

FRENCH PROSODIC STRESS PRODUCED BY TWI SPEAKERS COMPARED TO FRENCH SPEAKERS: AN ACOUSTIC INVESTIGATION

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ABSTRACT

French Prosodic Stress is acoustically related to a combination of duration, fundamental frequency (f₀) and intensity. This paper presents a comparative study investigating the use of these correlates by French native speakers and Twi speakers learning French. French speakers and students studying French were selected for this study. In a production experiment, their readings were recorded in a studio and analyzed with a sound Editor. Durational, intensity and fundamental frequency values were extracted for each of the selected target syllables. Results show that French and Twi speakers do not use these acoustic correlates in similar manner. Duration seems to be the preferred, reliable cue used by Twi speakers acquiring French prosodic stress, unlike the French speakers who combine all three cues. Acoustic results further show which syllable types were more stressed.

Keywords: Duration, intensity, fundamental frequency, syllabic stress.

1. INTRODUCTION

French prosodic stress operates within the framework of the rhythmic unit therefore it is imperative to recognize the strong and weak positions that determine pronunciation habits. Wioland [32] showed that syllables occupy 3 positions: (i) an accented/stressed position, called the rhythmic stress, the final position of a rhythmic unit, is a position to be privileged par excellence and on which the main part of teaching of pronunciation and acquisition of prosodic stress must be focused; (ii) a stressable position which, in spite of the brevity of its realization, keeps a vocalic timbre comparable to that of the stressed position; (iii) an unstressable position whose syllabic structure, mostly open, does not require the differentiation of timbres for certain vowels. A syllable is in the unstressed position because it is not the final syllable of the rhythmic unit. A two stress system, Initial Accent (IA) and Final Accent (FA) [6, 10, 11], penultimate accentuation in certain varieties of French [27], and a ‘stressless?’

type [25] have been accounted for the French language. This study will focus on the first category i.e. the syllable in the final position of a rhythmic group, which is a group of words spoken in one breath, where there is no pause between words. Punctuation marks help to distinguish rhythmic groups in a long sentence.

The place of the French stress is always on the last syllable of the word or group of words. In other words, the French stress strikes the final syllable of any group of words linked by meaning and not separated by a pause. The place of the stressed syllable therefore varies from one statement to another. The final syllable of each rhythmic group is pronounced with a longer duration than the syllables preceding it. For a consonant, the final position of the syllable, whatever the place of the syllable in the rhythmic unit, is a weak position which leads to a systematic relaxation of its articulation.

Duration: Syllabic duration/lengthening i.e. short vowels vs. long vowels is the quality of a sound which is related to the time it takes to produce a phoneme. In French, the open or closed structure of the syllable determines timbre and vowel duration. Variations in duration of stressed vowels comprise three types of duration: unmarked/short duration, marked/long duration and very marked/very long duration [32]. Short duration includes not only open syllables but also closed syllables with voiceless consonants [p t k f s ʃ] and [l] e.g. bref [ˈbrɛf], tasse [ˈtas].

Long duration is the intermediate between short and very long duration. They have closed syllables i.e. oral vowels plus [b d g m n ɲ j]. Very long duration exhibits closed syllables with oral vowels plus these voiced consonants [z v ʒ ʒ] and [vʁ] e.g. brève [ˈbrɛ:v], tard [ˈta:ʁ] père [ˈpe:ʁ], livre [ˈli:vʁ].

A stressed syllable has a relatively longer duration, as well as a higher intensity and a higher fundamental frequency (f₀). In this study, we dwell on the third category: very long duration.

Aim

This study reports observations and results obtained in an experiment on the comparison of the production of French prosodic stress by French native speakers

and learners of French as a foreign language viz. Twi speakers.

1. f0 values of the target syllables (final) and the preceding syllables (penultimate) were obtained in order to verify that prosodic stress contrasts indeed rely on factors pertaining to difference in pitch.
2. f0 values were calculated for the penultimate and final syllables.
3. Intensity values were calculated for the two juxtaposing syllables.
4. Durational values were taken for the two syllables. Statistical analyses (ANOVAs) were carried out on all measures obtained from the speakers ($p \leq 0.01$).

