved in retention or loss of minority languages. In addition to presenting an interesting vantage point from which to better understand multilingual contact effects, Frisian prosody is an interesting topic of study because it is yet to be sufficiently described. In the past, there has been scant research on Frisian

prosody. The available literature consists of Peters, Hanssen and Gussenhoven [4], investigating the differences in pitch and syllable length in focus realisation in six languages and dialects along the Dutch-German coastal area, including Frisian. Additionally, there are brief mentions of Frisian prosody in [5] and [6]. No inventory of Frisian prosody at sentence level in declarative, interrogative or imperative sentence constructions exist, nor does a comparison between Frisian intonation patterns with those of the variety of Dutch which is in direct contact with Frisian.

Research into prosody in contact linguistics invariably shows that “[t]he prosodic system in long-term contact settings is highly vulnerable to change” [7], even in the case of contact between closely related varieties -- such as English dialects, [8]; [9], Italian dialects [10] or the Orkney and Shetland dialects [11]. Although some studies attest to an influence of the majority language on the minority one (c.f. [7]), the most frequent finding indicates bidirectional influence (c.f. [12], [13], [14], [15]).

2. Pitch peak alignment

Pitch peak alignment, or the alignment of the F0 peak with a word's stressed syllable, has previously been shown to differ between closely related languages or dialects (c.f. [11], [16], [17], [18]). Although the majority of studies have focused on pitch peak alignment in focus position, i.e. in words receiving sentence stress, differences in pitch peak alignment can also be found in syllables containing only word stress.

Peters, Hansen and Gussenhoven investigated pitch peak alignment and the alignment of the end of the fall in rising-falling accents in focus position in six Germanic dialects from the Dutch and North-West Germanic coastal area. These dialects were three Dutch dialects, West-Frisian (from the city of Grou) and two German dialects. With regards to pitch peak alignment, their main conclusion is that it is “stably aligned with the beginning of the nuclear accented syllable” [4, pp. 1] across the different dialects. However, they also found that “significant rightward shifts in the alignment of H as a function of word length was detected in four out of 14 cases [...], but the effects were negligibly small and occurred [...] only in the case of Grou.” [4, pp. 36]. Within the scope of that study, small differences in pitch peak alignment in one out of six cases could indeed be ignored. For the current study however, it poses an interesting question. It must be noted that of the three Dutch dialects investigated in the previous study, none were in direct contact with Frisian. This leads to the question whether pitch peak alignment in the variety of Dutch which is in close contact with Frisian also shows instances of rightward shifts in pitch peak alignment, as its local Frisian

counterpart appears to do, or whether it is similar to other varieties of Dutch and shows earlier pitch peak alignment than Frisian.

3. The Multilingual Melodies project

The current paper is part of a larger study aimed at providing descriptions of intonation contours of declarative, interrogative and imperative sentence constructions in both Frisian and the local variety of Dutch it is in close contact with. It takes into account speaker age, gender, and regional background, investigating speech production of 40 Frisian-Dutch bilinguals and 20 matching local monolingual Dutch native speakers. The current paper focuses on a subset of the data; speaker age and gender in declarative sentences produced by bilinguals. It aims to answer the following research questions:

1: Can indications of the existence of differences in pitch peak alignment between Frisian and local Dutch be found in standard sentence intonation contours containing no sentence stress?

2: Can differences in pitch peak alignment be found between the two languages in focused contexts?

4. Methodology

Following Jun [19], we devised a sentence reading task which allowed for the separation of focus or sentence stress and word stress. The task consisted of nine declarative SVO sentences, each containing three trisyllabic words. The first three sentences received focus on the subject, with focus on its onset syllable in the first sentence, its penultimate syllable in the second and its ultimate syllable in the last sentence. This was repeated with focus on the verb in the next three sentences, and with focus on the object in the last three sentences. Words without focus were words with stress on the penultimate syllable. This default option was chosen to avoid stress clashes with the focused words. This results in nine sentences containing a stress pattern as depicted in example (1), with focus shown in bold.

