Voice Assessment Before and After Phonetic Voice and Pronunciation Exercises

Gordana Varošanec-Škarić
Faculty of Philosophy, Department of Phonetics
E-mail: gvarosan@ffzg.hr

ABSTRACT

The research objective has been to confirm the efficiency of phonetic voice and pronunciation exercises. The results of listeners' assessment have then been compared to the objective parameters f_0, shimmer and jitter, as well as to the spectra energy on the basis of LTASS. The dissimilarity index (SDDD) has been calculated to compare the spectra before and after the exercises. Voices that have improved the most have had higher SDDD values. There has also been more relative energy in the area of voluminosity and sonority. Phonetic exercises have proved efficient for improving the timbre of the voice, making it more consistent, better set and for sharpening the speech.

1. INTRODUCTION

There are different voice exercises in the pedagogy of voice of the vocal professionals, voice therapy, and disphonic voices and some of them are phonetic exercises for voice and pronunciation [12] that act in such a way as to effect on timbre and on diction. They relay on abdominal diafragmatic and lower rib breathing, sternum, front hard palate and listening. Phoneticians, voice pedagogists, know that what is expected from the voice of a vocal professional, especially singers, theater actors, teachers and so on, is efectively different from the everyday conversation expectancy. The vocal professionals' voice is required to be prepared for the speach, the effort of voice must not be noticable and screaming must not be heard in the speach. Further more, we claim that, for example theatrical voice, is not sponatanous but trained. Exercises are used in order to acomplish better supralaryngeal and laryngeal setting, i.e. better voice quality and better setting of prozodic features, pitch, consistency and loudness.

The research is based on the assumption that voice training effects the timbre [8]. Scientific research has pointed out the importness of listening [2, 10], breathing tehnique during the voice training [9, 3] and chestwall vibration [7]. The purpose of this paper is to establish efficiancy of phonetic exercises for voice and diction in shorter time, i.e. its effect on the quality of voice in speech.

2. PROCEDURE

Voice and pronunciation exercises were in average 90 minutes long. According to the phonetic protocol, phoneticians (N=24) were evaluating the voices of vocal professionals and non-professionals (N=76) in random order before and after the exercise, in continual neutral speech of standardized non-fricative text (15s) and restrained phonation of vowel /a/ on the most comfortable pitch for the examinee (10s).

2.1. Subjective evaluation variables

The aesthetic category of voice, pitch range, loudness, and consistency were evaluated on the scale of 5 with 1 meaning extremely pleasant voice, 2 pleasant voice, 3 average voice, 4 unpleasant voice, 5 very unpleasant voice, also, pitch range scaling from very deep (1) to very high (5), loudness scaling from very silent to very loud, and so on, as it is usual in the descriptive phonetic description of voice [4]. Form of settings were estimated on the scale of 6 degrees change (ranging from normal (1-3) to ubnormal settings (4-6): supralyngeal forms (velopharingalysation, pharingalysation, supralaryngeal tension) and laryngal forms of settings (tension, position of larynx, phonation types: harshness and breathness, while modal and falsetto phonation types have not been graded but only marked if present). Quality of diction was estimated on the fricative text (it also contained normal fricative and africative distribution of Croatian voices [s, ʃ, ʒ, z, ts, tʃ, tɕ, dʑ, dʒ], (fitted for 30s).

2.2 Objective parameters

The results of phonetic listening evaluation were compared to objective parameters, which calculation was based on the average (5 s) of three phonation of /a/ before and after exercises: f_0, shimmer and jitter based on E.Z. of the Voice program, and to spectral energy based on LTASS, which development was based on standard texts in duration of approximately 70 s [11, 14]. The relative variables of spectral energy for female voices were defined as 0 – 0.150, 0 –0.4, 0.4 – 0.8, 0.8 – 2, 2-2.5, 5-10 kHz and for male voices as 0 – 0.1, 0 – 0.3, 0.3 – 0.8, 0.8 – 2, 2 – 3.5 and 3.5 – 10 kHz. Similarity and dissimilarity index were calculated for the comparison of pre- and post- exercised voices.