2. METHOD

Two adult male and female native French Speakers (FS) and three male and four female native Twi Speakers (TS), with no speech or hearing impairment, served as speakers. Twi is a register tone language of the Kwa Group, spoken in Ghana. It is one of the languages spoken by the Akan including people in the Asante Region, parts of the Western, Eastern, Central, Volta, Bono, Bono East and Ahafo Regions [2]. All Akan languages are mutually intelligible. The data consisted of acoustic productions i.e. reading a text, at a self-selected conversational rate. Speakers were not given any indication of the position of the stress on the syllables. The reading was produced at least 3 times by each speaker. Material: 11 syllables of 20 (bold) were selected from *Cauchemar*, Paul Verlaine's *Poèmes saturniens*. The poem [31] contains stress patterns and challenges in varying degrees which permitted to make a reasonably satisfactory analysis: CAUCHEMAR

J'ai vu passer dans mon **rêve**
 Tel ouragan sur la **grève**,
 D'une main tenant un **glaive**
 Et de l'autre un sablier,
 Ce cavalier
 Des ballades d'Allemagne
 Qu'à **travers** ville et campagne,
 Et du **fleuve** à la montagne,
 Et des forêts au vallon,
 Un étalon
 Rouge-flamme et **noir** d'ébène,
 Sans bride, ni **mors**, ni rêne,
 Ni hop ! ni cravache, entraîne
 Parmi des râlements **sourds**
Toujours ! toujours !
 Un grand feutre a longue plume
 Ombrail son œil qui s'allume
 Et s'éteint. Tel, dans la brume,
 Éclate et **meurt** l'**éclair** bleu
 D'une arme à feu.
 Comme l'aile d'une orfraie
 Qu'un subit orage effraie,
 Par l'**air** que la **neige** raie.

Son manteau se soulevant
 Claquait au vent,
 Et montrait d'un **air de gloire**
 Un **torse** d'ombre et d'**ivoire**,
 Tandis que dans la nuit **noire**
 Lusaient-en des cris stridents
 Trente-deux dents.

Paul Verlaine, Poèmes saturniens

By means of PRAAT sound editor, fundamental frequency (f0) and Intensity measurements were taken for the target stressed syllables and the corresponding preceding syllables. Durational measurements of the stressed syllables were also done for the:

- a) target syllable
- b) preceding syllable

Intensity, f0 and Duration are key because it is widely known that a prominent syllable is marked by variations in four acoustic cues: fundamental frequency (pitch), amplitude (volume), duration (length), and formant structure (a different timbre of the vowel). Of all the cues f0 seems the most important in terms of perception in French [13]. In the Twi language, like many tone languages in E. Asia and Africa, there is also a one-to-one association between tone and syllable i.e. each monosyllabic word or morpheme is associated with a tone [1, 34, 35].

A stressed syllable, like a high tone, is said to be distinguished not only by acoustic features but also has to be considered as a perceptual phenomenon. Therefore, in defining it one must account not only for its production but also for its perception by the interlocutor [13]. How do Twi learners (perceive and) produce the unfamiliar prosodic stress distinctions of the French language? Given that the amount of linguistic experience in stress use does not guarantee a facilitating effect for the learners of another foreign language. A study [3] on production of English lexical stress by TS revealed that f0 is one of the determining factors in distinguishing stress differences in English, but the key factor is intensity. The core question of the present study, therefore, was how French prosodic stress may be identified and produced by Twi learners of the French language, in terms of rhythmic groups and at the sentence level.

Experimental Design

This experiment was performed to find an answer to the question. In this preliminary study, we sought to compare native speaker stress production and the language learner production of the same text. Two French (1 male, 1 female) native speakers and seven (3 males and 4 females) Ghanaian final year students pursuing a four-year undergraduate program in French were recruited to accomplish the task. To best enable us obtain answers to the questions, Purposeful

Sampling was used in selecting the subjects. The students had previous exposure to the Oral French Language and its prosodic structure.

To detect the presence of differences in stress, we juxtaposed duration, intensity and fundamental frequency values of all preceding (penultimate) syllables of the target (final) syllables produced by each speaker.

