Acoustic Correlates of Emphatic Accent in French Vowels /i, a, u/

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The term "emphasis" refers to the "relative prominence given to certain syllable or word compared to others" [1]. An emphatic accent, an accent resulting from emphasis, affects both prosodic (suprasegmental) and segmental aspects of the syllable produced with an emphatic accent. From a prosodic point of view, a syllable with an emphatic accent is generally realized with a longer duration, higher F0, and greater intensity than a syllable without an empathic accent [2]. From a segmental point of view, the F1 values of the vowel with an emphatic accent are smaller in closed vowels and larger in open vowels, and the F2 values are larger in front vowels and smaller in back vowels [3]. Thus, the vowel space (F1*F2) of accented vowels results in an expansion, which is reported as speech enhancement phenomenon observed in clear speech and in different prosodically strengthened positions [4, 5]. The French language is known to have a "tonic accent (*accent tonique*)," which is realized on the final vowel of a rhythmic group, unless the final vowel is a schwa, with a longer duration and higher or lower pith [6]. Its primary function is to mark phrasing boundaries in a given utterance [7]. On the other hand, an *emphatic accent* in French is known to appear in the initial syllable of a word and is called by different names such as "*accent initial* (initial accent)" [8], "*additional accent*" [9], "*accent d'insistance* (accent for insistence)," and "*accent didactique* (didactic accent)" [6]. According to [10], the vowel space in the first vowel of French words is reduced compared to that of the final vowels of such words.

The objective of this study is to examine the acoustic properties of three French peripheral vowels /i, a, u/ with an emphatic accent based on an analysis of the words spoken in isolation (citation forms). We extracted 405 disyllabic words from the NAVER French-Korean dictionary, which is designed for Korean learners of French. Each word in the dictionary is provided with a sound file recorded by a local voice actress who speaks standard French. The words used for this study are each of a C1V1.C2V2 structure with stop consonant as the preceding consonant. A total of 241 words with an emphatic accent on V1 are selected (/ˈi/ 71 ***pi****pa*, /ˈa/ 101 ***ta****pa*, /ˈu/ 69 *c****ou****per*) and 164 words without an emphatic accent on V2 are selected (/i/ 58 *pap****i***, /a/ 64 *cat****a***, /u/ 42 *couc****ou***). Acoustic measurements for duration, F0, intensity, F1, F2, and F3 were performed using Praat. Statistical analysis was conducted by using SPSS.

Table 1 presents the results of a t-test for prosodic features with and without an empathic accent for /i, a, u/. In Table 1, F0 and intensity show statistically larger values in all three vowels, while the duration of V1 is significantly shorter than the duration of V2 in all three vowels. A regression analysis on the prosodic features indicate that the most significant prosodic feature in V1 was intensity (β=0.660), followed by duration (β=-0.224), and F0 (β=-0.089). Table 2 reveals the results of the t-test for segmental features with and without an empathic accent. The F1 values of V1 are significantly higher than that of V2 for high vowels /i, u/, while F2 values of the low vowel /a/ show significantly higher values in V1. As for F3, the front high vowel /i/ is higher in V2, while the back high vowel /u/ is significantly higher in V1. This means that /i/ becomes more round and /u/ becomes less round in V1. Finally, Figure 1 illustrates that the vowel space of V1 (24.83kHz^2) and V2 (25.74kHz^2).

In this study, we have examined the acoustic properties of three French peripheral vowels /i, a, u/ with an emphatic accent in prosodic and segmental aspects. The results show that compared to unaccented vowels the duration of the accented vowels is shorter and the vowel space smaller. The results are similar to studies done on French [10] but do not conform to previous works on English, Croatian or Korean [2, 3, 4, 5]. Based on the results, it may be asserted that the French words have different acoustic and articulatory behavior compared to other languages such as English, Croatian

or Korean. Further research will be required to confirm this assertion and to identify their causes.