- (1) **Sss** sSs sSs sSs **Sss** sSs sSs sSs **Sss**
 s**Ss** sSs sSs sSs s**Ss** sSs sSs sSs s**Ss**
ssS sSs sSs sSs **ssS** sSs sSs sSs **ssS**

An example of the first sentence in Frisian would be (2):

- (2) Anneke bedriget Kornelis
Anneke cheats on Kornelis

This reading task was developed in both Frisian and Dutch. Where possible, literal translations were used and names were kept the same, to ensure the tasks matched to the highest possible degree. Where this was not possible due to differing syllable counts and stress patterns in translation, words were replaced. Each SVO main clause was followed by a relative clause. This was done to reduce monotony in the reading of the sentences, as well as to ensure that participants would not reduce the end of the main clause to such an extent that measurements were no longer possible. As Frisian is a mainly spoken and very informal language, sentence final reduction is a well-known problem. Example (2) was therefore presented as example (3). All relative clauses were structurally similar, and were not taken into account in the analysis.

- (3) Anneke bedriget Kornelis dy't altyd trou is.

Anneke cheats on Kornelis who is always loyal.

The reading task was performed by 20 Frisian-Dutch bilinguals within a larger set of tasks. The order of reading the Frisian and Dutch tasks was balanced between the participants, with half performing a block of tasks in Frisian followed by a block of tasks in Dutch, and the other half performing the two blocks in reverse order. Several different tasks were performed between the readings of this task in both languages. Of the 20 participants, ten were male and ten were female, five out of each gender group belonged to the age category of 16-25 years old, while the other five were aged 40-50.

5. Analysis

5.1. Melodic Analysis of Speech

The comparison of two closely related languages requires a fine-grained method of analysis which allows not only for description of pitch contours, but for qualitative phonetic measurements providing the ability to statistically compare pitch contour productions. Additionally, any comparison of pitch productions by different speakers, especially speakers of different ages and genders, requires normalisation of the pitch contours. To this end, an adapted [20] version of the Melodic Analysis of Speech (MAS) method [21] was used. The MAS is a phonetic measure particularly suited for comparison and quantification of differences in speech production by different speakers, as well as free speech production, as it does not require a continuous pitch contour. It allows for stable comparison of different utterances, as it measures F0 production for every uttered syllable at the intensity peak, thereby eliminating most segmental-specific coarticulation effects. The MAS and adapted MAS+ methods, consist of several steps:

- The first is to measure F0 production [22] at the intensity peak of each syllable in the utterance.

Although two rises from one syllable's F0 value to the next may be equal in absolute numbers, i.e. from 100 to 200Hz and from 200 to 300Hz, the former is more perceptually salient. To incorporate both the relational nature of the syllables within the intonation contour and the perceptual salience, Hz values are converted to percentual relationships, describing the change required from one syllable to the next.

- The next step in MAS is to calculate percentual relations (%) for each syllable (σ) from left to right, using the formula given in (4). As nothing precedes the onset syllable, no percentual relation is calculated for this syllable.

$$\sigma_{N\%} = ((\sigma_N - \sigma_{N-1}) * 100 / \sigma_{N-1}) \quad (4)$$

The downside of only calculating left-to-right percentual relationships is that the further removed from sentence onset, the larger distortion can be. To counteract this and allow for balanced normalisation, MAS+ also calculates right-to-left percentual relationships, using the formula presented in (5):

$$\sigma_{N\%} = ((\sigma_N - \sigma_{N+1}) * 100 / \sigma_{N+1}) \quad (5)$$

- The final step is normalisation. In MAS, this is done by normalising the onset syllable – for which no relational percentage can be calculated – to a value of 100, and calculating standardised values (S) for each following syllable by applying its calculated percentual

relationship to the normalised value of the preceding syllable, as in the formula in (6):

$$\sigma_{NS} = (\sigma_{N-1S} * (\sigma_{N\%} / 100) + \sigma_{N-1S}) \quad (6)$$