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2.3 Statistical analysis of data

Based on the obtained data, basic statistical analysis for the listening evaluation categories and for objective parameters, mean values, standard deviation for all data before and after phonetic exercises for voice and diction were done. The differences before and after exercises were calculated by using the t-test for subjective and objective variables. Based on the data of long-term average spectar, the dissimilarity index (SDDD) of voice spectra was calculated before and after exercises for every individual examinee in order to see the differences for every speaker before and after exercises. In this way, their efficiency can be established and the results compared to subjective evaluation. It is customery for the dissimilarity index (SDDD) [6] to be used for the spectra comparison and be compared with corelational coeficient, especially in interlingual comparisons LTASS [6, 1].

Co-relational coefficients were calculated between subjective and objective variables based on the phonation of /a/.

3. RESULTS AND DISCUSSION

3.1 Subjective evaluation

The t-test shows that after exercises, male voices were evaluated as firmer, less nasal, of lesser supralaryngeal tension, breathiness and harshness ($p < 0,001$), more pleasant, less pharyngealised and of lesser laryngeal tension ($p<0,01$), while female voices came out also as louder but notably more pleasant, less pharyngealised, of lesser supralaryngeal tension, and with larynx raised to a lesser degree ($p<0,001$; Table 1). The greater number of very significant results in favour of female voices can be explained by a larger sample of female voices.

3.2 Corelational coeficients

Total results of cross-corelational procedure for all male and female voices show that aesthetical assessment is mostly influenced by the estimated supralaryngeal tension, pharingalisation, raised larynx, pitch, followed by the laringal tension, nasality, lesser hardness and breathiness. Setting categories, such as denasalisation, supralaryngeal and laringal tension, have not proved significant for male voices, while the latter two have proved significant only for female voices.

Positive corelational coeficients among unpleasant voice and pharingalisational categories (r=0.76), supralaryngeal tension (r=0.76), raised larynx (r=0.73) pitch (r=0.70) laringal tension (r=0.65), nasalisation (r=0.61) have been calculated for male and female voices respectively. Beside to unpleasant voice, pharingalisation is in positive corelation to supralaryngeal tension (r=0.81), laringal tension (r=0.78) raised larynx (r=0.70), nasalisation (r=0.68). It is, however, in medium corelation to modal phonational type (r=0.54) and pitch (r=0.44), and in little corelation to lower larynx (r=0.34), breathy phonation type (r=0.31), and loudness (r=0.26).

	Male				
	Before		After		
Category	x	s	x	s	p
Aesthetic	2.75	0.97	2.51	0.95	0.00
Pitch	2.35	0.99	2.37	0.97	0.77
Consistency	3.03	1.06	2.58	0.97	0.00
Loudness	3.50	0.73	3.49	0.74	0.90
Nasality	2.66	1.27	2.17	1.12	0.00
Denasality	1.56	0.88	1.36	0.92	0.64
Pharyngeal	2.07	1.04	1.73	0.92	0.00
Supralaryngeal - tense	2.07	1.04	1.64	0.81	0.00
- lax	1.75	0.90	1.44	0.73	0.11
Laryngeal - tense	1.71	0.94	1.78	0.95	0.00
- lax	2.03	1.09	1.46	0.70	0.22
Raised larynx	1.78	1.06	1.76	0.92	0.01
Lowered larynx	1.25	0.73	1.60	1.02	0.20
Harshness	2.80	1.17	2.26	1.06	0.00
Breathiness	2.47	1.05	2.03	1.00	0.00

