FUNDAMENTAL FREQUENCY AND INTENSITY EFFECTS ON CEPSTRAL MEASURES IN SPEECH VOWELS OF PATHOLOGICAL VOICES

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Introduction: Cepstral peak prominence (CPP) and smoothed CPP (CPPS) evaluate the degree of harmonic organization in an acoustic voice signal[1] and have been described as reliable parameters to detect overall dysphonia in standardized connected speech samples[2-5]. However, studies in healthy and pathologic voices indicate vocal intensity (SPL)[4], fundamental frequency (F0) sample duration, syllable stress[2,6] and vowel context (type of sustained vowel and speech sample) may influence on cepstral measures[3,5], yielding different assessment results.

Objective: to evaluate the effects of F0 and SPL on CPP and CPPS in vowels of connected speech from pathological voices.

Method: In a retrospective cross-sectional study, recordings of 26 voice disordered Brazilian Portuguese speakers (15 women, 11 men) with a mean age of 47 years (SD = 14) were assessed. Five /a/ vowels were manually excised from stressed syllables of four CAPE-V sentences. All sentences were recorded in a silent booth of a Brazilian University Hospital using a headset microphone (5cm/45º distance) and 44 kHz with 32-bit resolution. Excised vowel (EV) exclusion criteria were signal-to-noise ratio (SNR) below 26 dBA, sample duration below 65 milliseconds (ms), and peak clipping. Acoustic analysis was done using PRAAT program. Statistical analysis included Linear Mixed Model and Spearman`s rank correlation coefficient.

Figure 1 displays the five extracted vowels

Sentence
"'Agora é horA de acAbAr"
"sônia sAbe sambAr sozinha"
" olha LÁ o Avião Azul"
"PApAi trouxe pipoca quente"

Results: SPL and F0 were significantly and positively correlated with CPP and CPPS, r (104) = 0.4 and 0.5, (p<.001); also, the interaction between SPL and F0 had significant effects on CPP and CPPS, respectively F (1, 100) = 43.0 and F (1, 100) = 54.4, (p<.001). However, SPL and F0 as separate factors showed no significant effects on cepstral measures (p>.05).

Table 1. Descriptive results:

Parameter	EV acabAr (SD)	EV sAbe (SD)	EV sambAr (SD)	EV LÁ (SD)	EV papAi (SD)
F0	137 (30)	159 (37)	148 (34)	147 (37)	172(30)
SPL	86(3)	90 (3)	89(3)	89(4)	90(2)
CPP	35 (5)	35(5)	34 (5)	34 (6)	36(5)
CPPS	23 (4)	24(3)	23 (4)	23 (5)	25 (4)
Sample	0.097	0.119	0.094	0.12	0.082
Duration(s)	(0.03)	(0.04)	(0.03)	(0.04)	(0.02)
Total (EV)	15	24	23	23	19

Figure 2. Regression line CPPS x SPL (R^2 = 0.19). CPP x SPL was similar (R^2 = 0.18):

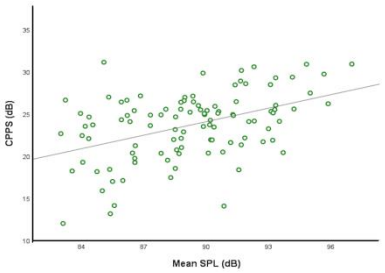
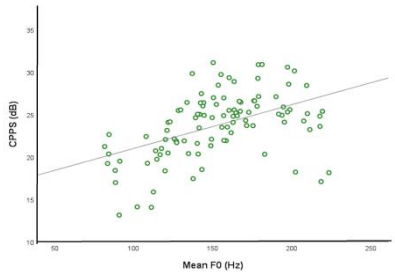


Figure 3. Regression line CPPS x F0 (R^2 = 0.23). CPP x F0 was similar (R^2 = 0.22):



Conclusion: In pathological voices, combined higher F0 and SPL yielded higher cepstral measures in excised vowels. Higher F0 and SPL are associated with increased vocal fold tonus, and thus may result in more phonatory stability during speech. Thus, patients talking systematically louder and higher during measurements may obtain better assessment results for CPP and CPPS. Naturally, F0 and SPL variation reflect speech characteristics influenced by language, pragmatics, dialect, but also pathology. In this sense, variations of CPP and CPPS expected in speech utterances of healthy voices should be better understood in pathologic voices. Therefore, a larger clinical study will confirm how SPL and F0 effects could be controlled for.

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