Voice changes during the period of 18 month in the voice training of students of acting

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Abstract

The main aim of this study was to evaluate the change of the voice training of drama acting students (8 females and 9 males). For all students were made acoustical recordings of their speaking voice and speaking phonetogram measure in the beginning and at the end of the training (after 18 month). The recordings consisted of reading standard text in habitual voice, aloud normal voice and in "stage like" voice with normal loudness and aloud.
The recordings were analyzed by software ParVRP (in MATLAB), that provide analysis of these parameters: parameters of speaking range profile (SRP) – pitch and SPL, their mean, median, modus values and dynamic and tone ranges; parameters of long time average spectra in third octave bandwidth, whole LTAS spectral tilt and LTA spectral tilt of 400 4000 Hz bandwidth. Additional spectral parameters: level difference between first and second harmonics; spectral centroids of whole spectra and bandwidths 0 25 kHz and 2 5kHz; spectral balance parameters: ER, SPR, alpha ratio; formant positions (from LPC): F1, F2, F3, F4, F5; and parameters of multidimensional analysis: PFR, Jita, Jitt, ShdB, Shim, SPI, VTI, MAJ, RAP, PPQ, vF0.
Values of given "speaking" parameters were statistically analyzed by paired student t test before and after voice training separately for males and females group. The results show that vocal training statistically increased the loudness of voice, although, the voice pitch did not change. After training significantly lowered the positions of F2, F3, F4, decreased values of spectral tilt parameters and spectral centroids. Results indicated the change in voice properties "darkness" or "dullness". Parameters of MDVA significantly changed only in decreasing of Shimmer that means improvement in an amplitude stability of voice.

Aim of study

To compare acoustical parameters of speaking voice before and after voice training in drama acting students.

Participants

Beginning students of drama acting at Academy of performing arts of Prague, 8 females, 9 males.
Speech recordings (reading standard text) **in the beginning** of study **and after 18 months** of vocal training in 4 voice utterances:

- habitual comfortable (HC);
- habitual aloud (HA);
- supported comfortable (SC);
- supported aloud (SA).

Methods

Segmental acoustical parameterisation (window 30 ms length, 10 ms step)**:**

- **Speech range profile**:
  - Pitch (midi);
  - Sound pressure level SPL (dB);
  - SRP area
- **Long time average spectra** in 1/3 octave bandwidth:
  - whole LTAS spectral tilt;
  - LTA spectral tilt of 400 4000 Hz bandwidth;
- **Spectral parameters**:
  - level difference between first and second harmonics (H1 H2);
  - spectral centre of gravities of whole spectra (COGamp) and in bandwidth 0- 2.5 kHz (COG0k25) and bandwidth 2- 5 kHz (COG25k);
  - spectral balance parameters: ER, SPR, alpha ratio;
  - formant positions (from LPC): F1, F2, F3, F4, F5;
- **Multidimensional voice analysis:**
  - PFR, Jita, Jitt, ShdB, Shim, SPI, VTI, MAJ, RAP, PPQ, vF0.

Statistical analysis:

- paired t-test comparison of mean values of acoustical parameters before and after voice training in a given utterance.

Results

Table 1 shows results of **Speech range profile parameters** (Pitch and SPL), SRP area and Spectral tilts for comparison of habitual voice with comfortable loudness (HC) before and after vocal training (for both male and female groups). Resultant outcomes of t tests, tinged blue for male and orange for female, are used in summary Table 2 (similar way for all utterances).

Summary of t test (Table 2) shows no change in the voice pitch (Pitch mean) after training in general (for both groups males and females), but the significant change ($p<0.05$) in loudness (SPL mean in dB) for all utterances. Mean overall increasing of SPL was 8.51 dB for male group and 7.86 dB for females. Pitch range and standard deviation increased only for females. SRP area decreased for males after training, overall LTAS tilt decreased in general for males and females, but tilt between 0.4 4kHz decreased only for habitual voice.

Results of other **Acoustical parameters** in habitual comfortable voice are in Table 3. These results show significant increasing of the level of the first harmonic, and significant decreasing of parameters: VTI, ER, SPR, H1 H2, Alpha, all Centres of spectral gravity, formant positions F2, F3 and PFR for both males and females after vocal training. Difference between groups were in parameters SPI- increased and F1 – decreased for males, and F4- increased for females after training.