Procedure: Acoustic data were recorded in an anechoic room for all speakers at TekTV Recording Studio, KNUST. A subject read the poem (3 times). DAW (digital audio workstation) used in executing the production is Steinberg Cubase 5 for both recordings and mixing. The audio sample rate of the project was set to 44100k Hz with Bit Depth of 16 Bit. A short training session consisting of reading examples preceded the test.

Results: Conforming to standards, French prosodic stress production by TS using one of the three cues (duration) was displayed in this experiment. The performance for duration was very high (100% of the time) in the production of stressed syllables by both French and Twi speakers (Tables 2 and 3). The second most dominant parameter was the fundamental frequency for the two categories of Speakers: FS (69%), TS (15.8%). The performance rate for the intensity cue, was the poorest, the least used by native FS (36%) and TS (5.3%) to distinguish the two classes of syllables: unstressed (penultimate) and stressed (absolute final). The production rate of the prosodic stress in duration was therefore higher than f0 and intensity (Table 1).

3. RESULTS AND DISCUSSION

Table 1 below illustrates the general tendency of the results i.e. the success rate of production of duration, f0 and intensity of the stressed syllables by the two groups of speakers. Data were obtained by averaging over the individual values of those measurements for all eleven tokens of the corpus. The overall data indicate that the most important parameter for determining prosodic stress assignment contrasts, i.e. relative duration, is highly significant ($p < 0.001$).

In absolute terms, the general tendency i.e. performance rate of 100% of duration of the target syllables were greater than the penultimate syllables for both native FS and TS. The second most dominant parameter was the f0 with a performance rate of 32%. On intensity, the most stressed syllable was /ʒu:ʁ/, the least being /vwa:ʁ/ and /su:ʁ/ by TS. Intensity values in absolute terms for the target syllables were higher than those of the penultimate syllables for the FS compared to TS.

Native speakers combined the 3 acoustic cues in varying degrees with duration, f0 and intensity

whereas Twi learners relied on duration (100%) but less on f0 and intensity, like the native speakers. Here, the most stressed syllables are /su:ʁ/, and /gle:v/, the least stressed being /nwa:ʁ/ for the TS. On the f0, the most stressed syllable was /ʒu:ʁ/ for the TS. The most stressed syllable is /ʒu:ʁ/, the least being /vwa:ʁ/ and /su:ʁ/ for the TS in intensity. All in all, the Ghanaian learners (TS) stress syllables in final position lesser/shorter than the FS, as far as duration is concerned. The marked stress in the study is evident in Tables 1, 2, 3. Syllable type and syllable position are factors that influenced the production of prosodic stress. Many syllables that are in the final positions tend to be very long e.g. /ʒu:ʁ/ and /gle:v/.

French Speakers (FS)			Twi Speakers (TS)			
syl	duration (ms)	f0 (Hz)	intensity (dB)	duration (ms)	f0 (Hz)	intensity (dB)
/ma:ʁ/	386	197	68	402	196	65
/ʁe:v/	453	200	69	392	173	63
/gʁe:v/	497	187	66	380	164	62
/gle:v/	524	200	66	419	183	63
/nwa:ʁ/	287	191	70	386	188	66
/mɔ:ʁ/	421	199	72	425	210	66
/su:ʁ/	500	314	66	439	185	63
/ʒu:ʁ/	531	199	70	392	212	66
/ʒu:ʁ/	289	174	66	372	162	63
/glwa:ʁ/	520	189	67	414	180	64
/vwa:ʁ/	451	199	66	421	170	64
AVER	442	206	68	404	184	64
STDEV	89	39	2	22	17	2

Table 1: Average and Standard Deviation for Duration, Fundamental Frequency and intensity: French and Twi speakers.

Of the three cues, f0 seems the most important in terms of perception in French [13]. The acoustic results of this study, involving native and non-native speakers suggest that, of the three cues, duration seems to be the most important in terms of production in French (Tables 1, 2, 3). However, intra-speaker comparison of production reveals that speakers' performance rate is not the same for the three cues. In fact, the performance rate is higher in f0 for the female French speaker (82%) than the male speaker (55%). The performance rate is 46% female and 36% male respectively with regards to intensity (Table 2). Durational values range between 287 ms and 524 ms (FS) and 372 ms and 419 ms (TS) with a very low standard deviation of 22%. The corresponding figures for intensity ranges from 66 dB and 72 dB (FS) and 62 dB and 66 dB (TS) with a very low standard deviation of 2% for both FS and TS.

