The Obligatory Contour Principle in African and European Varieties of French

Mathieu Avanzi[1], *Guri Bordal*[2], *Gélase Nimbona*[3]

[1]Laboratoire de Linguistique Formelle, UMR 7110, University Paris Diderot, France
[2]MultiLing (CoE), University of Oslo, Norway
[3] Institut Langage & Communication, Centre VALIBEL, UCLouvain, Belgium

mathieu.avanzi@gmail.com, guri.bordal@iln.uio.no, gelase.nimbona@uclouvain.be

Abstract

This study provides evidence that the role of the Obligatory Contour Principle (OCP) in substrate languages is reflected in prosodic systems of contact varieties of French. We have compared two contact varieties: Central African French, a variety of French spoken by L1 speakers of Sango a lexical tone language where the constraint is not respected, and Burundi French, which is spoken by L1 speakers of Kirundi, a lexical tone language where the OCP plays an important role in the distribution of tones. Our data indicate that clashes are permitted in the former, but avoided in the latter.

Index Terms: *CLASH, Obligatory Contour Principle, Prosody, Language contact, Lexical Tone systems.

1. Introduction

The Obligatory Contour Principle (OCP) [1] and [2] was first proposed as a constraint of lexical tone systems, prohibiting the adjacency of identical elements at the melodic level, in particular the contiguity of high (H) tones. It was later applied to stress systems, as a motivation for Clash Resolution processes [3]. Thus, in recent phonological theory, the OCP is seen as a universal and violable markedness constraint that operates against the adjacency of any similar phonological elements on the same level of representation [3]. Even if the avoidance of adjacent similar lexical tones and stress clash resolutions are results of different phonological processes given the differences in behavior between tones and stress, we are here basing our discussion on a this broad definition of the OCP since both stress and tone systems are involved in the study. For a deeper discussion on the role of the OCP at different aspects of a phonological system, see for example [5].

In this paper, we are interested in role of the OCP in contact-induced prosodic change. More precisely, we are comparing the effects of this constraint in the productions of speakers of 4 different varieties of French: Parisian French (henceforth EPF) and Brussels French (henceforth EBF), Central African French (henceforth CAF) and Burundi French (henceforth ABF).

The African varieties (CAF and ABF) can be referred to as "contact varieties". That is, they exhibit conventionalized phonological properties, some of which stem from transfers from the African languages spoken in the respective areas. Also, the speakers of these varieties are without exception multilingual and alternate daily between several languages. The speakers of the European varieties (EPF and EBF) are generally monolingual, that is French is first language acquired and the only language used by the speakers in everyday communication. We refer to these varieties as "monolingual varieties". We are comparing the effects of the OCP in the monolingual and the contact varieties in order to discuss the influence of the substrate languages in the latter

2. The OCP in different prosodic systems

French was introduced in what is today the Central African Republic (RCA) by French colonists whereas Burundi is a former Belgian colony. Obviously, we cannot claim that French the way in which it is spoken by the Brussels and Parisian speakers today is identical to the varieties that were spoken by those who disseminated French in RCA and Burundi (colonialists, teachers, missionaries, etc.). Nevertheless, it is likely that contemporary Brussels and Paris French do share some prosodic properties of the systems from which the current African varieties have developed, *e.g.* the phrasal accent has replaced word accent [6]. Therefore, we use the comparison with the European speakers as a starting point for the identification of potential (contact-induced) change.

2.1. OCP in French prosody

The effects of OCP in Standard French prosody are manifested in the tendency to avoid adjacent pitch accents (H*), referred to as result of the *CLASH constraint [7]. In Standard French, as in other languages [8], Stress Clash is defined as the adjacency of two pitch accents belonging to different Prosodic Words (PW), and the avoidance of stress clash has been invoked to account for the absence of pitch accents associated with the underlined syllables in (1)-(4) (see [9]-[15]):

(1) des [gentilles]$_{PW1}$ [filles]$_{PW2}$
(2) elle est [relativement]$_{PW1}$ [fine]$_{PW2}$
(3) il [s'appelle]$_{PW1}$ [Jean]$_{PW2}$
(4) une [journée]$_{PW1}$ [chaude]$_{PW2}$

Because they constitute lexical items, the PW1s above could receive a pitch accent on their rightmost syllable (underlined). Nevertheless, to avoid the succession of two pitch-accented syllables; the first pitch accent tends to be obliterated in these contexts.