Resultant t test comparisons for all utterances are in Table 4. In general, the Level of H1 increased, centres of gravities and formant positions shift toward lower frequencies, parameters ER, SPR, Alpha drops down. From the perturbation parameters changed only ShdB and Shimmer – the amplitude perturbation decreased after training.

habitual comfortable			Pitch mean	Pitch std	Pitch min	Pitch max	Pitch median	Pitch modus	Pitch range	SPL mean	SPL std	SPL min	SPL max	SPL median	SPL modus	SPL range	SPR Area	LTAS tilt	LTAS tilt 0.4-4
Male	before	mean	45,5	2,1	39,4	51,5	45,6	45,5	12,1	61,4	4,4	47,9	71,6	61,9	63,2	23,7	163	-4,0	-9,5
		SD	1,9	0,3	2,5	1,8	1,9	1,9	2,0	2,2	0,5	2,5	3,3	2,2	3,1	2,3	36,0	0,5	1,0
	after	mean	45,2	2,0	39,8	50,4	45,2	44,6	10,6	70,5	3,3	60,9	78,6	70,8	71,0	17,7	110	-5,2	-10,1
		SD	1,0	0,2	1,3	1,2	1,0	1,1	0,8	1,6	0,4	1,4	2,4	1,7	2,7	2,1	28,7	0,4	1,1
		p val	0,612	0,687	0,567	0,064	0,467	0,133	0,098	0,000	0,000	0,000	0,000	0,000	0,001	0,000	0,003	0,000	0,002
		hyp								+	-	+	+	+	+	-	-	-	-
Female	before	mean	55,2	1,9	50,2	60,4	55,2	54,6	10,2	60,3	4,7	45,2	70,2	60,9	61,4	25,0	152	-2,4	-9,3
		SD	1,6	0,4	1,3	2,0	1,7	1,9	1,8	1,7	0,4	1,3	1,9	1,8	1,2	2,2	20,9	0,4	1,4
	after	mean	55,0	1,8	50,2	60,2	55,0	54,6	10,0	69,2	4,3	56,3	79,6	69,7	71,0	23,2	134	-3,7	-10,0
		SD	1,1	0,3	1,1	1,6	1,1	1,4	1,5	2,8	0,6	2,2	3,8	2,9	3,2	3,9	34,0	0,5	1,1
		p val	0,771	0,771	0,994	0,773	0,703	1,000	0,748	0,000	0,016	0,000	0,000	0,000	0,000	0,127	0,107	0,000	0,033
		hyp								+	-	+	+	+	+			-	-

*Table 1: T-test comparison of **Speech range profile parameters** for habitual comfortable voice (male and female group) before and after vocal training. Mean and standard deviations (SD) values of SPR parameters, probability values (p-val) of t-test and marker of hypothesis (hyp) used in Table 3. (+/- means that mean value of parameter was significantly higher / lower after voice training.)*

Utterance		Pitch mean	Pitch std	Pitch min	Pitch max	Pitch median	Pitch modus	Pitch range	SPL mean	SPL std	SPL min	SPL max	SPL median	SPL modus	SPL range	SPR Area	LTAS tilt	LTAS Tilt 0.4-4 kHz
Male before vs. after training	habit.comf.								+	-	+	+	+	+	-	-	-	-
	habit.aloud		-					-	+	-	+	+	+	+		-	-	-
	support.comf.								+	-	+	+	+	+	-	-	-	
	support.aloud								+		+	+	+	+			-	
Female before vs. after training	habit.comf.								+	-	+	+	+	+			-	-
	habit.aloud		+					+	+		+	+	+	+			-	
	support.comf.		+					+	+		+	+	+	+			-	
	support.aloud		+						+		+	+	+	+			-	-