TS seem to lengthen /ma:ʁ/ and /mɔ:ʁ/ more than the FS. The results differ from one stressed syllable to another. The French production of 7 syllables

/kɛ:v/, /gkɛ:v/, /glɛ:v/, /su:ɪ/, /ɜu:ɪ/, /glwa:ɪ/ and /vwa:ɪ/ are all higher than those of the Ghanaians for all three acoustic parameters namely, duration, fundamental frequency and intensity. The average production for all syllables follows the same trend, duration is 442 ms for FS and 404 ms for TS, f0: 206 Hz and 184 Hz, Intensity: 68 dB and 64 dB for FS and TS respectively, with relatively low standard deviations (Table 1).

	syllable	duration (ms)	intensity (dB)	f0 (Hz)
Penultimate Sy	/koʃ/	242	72.1	324.4
Stressed Sy	/ma:ɪ/	391	68.3	259.4
Difference +/-		+149	-3.8	-65.0
Penultimate Sy	/mɔ̃/	203	69.4	200.5
Stressed Sy	/kɛ:v/	470	67.5	217.2
Difference +/-		+267	-1.9	+16.7
Penultimate Sy	/la/	111	66.0	169.8
Stressed Sy	/gkɛ:v/	521	66.3	209.2
Difference +/-		+410	+0.3	+39.4
Penultimate Sy	/ɛ̃/	194	66.1	176.8
Stressed Sy	/glɛ:v/	552	67.3	247.0
Difference +/-		+358	+1.2	+70.2
Penultimate Sy	/e/	79	71.0	224.9
Stressed Sy	/nwa:ɪ/	312	69.9	222.2
Difference +/-		+233	-1.1	-2.7
Penultimate Sy	/ni/	154	74.1	251.1
Stressed Sy	/mɔ:ɪ/	441	74.9	253.9
Difference +/-		+287	+0.8	+2.8
Penultimate Sy	/mã/	172	69.2	221.0
Stressed Sy	/su:ɪ/	430	66.1	225.5
Difference +/-		+258	-3.1	+4.5
Penultimate Sy	/tu/	120	73.5	238.3
Stressed Sy	/ɜu:ɪ/	462	72.9	264.3
Difference +/-		+342	-0.6	+26.0
Penultimate Sy	/tu/	133	64.1	167.2
Stressed Sy	/ɜu:ɪ/	312	67.1	216.0
Difference +/-		+179	+3.0	+48.8
Penultimate Sy	/də/	132	71.7	214.2
Stressed Sy	/glwa:ɪ/	451	69.7	223.4
Difference +/-		+319	-2.0	+9.2
Penultimate Sy	/di/	112	69.1	231.3
Stressed Sy	/vwa:ɪ/	434	70.2	257.4
Difference +/-		+322	+1.1	+26.1

Table 2: Duration, intensity, fundamental frequency values for French native speaker (female)

The closed syllable type influenced the speakers' production of stress. When the final phonemes /ɪ/ and /v/ were presented to the FS subjects and the TS subjects, they consistently assigned final stress (duration) to the word 100% of the time. It would be worthwhile to investigate the performance rate of speakers in other post-vocalic consonantal /z, ʒ, vɪ/ environment.