As illustrated in the examples above, clashes may occur at different levels of the prosodic hierarchy [15]-[21]. *CLASH can apply within a single Phonological Phrase (PP), typically in the cases where an adverb or an adjective modify a postposed lexical head as in (1) and (2). It can also apply across two PPs which are candidates to restructuration (henceforth restrPP), i.e. when a lexical item is followed by a monosyllabic noun or an adjective as in (3) and (4). According to [15] and [20], *CLASH applies to a different extent according to the level in the prosodic hierarchy at which it applies. It would be obligatory within a single PP such as (1)-(2), while it would be optional between two PPs such as (3)-(4).

2.2. OCP in the tonal systems of Kirundi and Sango

The OCP plays a different role in the prosodic systems of the African substrate languages in RCA and Burundi, respectively Sango and Kirundi.

Kirundi is a Bantu language, whose tonal systems actually played a decisive role in the discovery of the OCP [22]: in these languages adjacent H lexical tones are avoided, hence the OCP is crucial in the output tonal alignment in Kirundi. For instance, both the stem "bon" and the prefix "i" are specified for high tones in the verb *Kwiibona* ('to boast'), but only the prefix is realized with a high tone in order to avoid adjacent high-toned syllables.

In Sango, by contrast, the underlying tonal representation is in most cases reflected in the output. If morphemes specified for identical tones follow each other, for instance an H-toned grammatical morpheme and an H-toned monosyllable lexical stem, both will be realized. For instance, *wali* ('woman') has the underlying tonal pattern HL, the plural affix *a* has an H tone and the plural of form of *wali, awali* surfaces with the tonal pattern HHL. In order words, no direct effects of the OCP are reported in the tonal system of Sango [23].

2.3. Hypotheses

As shown in the previous section, the OCP can be seen as a motivation for the avoidance of adjacent lexical H tones within PWs in Kirundi and of pitch accents H* within the PP or across two PPs in Standard French. Obviously, lexical tones and pitch accents are different in nature, but in both cases we are dealing with the avoidance of adjacent H tones (an H lexical tone or an H* pitch accent) at some level in the prosodic hierarchy. Henceforth, we refer to the *CLASH constraint as a force operating against adjacent high tones in the contexts mentioned in 2.1., without entering the discussion of the nature of these tones ([23] argues that an important difference between Standard French and CAF is that high pitch on word-final syllables in the former is a pitch accent and a lexical tone in the latter).

Prosodic differences between Parisian and Brussels French are reported, but the *CLASH constraint operates according to the predictions of Standard French in both varieties. Therefore, our hypothesis is that Parisian and Brussels speakers will tend to avoid adjacent pitch accent in the contexts evoked in 2.1 [21].

Several studies have shown that prosodic systems of contact varieties tend to be extensively influenced by the prosody of the substrate languages (for a summary, see [23]). For instance, CAF and ABF both have features from the lexical tone systems of the Sango and Kirundi, *e.g.* the tendency that transitions from low to high tones happen directly from one syllable to another, by contrast with the gradual transitions between high and low tonal targets over the span of several syllables which characterize the European varieties [23] and [24]. However, as in the European varieties, high pitch on the last syllable is frequent in ABF and almost systematic in CAF.