*Table 2: T-test results of **Speech range profile parameters** comparison. +/- means that mean value of parameter was significantly higher / lower after voice training.*

habitual comfortable			SPI	VTI	ER	SPR	H1-H2	Alpha	H1	COGamp	COG25k	COG0k25	COGharm	F1	F2	F3	F4	F5	PFR
Male	before	mean	166,5	0,1	-22,2	-24,5	-0,3	-27,2	-53,7	634,1	2901	388,8	616	393	1289	2411	3382	4318	3,7
		SD	21,4	0,0	2,7	2,8	1,1	2,0	2,0	100,6	191,8	43,7	94,8	21,4	47,4	52,2	88,2	87,3	1,1
	after	mean	177,1	0,0	-25,7	-27,6	0,3	-30,3	-49,4	370,0	2792	338,9	363	372	1203	2336	3354	4351	1,5
		SD	19,6	0,0	2,6	2,9	1,4	2,1	1,1	55,8	185,6	42,4	52,5	7,7	50,8	45,4	65,1	69,1	0,4
		p val	0,040	0,000	0,001	0,004	0,153	0,000	0,002	0,000	0,007	0,001	0,000	0,012	0,000	0,010	0,289	0,216	0,002
		hyp	+	-	-	-		-	+	-	-	-	-	-	-	-			-
Female	before	mean	197,2	0,2	-24,2	-27,4	1,6	-27,0	-52,3	834,9	3211	433,4	780	403	1199	2381	3395	4389	5,2
		SD	17,4	0,1	2,5	2,8	1,4	1,6	1,8	60,7	147,7	39,2	58,9	18,5	74,5	96,7	96,8	75,7	0,8
	after	mean	209,9	0,0	-27,6	-30,3	0,9	-30,0	-49,6	526,3	3060	405,0	505	388	1130	2264	3313	4339	4,4
		SD	29,1	0,0	3,0	3,4	2,3	2,7	2,8	87,4	165,8	54,1	77,5	21,1	62,1	81,9	87,0	82,3	1,0
		p val	0,107	0,000	0,001	0,004	0,293	0,004	0,029	0,000	0,000	0,091	0,000	0,053	0,027	0,020	0,049	0,062	0,008
		hyp		-	-	-		-	+	-	-		-		-	-	-		-

*Table 3: T-test comparison of **Acoustical parameters** for habitual comfortable voice (male and female group) before and after vocal training. Mean and standard deviations (SD) values of SPR parameters, probability values (p-val) of t-test and marker of hypothesis (hyp) used in Table 4. (+/- means that mean value of parameter was significantly higher / lower after voice training.)*

Utterance		SPI	VTI	ER	SPR	H1-H2	Alpha	H1	COGamp	COG25k	COG0k25	COGharm	F1	F2	F3	F4	F5	PFR	Jita	Jitt	ShdB	Shim	MAJ	RAP	PPQ	vF0
Male before vs. after training	habit.comf.	+	-	-	-		-	+	-	-	-	-	-	-	-			-								
	habit.aloud		-	-	-		-		-	-		-		-	-	-					-	-				
	support.comf.	+	-	-	-		-	+	-	-	-	-	-	-	-	-		-			-	-				
	support.aloud		-				-	+	-	-		-		-	-	-					-					
Female before vs. after training	habit.comf.		-	-	-		-	+	-	-		-		-	-	-		-			-	-				-
	habit.aloud		-	-	-		-	+	-	-		-	-		-	-					-	-				
	support.comf.		-	-	-		-		-	-		-	-	-	-	-	-				-	-				
	support.aloud	+	-	-	-		-		-	-	-	-	-			-					-	-				

*Table 4: T-test results of **Acoustical parameters** comparison. +/- means that mean value of parameter was significantly higher / lower after voice training.*

Discussion and conclusion

The main effect of vocal training was in increasing of the voice loudness. Our data are slightly higher than those in literature (Siupsinskiene et al., 2011, Awan, S.N. 1993). The pitch range grew in females but in high frequency, that is in opposite way than in (Walzak, P. et al. 2008). The change in SPR an ER in projected voice showed (Pinczower, R. et al. 2005). Similarly, the lowering of the formant positions showed in Y Buzz resonance technique by Lessac (Barrichelo indstrom et al., 2009).

In general, after vocal training increased amount of acoustical energy in the lower part of the spectrum. That indicates change in the voice **brightness toward more dark** or dull. Decreasing of Shimmer indicate more stable and concentrate voice amplitudes.

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