	syllable	duration (ms)	intensity (dB)	f0 (Hz)
Penultimate Sy	/koʃ/	311	61.1	251.1
Stressed Sy	/ma:ɪ/	505	63.1	238.1
Difference +/-		+194	+2.0	-13.0
Penultimate Sy	/mɔ̃/	252	60.0	196.1
Stressed Sy	/kɛ:v/	329	60.7	208.0
Difference +/-		+77	+0.7	+11.9
Penultimate Sy	/la/	256	61.0	202.6
Stressed Sy	/gkɛ:v/	414	62.1	204.5
Difference +/-		+158	+1.1	+1.9
Penultimate Sy	/ɛ̃/	276	66.1	221.7
Stressed Sy	/glɛ:v/	584	64.1	210.2
Difference +/-		+308	-2.0	-11.5
Penultimate Sy	/e/	130	64.8	228.6
Stressed Sy	/nwa:ɪ/	523	66.5	234.0
Difference +/-		+393	+1.7	+5.4
Penultimate Sy	/ni/	262	64.8	234.3
Stressed Sy	/mɔ:ɪ/	389	65.9	231.1
Difference +/-		+127	+1.1	-3.2
Penultimate Sy	/mã/	270	63.9	214.8
Stressed Sy	/su:ɪ/	491	61.3	226.3
Difference +/-		+221	-2.6	+11.5
Penultimate Sy	/tu/	178	65.2	257.3
Stressed Sy	/ɜu:ɪ/	357	64.4	238.0
Difference +/-		+179	-0.8	-19.3
Penultimate Sy	/tu/	191	61.9	240.9
Stressed Sy	/ɜu:ɪ/	462	63.1	216.5
Difference +/-		+271	+1.2	-24.4
Penultimate Sy	/də/	120	64.1	204.0
Stressed Sy	/glwa:ɪ/	391	61.1	200.6
Difference +/-		+271	-3.0	-3.4
Penultimate Sy	/di/	118	61.9	226.5
Stressed Sy	/vwa:ɪ/	489	61.1	197.3
Difference +/-		+371	-0.8	-29.2

Table 3: Duration, intensity, fundamental frequency values for Twi speaker 7 (female)

4. CONCLUSIONS

This investigation has shown, on the basis of the selected corpus and evidence from our acoustic data that the most important acoustic parameter in producing French prosodic final stress, by both native speakers and Twi learners of French, is duration which is consistent. Pitch difference (f0) and intensity are not the key determining factors in distinguishing prosodic stress differences between penultimate and final syllables. Intra syllabic phonemic comparison, suggests that French Speakers' (f0) performance rate is higher than the Twi Speakers in distinguishing stress differences between the two syllables. The intensity cue reveals that Twi Speakers' performance rate is very low compared to the French Speakers.

Further investigations will focus on identification performances for non-poetic corpus on prosodic stress contrasts since different tones, stress patterns could be used when reading poems compared to daily conversation. Data will also be based on more and same number of female and male native FS and TS.