MAS+ adds to this normalisation method by normalising at the arbitrary value of 100, not only on the onset syllable, but on each syllable. It calculates a number of normalised contours equal to the number of syllables in the utterance, normalising once on each syllable, using the formula in (6), based on the left-to-right percentages to calculate normalised values to the right of the value 100, and the formula in (7), based on right-to-left percentages, to calculate normalised values to the left of the value 100.

$$\sigma_{NS} = (\sigma_{N+1S} * (\sigma_{N\%} / 100) + \sigma_{N+1S}) \quad (7)$$

These normalised contours are subsequently averaged to arrive at the final contour in which normalisation is balanced across the utterance.

5.2. Pitch peak alignment

As MAS uses single measurements per syllable, delayed pitch peaks in the signal do not result in delayed peaks in the normalised contours. Instead, a delayed peak will show as a flat(ter) contour, in which the high pitch is continued from the stressed to the following syllable. This is due to the fact that, in a delayed peak in the signal, the intensity peak at which point measurements are taken precedes the F0 peak. In other words, the F0 peak can be found at a certain point between the intensity peaks of the stressed and subsequent syllable, resulting in measurements of the rising and falling pitch surrounding the actual peak. As a measurement of alignment (A) of the F0 peak with the stressed syllable, the formula in (8) is used, in which the difference in pitch between the stressed syllable (σ_S) and the subsequent syllable is compared to the difference in pitch between the stressed syllable and the one preceding it.

$$A = 1 - (\sigma_S - \sigma_{S+1} / \sigma_S - \sigma_{S-1}) \quad (8)$$

Using this formula, $A = 0$ when the pitch peak aligns with the intensity peak of the stressed syllable, visualised as an equal rise and fall in the intonation contour, and $A = 1$ when the pitch peak is delayed to such an extent that it occurs at the midpoint between the measurements, visualised as a plateau. This method cannot be applied to the pitch peaks in the subject's onset syllable (S1) or the object's ultimate syllable (O3), as there is no syllable preceding or following it, respectively. Pitch peak alignment A in onset syllables is therefore analysed in V1 and O1, A in penultimate syllables in S2, V2 and O2, and A in ultimate syllables in S3 and V3.

6. Results

6.1. Intonation contours without sentence stress

Elimination of all measurements taken from words on which focus was placed results in intonation contours which no longer contain any distorting influence of sentence stress. The remaining rises and falls are due to word stress, as the penultimate syllables of all three words (S2, V2, O2) are stressed.

Figure 1 shows that for both languages, standard intonation contours - without any influence of sentence stress - are very similar. A similarly larger pitch range is covered at the beginning of the utterance when compared to the end of the utterance - as is to be expected - and older speakers have

slightly wider pitch ranges than younger speakers. The only slight difference between the two languages that can be noted is that of pitch peak alignment, with more instances of delayed pitch peaks in the Dutch graph (i.e. in the older men in the subject and the older women and men in the verb). These differences are significant, or approach significance in the case of the S2: $t(28)=-1.822$, $p=.079$. Older female V3: $t(29)=2.632$, $p<.02$; older male V3: $t(29)=2.061$, $p<.05$.

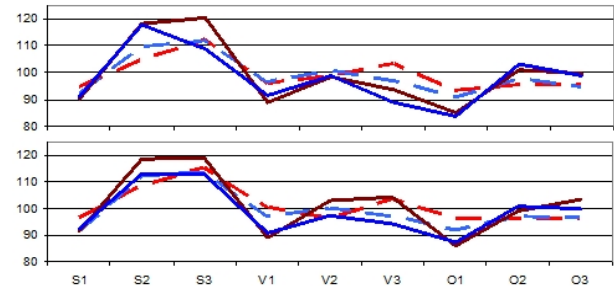


Figure 1. Intonation contours without sentence stress. Frisian contours are depicted in the top graph, Dutch in the bottom. Dotted lines represent young speakers, uninterrupted lines older speakers. Red lines are females, blue are males.