	Female				
	Before		After		
Category	x	s	x	s	p
Aesthetic	3.09	0.84	2.88	0.82	0.00
Pitch	3.08	0.86	3.08	0.76	0.97
Consistency	3.07	0.95	2.51	0.88	0.00
Loudness	3.15	0.79	3.51	0.73	0.00
Nasality	2.70	1.19	2.20	1.06	0.00
Denasality	1.65	0.92	1.60	0.96	0.83
Pharyngeal	2.20	1.13	1.89	1.01	0.00
Supralaryngeal - tense	2.24	1.10	1.89	0.95	0.00
- lax	2.01	1.01	1.65	0.79	0.00
Laryngeal - tense	2.14	1.06	1.82	0.93	0.00
- lax	1.84	1.03	1.56	0.87	0.01
Raised larynx	2.08	1.07	1.76	0.91	0.00
Lowered larynx	1.98	1.12	1.71	1.03	0.01
Harshness	2.57	1.15	2.14	1.05	0.00
Breathiness	2.71	1.22	2.22	1.12	0.00

Table 1: T-test results between the subjective estimate variables before and after phonetic exercises

It is interesting to notice only slightly important positive corelational coeficient between unpleasant voice and breathy phonation type (r=0.26).

Objectively, the aesthetic evaluation is more influenced by the measure of jitter (r=-0.47), which means that unpleasant voices objectively have higher jitters.

Since the sample did not contain severe organic voice disorders, the research has confirmed earlier results that nasality is more connected to unpleasant voices than to breathiness (13). The most unpleasant are believed to be those voices that are pharyngealised, tensed, of raised larynx and higher pitch. This caries indexical information for non-cultivated voice. That is why pedagogical mission of phonetics is to, by using exercises, influence the proper voice setting, especially the professional voice.

3.3. Objective paramethers

3.3.1 SDDD index

Voices that have improved the most in the aesthetical category have also had the larger dissimilarity index before and after exercises based on the LTASS nonfricative text (R = 0.95, SDDD = 4.91 for male voice; R=0.98, SDD=4.04 for female voice (Figure 1), while SDDD based on the fricative text was higher (for male voice: R=0.94, SDDD=5.18; for female voice: R=0.95, SDDD=6.06 (Figure 2)).

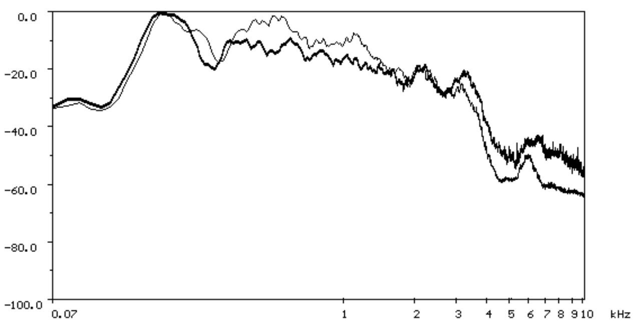

Figure 1: LTASS of female voice of nonfricative text before (thin line) and after exercises (bold line)

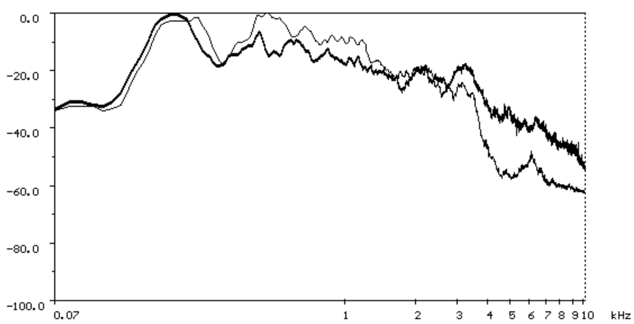

Figure 2: LTASS of female voice of fricative text before (thin line) and after exercises (bold line)

This can be explained by considerably more precise diction after exercises. Every speaker had SDDD much lower before exercises (3 recordings), their spectra were more similar (male voice for nonfricative texts: R=0.99, SDDD=2.04; for fricative texts: R=1.00, SDDD=1.15; female voice for nonfricative texts: R=0.99, SDDD=1.40; for fricative texts: R = 0.99, SDDD = 1.38). From this can be concluded that voice exercises effect the differences in certain, here described, parts of spectar and that SDDD is higher. All of this can be percived through improved quality of voice after exercises.