Our hypothesis is that the outcome of French/Kirundi and the French/Sango contact will be different as regards the effects of OCP. Concretely, we hypothesize that the Burundi speakers will respect the *CLASH constraint in the contexts mentioned in 2.1; the fact that adjacent H tones are forbidden in Kirundi, makes it probable that ABF does not differ from the European varieties in this respect. By contrast, since adjacent H tones are permitted in Sango and since previous studies have attested that high pitch on the last syllable of lexical words is almost systematic in CAF, our hypothesis is that the *CLASH constraint will not be respected in this variety.

3. Material

Our material consists of speech samples extracted from the PFC database [25]. We analyzed data from 32 speakers, 8 of each variety. There are an equal number of men and women speaking CAF, EPF and EBF, but the ABF speakers are all men ([6] has shown that gender is not a decisive sociolinguistic variable in Africa). Participants range from 20 to 75 years old. They were instructed to read a journalistic text (the text used in the PFC project, which includes 398 words (22 sentences).

The processing (transcription, alignment, labelling, etc.) of these speech samples was made for a project dealing with regional variation of French prosody (see [21] and [24], for a detailed description) and for the purpose of PhDs dealing with description of French spoken in Africa [23]. Recordings were first orthographically transcribed with the Praat software [26]. Transcriptions were then semi-automatically aligned in phones, syllables and words with EasyAlign script [27]. Alignments were manually checked and corrected by inspecting waveforms and spectrograms, minor prosodic groups (prosodic words and clitic groups effectively bounded by a prosodic prominence) were identified and disfluent syllables were coded.

In total, the text contains 6 sites where the *CLASH can apply. The procedure to identify whether *CLASH was respected or not for the 192 sites (6 sites * 8 speakers * 4 groups) was conducted as follow: first, three prosody specialists (the three authors of this paper) listened to each stretch of recording containing the target context and coded a specific "0" tier if one of the two syllables was not perceived as prominent or not separated by a weak beat (a schwa, a silent pause or an hesitation), "1" if both syllables were perceived as prominent and not separated by a weak beat. Scores were computed, and we considered that the sites which received a score of 2 or 3 were occurrences of adjacent prominences, while the sites which received a total of 0 or 1 were considered as sites where the *CLASH took place.

Each of the two syllables potentially involved in clashes was then isolated in a tier, with S1 being the last syllable of the first PW (the first potential primary pitch accented syllable of the clash cluster) and S2 the syllable of the monosyllabic item that PW2 constitutes:

(5) un [charm<u>ant</u>^{S1}]$_{PW1}$ [<u>lac</u>^{S2}]$_{PW2}$
(6) des [en<u>fants</u>^{S1}]$_{PW1}$ [<u>sages</u>^{S2}]$_{PW2}$

Two acoustic parameters were retrieved for S1 and S2: duration in ms on the syllable and F0 mean in st on the vocalic nucleus.

Finally, articulation rate (expressed here in ms/syll) was computed for each of the minor prosodic phrases the corpus contains. We found it more relevant to consider articulation rate in ms/syll instead of syll/sec, given that some short minor prosodic phrases (2 syllables) were examined [28]. Note that articulation rate expressed in ms/syll corresponds to the mean syllabic duration within the minor prosodic phrase.

4. Results

The results are presented in three steps. First, we conducted some measurements to evaluate the reliability of perceptual coding of the *CLASH constraint. Then, we tested the effects of Variety (EPF, EBF, ABF, CAF) and of Phonological Condition (within a single PP or across two restrPPs) on the *CLASH application. Finally, to assess the fact that the differences between the European varieties and the African are due to a phonological transfer and not to a matter of performance, we also conducted an analysis comparing articulation rate between the four groups of speakers.

Data were analyzed by mean of Kappa statistics [29], a test used to assess the reliability between two annotators when coding categorical items and by means of Generalized Estimated Equations (GEE) with repeated measures. GEE are a type of Generalized Linear Models, but they are particularly useful to assess significant differences in dataset where data are correlated [30]. Bonferroni corrections were applied when examining pairwise comparisons between levels of a given predictor.