6.2. Intonation contours of focused words

As shown in Figures 2 and 3, depicting the intonation contours for the focused words in Frisian and Dutch, respectively, sentence stress is expressed to different degrees, depending on the location of the stress in the utterance.

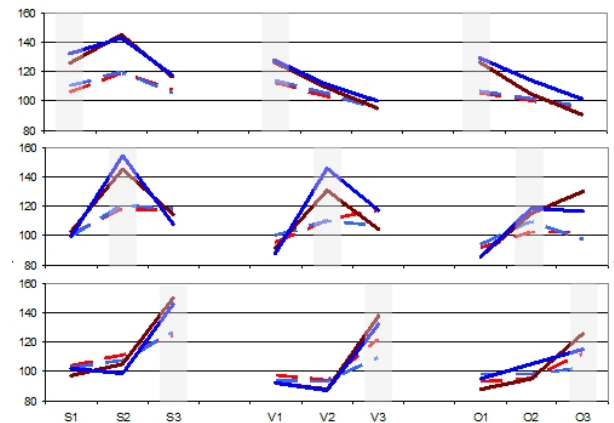


Figure 2. Intonation contours for Frisian focused words. The stressed syllables are indicated by the grey bars. Dotted lines represent young speakers, uninterrupted lines older speakers. Red lines are females, blue are males.

Noticeable is the difference between the realisations of sentence stress at the onset syllable in subject position compared to verb and object positions. This suggests stress production at utterance onset is difficult, resulting in a delayed pitch peak which is not affected by speakers' regular pitch peak alignment rules. Another noticeable difference is that between production by young and old speakers in Frisian, with young speakers frequently producing lower pitch contours with a smaller range. This is a significant difference between languages in young female speakers in the case of the focused

object production with word-initial stress; O1: $t(4)=4.363$, $p<.02$, O2: $t(4)=-2.849$, $p<.05$. and the focused verb production with ultimate word stress: V3: $t(4)=-3.749$, $p<.02$. The instances in which the young male speakers show significant differences, however, are those few in which their production is closer to the old speakers' production in Frisian than it is in Dutch: in object production with penultimate stress; O2: $t(4)=-6.499$, $p<.005$ and in verb production with ultimate stress; V1: $t(4)=3.742$, $p<.02$, V2: $t(4)=3.080$, $p<.05$.

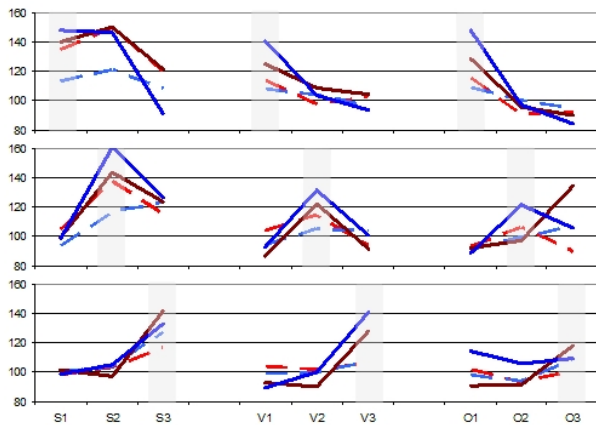


Figure 3. Intonation contours for Dutch focused words. The stressed syllables are indicated by the grey bars. Dotted lines represent young speakers, uninterrupted lines older speakers. Red lines are females, blue are males.

MANOVAs revealed that, aside from the second syllable of those words produced with initial stress, where the production of the subject's S2 differed from that of both the verb's V2 and the object's O2 in both Frisian and Dutch for all four speaker groups, production of a specific stress pattern (initial, penultimate or ultimate stress) did not differ significantly for all groups between production at subject, verb, or object position. For this reason, analysis of alignment was done comparing the three different stress patterns, but not across the three different word contexts.