5. REFERENCES

- [1] Adu Manyah K. 2019. Non-native Speakers' Identification of Lexical Tone Contrasts. *19th ICPhS*. Melbourne. 2782-2786.
- [2] Adu Manyah K. 2010. *Parlons Twi*. Langue et culture. Paris: l'Harmattan.
- [3] Adubofour I. 2019. *Lexical Stress in Ghanaian English*, MPhil Thesis, KNUST, Kumasi.
- [4] Aoyama K. 2007. Prosody in second language acquisition. *Language experience in second language speech learning*, 281-297.
- [5] Astésano, C. et al. 2007. Structural influences on initial accent placement in French. *PhonACog- the role of the initial accent in prosodic structuring in French- from phonology to speech processing. Language and speech 50 (Pt 3): 423-46*.
- [6] Astésano, C. 2016. Accentuation et niveaux de constitution en français: enjeux phonologiques et psycholinguistiques. *Langue Française, Paris, Armand Colin*.
- [7] Beaugendre F. et al. 2001, Accentuation boundaries in Dutch, French and Swedish. *Speech Communication 33(4):305-318*.
- [8] Best C. T., Bohn P. O, Faber A. 2003. Cross Language perception of non-native vowels: Phonological and phonetic effects of listeners' native languages, *15th ICPhS*. Barcelona. 2889-2892.
- [9] Conlen, M. 2016. *A Linguistic Comparison: Stressed-timed and syllable timed languages and their impact on their impact on second language acquisition*. Honors College Theses, 30.
- [10] Di Cristo, A. 2008. Vers une modélisation de l'accentuation du français : Première partie. *Journal of French Language Studies*.
- [11] Di Cristo, A. 2010. *Vers une modélisation de l'accentuation du français : Seconde partie* Cambridge, Cambridge University Press.
- [12] Engel, H. 2017. *Accentuation et transfert en français langue seconde*. Université de Stockholm. URN: urn:nbn:se:su:diva-155916.
- [13] Frost, D. 2011. Stress and cues to relative prominence in English and French: A perceptual study. *J. of the Int. Phonetic Assoc.* Vol. 41, No. 1, 67-84.
- [14] Lunden, A. 2018. Explaining word-final stress lapse. *From Part I- Phonetic correlates and prominence distinctions. The study of Word Stress and Accent: theories, methods and data.* 76-101.
- [15] Martin, P. 2006. Phonologies and Phonetics of French Prosody. *UFR linguistique Université Paris 7 Denis Diderot. ISCA Archive Speech Prosody 2006, Dresden*.
- [16] McRoberts, G.W. 1995. The role of fundamental frequency in signalling linguistics stress and affect: Evidence of dissociation. *Perception & Psychophysics* 57. 159-174.
- [17] Moyer, A. 2004. Age, accent and experience in second language acquisition. *Second language acquisition 7, Dublin : Trinity College*.
- [18] Obin, N., Rodet X., Lacheret-Dujour A. 2008. Un modèle de durée des syllabes fondé sur les propriétés syllabiques intrinsèques et les variations locales de débit. *HAL Id: halshs-00334347, version 1*.
- [19] Patalauskaitė, I. 2005. Comparaison de l'accentuation des deux langues: français et lithuanien. *VDU, ASU ir LEU iki/ until 2018*.
- [20] Piat M., Fohr D., Illina I. 2008. Identification de l'origine des locuteurs non natifs en utilisant des paramètres prosodiques. *JEP'08, Avignon, France*.
- [21] Quemoun, F. R. 2003. Le système accentuel du français et sa valeur stylistique. *Vol. 2. 405-418*.
- [22] Hagberg, R. L. 2006. An autosegmental theory of stress. *SIL e-Books, 3, Dallas, SIL International*.
- [23] Rietmolen, N. 2019. Neural signature of metrical stress processing in French. *Université Toulouse le Mirail- Toulouse II English. version 1*.
- [24] Roosman L. M. 2009. Dutch word stress as pronounced by Indonesian students. *Wacana*, Vol. 11 No. 2: 241-256.
- [25] Rossi, M. 1980. Le français, langue sans accent ? *L'accent en français contemporain, Studia Phonetica, 15 Ottawa : Didier, 13-52*.
- [26] Schwab, S. 2013. Apprenants hispanophones de FLE et accentuation en français. *Travaux neuchâtelois de linguistique, 59, 71-86*.
- [27] Schwab, S. et al. 2012. An acoustic study of penultimate accentuation in three varieties of French. *Laboratoire d'Analyse et de Traitement du Langage (LATL)*.
- [28] Schweitzer C., Dodane C. 2020. Description de l'accent en français : des premiers grammairiens aux premiers phonéticiens (XVIIe-début du XXe siècle) *SHS Web Conferences. Volume 78, 7e Congrès Mondial de Linguistique Française*.
- [29] So, C. K. & Best, C. T. 2014. Phonetic influences on English and French listeners' assimilation of mandarin tones to native prosodic categories. *Studies in Second Language Acquisition, 36, 195-221*.
- [30] Vaissière, J. 2002. Cross-linguistic prosodic transcription: French Vs English. *St. Petersburg State University Press, FLE, Vol. 1*.
- [31] Verlaine, P. 1866. *Cauchemar Poèmes saturniens/ Eaux-fortes II Alph Lemerre Librairie-Éditeur*.
- [32] Wioland, F. 1991. *Prononcer les mots du français. Des sons et des rythmes*. Paris. Hachette.
- [33] Woehrling C., Boula P., Adda-Decker M. 2008. Aspects prosodiques du français parlé en Alsace, Belgique et Suisse. *LIMSI-CNRS, Orsay Cedex*.
- [34] Xu, Y. 2004. Understanding tone from the perspective of Production and Perception. *Language and Linguistics*. 5.4: 757-797.
- [35] Xu, Y. 1994. Production and perception of coarticulated tones, *J. Acoustical Society Of America*. 2240-2253.