Out of the 192 sites of potential clashes, 12 (i.e. 6.7% of the data) were identified as connected to a hesitation (the two syllables were separated by a "euh" or a silent pause). They were then discarded. The analysis was then conducted on a total number of 180 sites of potential clashes.

4.1. Evaluation of the perceptual annotation

Several studies have shown that the phonological system of the L1/dominant language of an annotator plays a role in his/her perception of sounds [see 23 for a review]. Therefore, we consider it an advantage that the three annotators have different L1: a L1 speaker of French from the Franco-Provençal region of France (whose prosodic system is similar to the one described in 2.1), a L1 speaker of Norwegian (a tone/stress language) and a L1 speaker of Kirundi (a lexical tone language, *cf.* 2.2). We can hypothesize that the annotators, due to the different use of acoustic cues in their L1, are sensible to different phonetic variations. Thus, we believe that the annotation is not biased by the constraints of one particular phonological system. Nevertheless, two additional measurements were performed to assess the reliability of the annotators.

First, the Kappa's Cohen values revealed that the agreement between the three pairs of raters was substantial, with $\kappa = 0.752$ for the pair A1/A2), $\kappa = 0.779$ for the pair A1/A2 and $\kappa = 0.686$ for the pair A2/A3.

We then checked whether the last syllable of PW1 (S1) and the syllable of PW2 (S2) had different acoustic profile when the annotators coded *CLASH as respected compared to when *CLASH was coded as not respected, in other words if S1was associated to a high tone or not, as it is illustrated on Figure 1.

For this purpose, we calculated the ratio between S1 with S2, by dividing the value of mean vocalic F0 of S1 with the value of mean vocalic F0 of S2. A value of 1 means that both syllables show the same value, a value below 1 that the first syllable has smaller values than the following one; above 1 that the second syllable has smaller values than the first one. We ran GEE with repeated measures with the speaker as a random variable and with the *CLASH respect (yes/no) as a dependent variable and the ratioF0 value as predictor. Statistics show an effect of the ratioF0 (Wald χ^2 (1) = 11.378, $p < 0.001$). When *CLASH is violated, the ratio S1/S2 is higher than when *CLASH is respected. An interaction with the variety nevertheless was found (Wald χ^2 (3) = 16.984, $p < 0.001$), revealing that the difference of ratio between the cases where *CLASH was respected and *CLASH was not respected was less important for the African varieties than for the European varieties, as it can be seen on Figure 2:

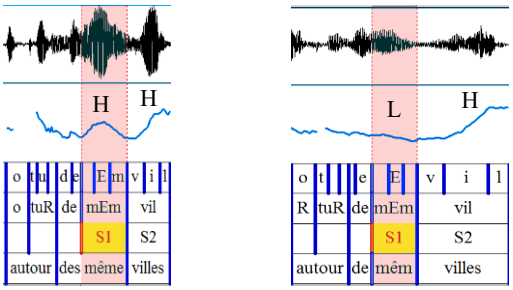

Figure 1: *F0 curves of the prepositional phrase "autour des mêmes]$_{PW1}$ villes]$_{PW2}$", produced by two ABF speakers. On the left panel, *CLASH is violated, on the right panel, *CLASH is respected.*

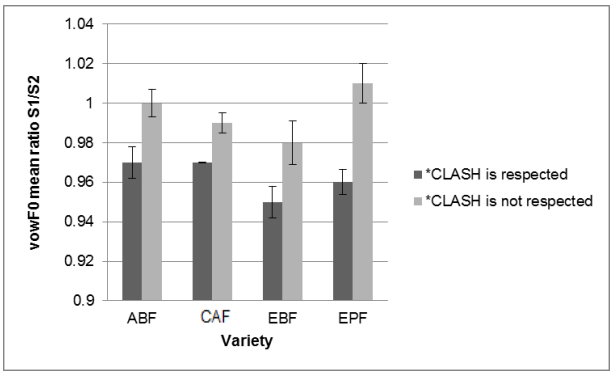

Figure 2: *Estimated syllabic duration (in ms) as a function of the variety (ABF, CAF, EBF and EPF). Error bars are standard error of the mean.*

4.2. Effects of Variety and Phonological Condition on *CLASH respect

GEE with repeated measures were run with the speaker as a random variable, the respect of *CLASH (yes/no) as a dependent variable, the Variety (CAF, ABF, EPF and EBF), the Phonological Condition (within a single PP/across two restrPPs) as independent variables.