3.3.2 Relative spectral energy

Voices evaluated as aestheticaly improved after exercises, have afterwords also had more relative spectral energy in the voluminous area (comparison of the first two female voices in the area range of 0 - 400 Hz: 23.46 % : 56.8 %; 77.63 : 85, 18 %, for male voices in the range of 0 - 300 Hz: 40.13 : 58.0 %, 80, 49 %). Overall results for male voices show that after exercises the relative energy has been increased in the voluminous area based on the nonfricative and fricative text up to 100 Hz and 300 Hz, while relative energy for female voices has significantly increased in the mean sonority area up from 0.8 to 2 kHz in nonfricative text ($p=0.05$) and not so considarably important in the area from 2 to 5 kHz in fricative text ($p=0.01$), and it has lowered in the area up to 150 Hz in nonfricative ($p=0.04$) and fricative ($p=0.05$) text. In very high part of the spectar, from 5 to 10 kHz for female voices and from 3.5 to 10 kHz for male voices, there is less relative spectral energy after exercises which is confirmed by the research on voice pleasantness [14]. That voice exercises influence decrease of spectral tilt and that sonority of voice quality is perceptively increased can be seen, for example, in the research made by Wedin et al [15] and on the example of acting voices of Leino and Kärkkäinen [5].

3.4 Results based on sustained phonation /a/.

In total, based on the phonation of vocal /a/for male and female voices, xf_0 has slighly increased, jitter, as well as shimmer for male voices, have decreased, which can be explained with the fact that male voices in general have higher shimmer than female voices.

Voices that have been evaluated as statistically significantly firmer after exercises have also in average had objectively lower values for shimmer and jitter based on phonation /a/ (Table 2).

		Jitter (%)		Shimmer (dB)	
		Before	After	Before	After
Consistency	M	0.692	0.288	1.263	0.245
	F	0.654	0.250	0.254	0.174
Harshness	M	1.288	0.823	0.180	0.141
	F	0.583	0.269	0.252	0.204
Breathiness	M	0.241	0.209	0.197	0.256
	F	0.465	0.228	0.257	0.212

Table 2: Mean values for jitter and shimmer for male (M) and female (F) voices that were evaluated as significantly more consistent, less harsh and less breathy after exercises

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Voices that have been evaluated as less harsh after exercises have also had objectively in average lower values for jitter (both females and males). Female voices, which were evaluated as significantly less breathy phonation types, have had objectively averagely lower values for shimmer as well, while male voices did not show such considerable results. It was shown that in aesthetic evaluation certain degree of breath is tolerated for male voices, which can be explained by indexical information of such male voices. It is interesting that jitter and shimmer values have influenced the falsetto evaluation more than f_0 calculated on the bases of phonation. That means that in overall percentage before and after exercises, voices evaluated by falsetto are less evaluated than those voices which jitter and shimmer values have lowered even when objectively their f_0 has not been lowered which makes sense since f_0 is in general enlarged in phonation after exercises. If some female voices had very high pitch in phonation they stayed high even after exercises but with improved phonation quality.

4. CONCLUSION

It has been shown that aesthetic voice evaluation is mostly influenced by pharyngealisation, supralaryngeal tension, raised larynx, pitch, followed by laryngeal tension and nasalization. Voices that have aesthetically improved after exercises have had higher values for dissimilarity index, and were more similar among themselves before exercises. Improved voices have had significantly more relative spectral energy in the voluminous and sonorous areas. Voices that were evaluated as significantly stronger after exercises have in average had lower shimmer and jitter, while female voices, evaluated as less harsh, have had lesser jitter and those evaluated as less breathy, have had less shimmer. Phonetic exercises are also efficient for their practicality since they improve voice colour, consistency, imposture and quality of pronunciation, that is, they influence the better supralaryngeal and laryngeal setting.

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