Table 1 displays means and standard deviations of the pitch peak alignment measure A, in which 0 indicates peak alignment with the point of measure, i.e. midway through the syllable, -1 is alignment midway between the point of measure and the previous point, i.e. at syllable onset, and 1 indicates alignment midway between the point of measure and the following point of measure, i.e. the end of the syllable. Arrows in the final column indicate whether Frisian pitch peak alignment occurs earlier or later than its Dutch counterpart. Although there are no statistically significant differences, the trend for later Frisian pitch peak alignment is clear, with Frisian aligning later than Dutch in 75% of the cases.

7. Discussion

When comparing the current findings to Peters, Hanssen and Gussenhoven's [4] general conclusion that Dutch, Frisian and German pitch peaks align stably with the onset of the stressed syllables in focus realisation, it must be concluded that the current study revealed tentative evidence of rightward shifts in pitch peak alignment in both Frisian and Dutch produced by Frisian-Dutch bilinguals.

6.3 Pitch peak alignment (A)

	M Dutch		M Frisian		
	sd		sd		
I YF	0.99	3.03	-0.14	2.27	←
I YM	-0.43	3.72	0.52	0.89	→
I OF	-0.10	2.52	0.72	1.03	→
I OM	0.03	0.62	0.56	1.65	→
P YF	-0.03	1.47	2.62	6.04	→
P YM	0.91	1.34	1.01	0.81	→
P OF	0.46	0.87	0.17	0.63	←
P OM	0.23	0.65	0.25	0.47	→
U YF	-0.55	1.72	-0.38	2.28	→
U YM	0.18	1.29	0.43	1.00	→
U OF	-0.27	0.46	-0.21	0.27	→
U OM	1.17	4.20	-0.05	0.24	←

Table 1. Means and SDs of alignment (A) in initial (I), penultimate (P) and ultimate (U) stress patterns in young female (YF), young male (YM), older female (OF) and older male (OM) speakers.

Interesting is that, in the non-focused intonation, most evidence of delayed peaks could be found in Dutch, while most evidence of delayed peaks in focused contexts could be found in Frisian. This latter finding corresponds with [4], where the focused context was the only context investigated. Additionally, in focused contexts, a clear trend of more extensive rightward shifts in pitch peak alignment was found for Frisian in all speaker groups. This might suggest structural differences in pitch production between the two languages, which are in this case not only in close contact, but originate from the same speakers. A follow-up investigation of pitch peak alignment in the variety of Dutch spoken by local monolingual Dutch speakers will therefore be conducted within the larger Multilingual Melodies project. This can shed light on the question whether the evidence of delayed pitch peaks found in Dutch in the current study is due to interspeaker influence of Frisian on Dutch, or whether the local monolingual Dutch variety, which was not investigated in [4], also differs from previous findings.

Finally, in focus realisation, younger, and especially female, speakers produce distinctly different, flatter intonation contours in Frisian than older speakers. This difference cannot be found in Dutch, which can be taken as a suggestion that Frisian prosody is undergoing change. Further analysis within the project on larger numbers of speakers and different grammatical constructions will provide more detailed insights into pitch production in both languages, as well as any possible changes occurring.

8. Acknowledgements

This work is part of the research programme which is financed by the Province of Fryslân.