First, the results show an effect of Variety (Wald χ^2 (3) = 12.617, $p < 0.01$). Post-hoc analyses reveal that there are significant differences between the CAF variety and the European varieties ($p < 0.01$), but not between the CAF and the ABF variety. The two European varieties are not distinguished from each other, or from the ABF variety, as it can be seen on Figure 3.

Statistics also reveal an effect of the Phonological Condition (Wald χ^2 (1) = 12.617, $p < .01$). *CLASH is more often respected within a PP (60.9% of the cases in average) than across two restrPPs (55.4% of the cases in average). No interaction was found within each variety, which means that this effect is identical across the 4 varieties in our database.

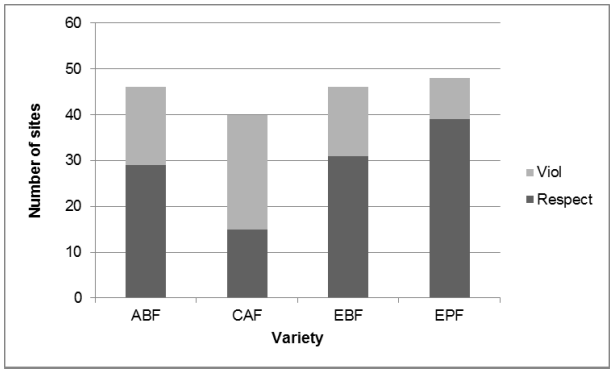

Figure 3: *Percentage of sites where *CLASH is respected, according to the variety.*

4.3. Articulation Rate

We ran GEE with repeated measures with the speaker as the random variable, Articulation Rate as a dependent variable and the Variety as a predictor. A significant effect was found (Wald χ^2 (3) = 28.103, $p < 0.001$). Post hoc revealed than there were no significant differences between the speakers in the African groups (ABF = 231.5 ms/syll; CAF 218.19 ms/syll), or between the two European groups of speakers (EBF 178.30 ms/syll; EPF 181 ms/syll), but a significant difference between CAF and the two European varieties ($p < 0.001$) and between ABF and the two European groups ($p < 0.01$). As shown in Figure 4, the articulation rate of African speakers is slower than that of European speakers:

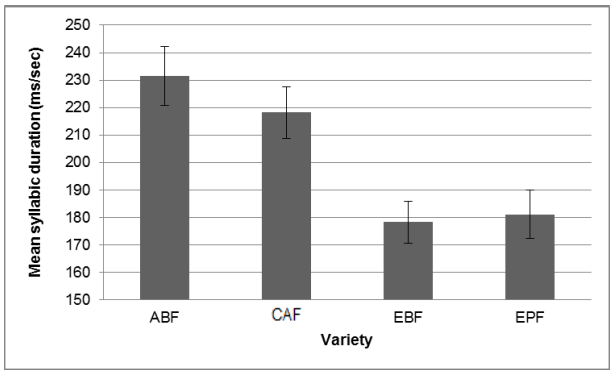

Figure 4: *Estimated syllabic duration (in ms) as a function of the variety (ABF, CAF, EBF and EPF). Error bars are standard error of the mean.*

5. Discussion

Our results can be summarized as follows: First, acoustic analyses showed the presence of two adjacent H tones when *CLASH was violated, and the presence of an L tone on S1 when *CLASH was respected. Second, CAF speakers do not produce more clashes than the ABF speakers on the one hand, but more than the European speakers on the other hand. We have also seen that the ABF speaker do not behave differently from the European speakers, *e.g.* they do not produce more clashes than the Parisian and Brussels speakers. Finally, we also found that the respect rate of the *CLASH constraint did not correlate with articulation rate, which indicates that the differences regarding the respect of *CLASH are due to transfer from the substrate, and are not a matter of performance. These tendencies are valid at the different levels of the prosodic hierarchy we have examined.