Table 1. Results of t-test for prosodic features with and without an empathic accent for /i, a, u/

Prosodic features		M(SD)	*t*(*p*)
Duration(ms)	[ˈi]	129.8(30.5)	**-5.194(0.000)*****
	[i]	157.2(28.7)	
	[ˈa]	126.6(23.6)	**-5.663(0.000)*****
	[a]	147.3(21.7)	
	[ˈu]	118.8(24.2)	**-3.341(0.001)****
	[u]	134.1(22.0)	
F0(Hz)	[ˈi]	320.1(34.1)	**36.154(0.000)*****
	[i]	154.5(16.4)	
	[ˈa]	300.6(29.2)	**48.954(0.000)*****
	[a]	137.7(13.0)	
	[ˈu]	323.4(29.5)	**36.540(0.000)*****
	[u]	159.5(17.8)	
Intensity(dB)	[ˈi]	78.7(3.5)	**15.027(0.000)*****
	[i]	69.6(3.2)	
	[ˈa]	81.2(3.7)	**16.700(0.000)*****
	[a]	72.8(2.8)	
	[ˈu]	81.5(2.7)	**19.530(0.000)*****
	[u]	71.4(2.5)	

Table 2. Results of t-test for prosodic features with and without an empathic accent on /i, a, u/

Segmental features		M(SD)	*t*(*p*)
F1	[ˈi]	362.8(32.9)	**7.917(0.000)*****
	[i]	308.6(42.7)	
	[ˈa]	781.1(76.6)	-1.256(0.211)
	[a]	796.6(78.5)	
	[ˈu]	388.3(52.6)	**3.613(0.000)*****
	[u]	352.5(47.1)	
F2	[ˈi]	2327.3(131.6)	1.696(0.092)
	[i]	2295.3(81.0)	
	[ˈa]	1810.4(230.0)	**7.098(0.000)*****
	[a]	1572.4(173.1)	
	[ˈu]	1108.4(162.9)	-1.148(0.256)
	[u]	1175.2(355.2)	
F3	[ˈi]	3199.8(222.4)	**-8.696(0.000)*****
	[i]	3448.6(84.1)	
	[ˈa]	2922.1(209.1)	1.070(0.286)
	[a]	2895.8(105.3)	
	[ˈu]	2867.2(196.1)	**4.078(0.000)*****
	[u]	2719.9(163.5)	

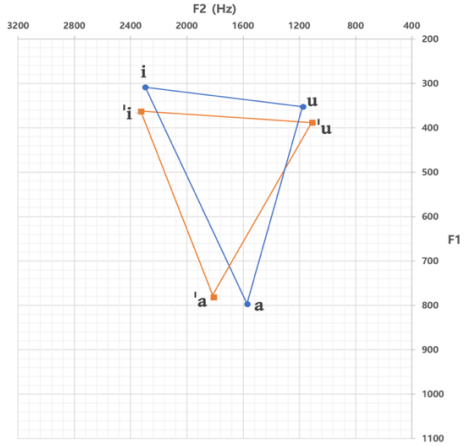

Figure 1. Vowel space (F1*F2) of /i, a, u/ with (red) and without (blue) an emphatic accent

References

[1] Bean, C., Folkins, J. W., & Cooper, W. E. (1989). The effects of emphasis on passage comprehension. *Journal of Speech, Language, and Hearing Research*, 32(4), 707-712.

[2] Lehiste, I. (1970). *Suprasegmentals.* Cambridge, MA: The MIT Press. 110, 131.

[3] Lindblom, B., Agwuele, A., Sussman, H. M., & Cortes, E. E. (2007). The effect of emphatic stress on consonant vowel coarticulation. *The Journal of the Acoustical Society of America*, *121*(6), 3802-3813.

[4] Cho, T., Lee, Y., & Kim, S. (2011). Communicatively driven versus prosodically driven hyper-articulation in Korean. Journal of Phonetics, 39(3), 344-361.

[5] Smiljanic, R., & Bradlow, A. R. (2008). Stability of temporal contrasts across speaking styles in English and Croatian. Journal of Phonetics, 36(1), 91-113.

[6] Carton, F. (1974). *Introduction à la phonétique du français*. Bordas. 117-122.

[7] Vaissière, J. (1991). Rhythm, accentuation and final lengthening. *Music, language, speech and brain*, 59, 108-120.

[8] Astésano, C., Bard, E. G., & Turk, A. (2007). Structural influences on initial accent placement in French. *Language and speech*, 50(3), 423-446.

[9] Dahan, D., & Bernard, J. M. (1996). Interspeaker variability in emphatic accent production in French. *Language and speech*, *39*(4), 341-374.

[10] Gendrot, C., & Adda-Decker, M. (2006). Analyses formantiques automatiques en français : périphéralité des voyelles orales en fonction de la position prosodique. *Proc. Journées d'Étude sur la Parole*.