References

- [1] Province of Fryslân, *De Fryske taal atlas 2011*. Leeuwarden: Province Fryslân, 2011.
- [2] G. De Haan, “Over de (in)stabiliteit van het Fries,” *Nederlandse Taalkunde* vol. 01, pp.306-319, 1996.
- [3] G. De Haan, “Contact-induced changes in modern West Frisian,” In: J.F. Hoekstra, W. Visser and G. Jensma, (eds), *Studies in West Frisian grammar: selected papers by Germen J. de Haan*, pp. 275-300, 1997.
- [4] J. Peters, J. Hanssen, and C. Gussenhoven, “The phonetic realization of focus in West Frisian, Low Saxon, High German and three varieties of Dutch,” *Journal of Phonetics*. Vol.46, pp.185-209, 2014.
- [5] J.F. Hoekstra, “Standard West Frisian,” In: H.H. Munske, N. Århammar, V. Faltings, J.F. Hoekstra, O. Vries, A.G.H. Walker and O. Wilts (Eds), *Handbuch des Friesischen / Handbook of Frisian Studies*. Berlin: Mouton de Gruyter, pp.83-98, 2001.
- [6] J.F. Hoekstra, “Oer it beklamjen fan ferhâldingswurden yn it Frysk, it Hollânsk en it Ingelsk,” *Us Wurk* vol.40, pp.67-103, 1991.
- [7] B.E. Bullock, “Prosody in contact in French: A case study from a heritage variety in the USA,” *International Journal of Bilingualism*, vol.13, no.2, pp.165-194, 2009.
- [8] C.J. Mayo, *Prosodic transcription of Glasgow English: An evaluation study of GlaToBi*. Master’s thesis, University of Edinburgh, 1996.
- [9] E. Grabe, B. Post, F. Nolan and K. Farrar, “Pitch accent realization in four varieties of British English,” *Journal of Phonetics*. Vol.28, pp.161-185, 2000.
- [10] M. Grice, M. D’Imperio, M. Savino and C. Avesani, “Strategies for intonation labeling across varieties of Italian,” In: S.-A. Jun (ed), *Prosodic typology: The phonology of intonation and phrasing*. Oxford: Oxford UP. pp.362-389, 2005.
- [11] K. van Leyden and V. van Heuven, “On the Prosody of Orkney and Shetland Dialects,” *Phonetica* vol.63 pp.149-174, 2006.
- [12] L. Colantoni and J. Gurlekian, “Convergence and intonation: historical evidence from Buenos Aires Spanish,” *Bilingualism: Language and cognition*, vol.7, no.2, pp.107-119, 2004
- [13] T. Meisenburg, “Prosodic phrasing in the spontaneous speech of an Occitan/French bilingual,” In: C. Gabriel, C. Lleó (eds), *Intonational phrasing in Romance and Germanic, Cross-linguistic and bilingual studies*. Amsterdam: John Benjamins, pp.127-151, 2011.
- [14] R. Sichel-Bazin, C. Buthke and T. Meisenburg, “The prosody of Occitan-French bilinguals,” In: K. Braunmüller and C. Gabriel, *Multilingual Individuals and Multilingual Societies*, vol.13, pp.349-364, 2012.
- [15] M. Simonet, “Intonational convergence in language contact: Utterance-final F0 contours in Catalan-Spanish early bilinguals,” *Journal of the International Phonetic Association*, vol.41, no.2, pp.157-184, 2011.
- [16] D.R. Ladd, A. Schepman, L. White, L.M. Quarmby and R. Stackhouse, “Structural and dialectal effects on pitch peak alignment in two varieties of British English,” *Journal of Phonetics*. Vol.37 pp.145-161, 2009.
- [17] E. Grabe, “Comparative intonational phonology: English and German” *MPI series in psycholinguistics 7*, Wageningen: Ponsen & Looien, 1998.
- [18] J. Peters, “The timing of nuclear high accents in German dialects. *Proceedings of the 14th international congress of phonetic sciences, San Francisco, August 1-*, vol. 3 pp. 1877-1880, 1999.
- [19] S.-A. Jun, “Elicitation and documentation of intonation,” Master class taught at *The 4th international conference on language conservation and documentation*, University of Manoa, February 28, 2015.
- [20] A. Nota, N. Haug Hilton and M. Coler, “MAS+: an adapted methodology in the context of Frisian-Dutch prosody,” presented at *dag van de fonetiek*, University of Utrecht, Netherlands, December 16, 2015.
- [21] D. Font-Rotchés and F.J. Cantero, “Melodic Analysis of Speech Method applied to Spanish and Catalan,” *Phonica*, vol.5 pp.33-47, 2009.
- [22] P. Boersma and D. Weenink, *Praat: doing phonetics by computer*. Version 5.3.84. <http://www.praat.org/>, 2014.