The summarized results above confirm our hypotheses: (i) *CLASH applies in the same way in Parisian and Brussels French, and (ii) the Burundi speakers tend to avoid clashes to a significantly greater extent than the Central African speakers [2].

In previous studies comparing "contact" and "monolingual" French (CAF and Swiss German speakers living in the French-speaking part of Switzerland vs. Parisian and speakers from French-speaking Switzerland), we found that the speakers of both contact varieties respected the *CLASH constraint to a lesser extent than the monolingual speakers [24]. We attributed these differences to influences form the word prosodic systems of Sango (lexical tones) and Swiss German (lexical stress), i.e. that the prosodic marking of every prosodic word in Sango (lexically specified tonal patterns) and Swiss German (fixed stress) was transferred to French in the way that the speakers realized prominences on every prosodic word. The present study shows that this analysis needs to be nuanced; Kirundi, like Sango and Swiss German, has word prosody, but the ABF speakers, in order to respect the *CLASH constraint, produce lexical words without any prominent syllable in contexts of potential clashes (see §2.1). In other words, our results indicate that the outcome of the contact between different prosodic systems depend on similarities and differences in how output constraints operate in the languages involved, and not only on typological categories.

6. Conclusion

In this paper, we have looked at the effects of OCP in four varieties of French, two monolingual (Paris and Brussels) and two contact varieties spoken in former French and Belgian colonies (RCA and Burundi). The aim of the study was to examine if the differences of OCP's role in tonal systems of the substrate languages (Sango and Kirundi) are reflected in the contact varieties. Our results indicate that this is the case: in Sango adjacent high tones are allowed, and the speakers of CAF frequently produce adjacent high tones in contexts where it is avoided in the European French, while the OCP is powerful in Kirundi and ABF speakers avoid adjacent high tones in these contexts, like European speakers. Nevertheless, much more work is needed to get a deeper understanding of the development of prosodic systems of contact varieties of French (and of other languages): larger corpora should be analyzed; studies of spontaneous speech would give a more accurate picture of the speakers' vernacular and comparisons with other contact varieties with different substrates are necessary.

7. Acknowledgements

This study was conducted with the friendly help of James Costa (University of Oslo), Alice Bardiaux (UCLouvain) and Sandra Schwab (UZurich). Mathieu Avanzi's work was financed by the Swiss National Foundation (grant Advanced Postdoc Mobility n°P300P1-147781). Guri Bordal's work was partly supported by the Research Council of Norway through its Centres of Excellence funding scheme, project number 223265. Finally, we send a special thought to the CAF speakers these days.

8. References

[1] Goldsmith, J. An overview of autosegmental phonology. *Linguistic Analysis*, 2, 1976, 23-68.

[2] Leben, W.R. *Suprasegmental Phonology*. PhD Dissertation, MiT, 1973.

[3] Prince, A. & Smolensky, P. *Optimality Theory: Contraint Interaction in Generative Grammar.* Maldens, Mass: Blackwell, 2004.

[4] Salmons, J. From tone to stress: Mechanisms and Motivations. *Proc. of the 16th Annual Meeting of the Berkeley Linguistics Society*, pp.282-291, 1990.

[5] Odden, D. On the role of the obligatory contour principle in phonological theory. *Language 62(2),* 353-383, 1986.

[6] Lyche, C. & Skattum, I. Le français contemporain en Afrique et dans l'Océan Indien : usage, variétés et structure. *Le français en Afrique 26*, 9-20, 2010.

[7] Post, B. Restructured Phonological Phrases in French: Evidence from Clash Resolution. *Linguistics, 37*, 41-63, 1999.

[8] Liberman, M., & Prince, A. On Stress and Linguistic Rhythm. *Linguistic Inquiry, 8*, 249-336, 1977.

[9] Grammont, M. *Traité de phonétique*. Paris: Delagrave, 1963.

[10] Garde, P. *L'accent*. Paris: PUF, 1965.

[11] Rossi, M. Le français, langue sans accent ? *Studia Phonetica, 15*, 13-51, 1979.

[12] Dell, F. L'accentuation dans les phrases en français. In F. Dell, D. Hirst & J.-R. Vergnaud (Eds.), *Forme sonore du langage : Structure des représentations en phonologie* (pp. 65-122). Paris: Hermann, 1984.

[13] Martin, P. Prosodic and Rhythmic Structures in French. *Linguistics, 25*, 925-949, 1987.

[14] Mertens, P. L'accentuation des syllabes contiguës. *Institut vor Toegepaste Linguistik, 95/96*, 145-164, 1992.

[15] Verluyten, P. (1982). *Recherches sur la prosodie et la métrique du français.* (Thèse de doctorat), Université d'Anvers.

[16] Selkirk, E. Phonology and Syntax: The relation between Sound and Structure. Cambridge: MIT Press, 1984.

[17] Nespor, M. & Vogel, I. On clashes and Lapses. *Phonology, 6(1),* 96-116, 1989.

[18] Hoskins, S. Secondary stress and stress clash resolution in French: an empirical investigation. In M. Mazzola (Ed.), *Issues and Theory in Romance Linguistics* (pp. 35-47). Washington: Georgetown University Press, 1994.

[19] Delais-Roussarie, E. Phonological Phrasing and Accentuation in French. In M. Nespor & N. Smith (Eds.), *Dam Phonology* (pp. 1-38). La Haye: Holland Academic Graphics, 1996.

[20] Post, B. Restructured Phonological Phrases in French: Evidence from Clash Resolution. *Linguistics, 37*, 41-63, 1999.

[21] Avanzi, M. Note de recherche sur l'accentuation et le phrasé à la lumière des corpus de français. *Travaux neuchâtelois de linguistique, 59*, 5-24, 2013.

[22] Leben, W.R. *Suprasegmental Phonology*. PhD Dissertation, MiT, 1973.

[23] Bordal, G. Prosodie et contact de langues : le cas du système tonal du français centrafricain. (PhD Thesis), University of Oslo & Université Paris Ouest Nanterre, 2012.

[24] Avanzi, M., Bordal, G., & Obin, N. Typological variations in the realization of French Accentual Phrase. Proc. of the 17th ICPHS, 268-271, 2011.

[25] Durand, J., Laks, B., & Lyche, C. (Eds). (2009). *Phonologie, variation et accents du français*. Paris: Hermes.

[26] Boersma, P., & Weenink, D. (2014). Praat (Version 5.3). Retrieved from http://www.fon.hum.uva.nl/praat/

[27] Goldman, J.-P. (2011). EasyAlign: an Automatic Phonetic Alignment Tool under Praat. Proc. of Interspeech, 3233-3236, 2011.

[28] Miller, J., Grosjean, F., & Lomanto, C. Articulation rate and its variability in spontaneous speech: a reanalysis and some implications. *Phonetica, 41*, 215-225, 1984.

[29] Cohen, J. A Coefficient of Agreement for Nominal Scales. *Educational and Psychological Measurement, 20*, 37-46, 1969.

[30] Ghisletta, P., & Spini, D. An Introduction to Generalized Estimating Equations and an Application to Assess Selectivity Effects in a Longitudinal Study on Very Old Individuals. *Journal of Educational and Behavioral Statistic, 29*(4), 421-437, 2004.