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COMPARISON OF TWO DIFFERENT WARM-UP TASKS, USING A NEW TOOL ALSO

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SUMMARY. In our investigation, we compared two different warming-up sections on the singing voice. In the first section, we used traditional tasks which were based on the "linear model" of the phonation, consisted out of "vocalisation" exercises. In the second section we used developed tasks based on the "nonlinear model" – first and second level - of the phonation, using also the experiences of the SOVT (semi-occluded vocal tract) practice. We applied also a new – personally developed - tool – called "nose pipe"- for the warming-up. The sample consisted of 30 persons, who attend since more than one-year classical singing education, 21 of them were females, 9 of them were males. We organised two different sections. The participants came on both of the sections without previous warming-up for the singing voice. First we recorded three vowels – [i, a, u] – for females on G4, for males on G3 - keeping for longer as 2sec, with comfortable volume, then came the 20'-25' minute long warming-up procedure. After the procedures we repeated the recordings of the same vowels, and also surveyed the VRP (Voice range profile) of the participants on vowel [a]. For both of the warming-up procedures we used the same melodies. For recording we used TASCAM DR-07 MKII equipment. With the help of a stage, the microphones were held before the mouth of every participant, the same – 10cm – distance. For analysing the records, we used SIGVIEW 2.4., to appreciate the values of the parameters we used the SPSS software. We analysed one-second-long part – well balanced in sound level - of the records. The investigated parameters: number from the noise overriding overtones, the volume of f0 and H1→H7, mean of the signal and SNR (signal noise ratio) between 0-9/12 kHz and between 2-4 kHz. During the warm-ups visited voice range and the VRP (Voice Range Profile) surveyed after both of the sections. According to our results both of the

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warming-up sections are effective. The traditional – vocalisation – has a beneficial effect on volume of f0, on the value of SNR between 0-9/12kHz and on VRP. The second - with nose-pipe - section has beneficial effect on the number of - from the noise enhancing - overtones, on the volume of H1→H7, on the voice range visited during the section, and on the values of SNR between 2-4 kHz. As a conclusion we can enhance that both of the sections are useful, but for other aims. The mixed application of them would be referenced. The second section has also an accentuated beneficial effect on "singer-formant" (=intensification of overtones).

Keywords: vocalisation, SOVT, nose-pipe, voice range, SNR

Introduction

The different ways of vocalisation – based on the "linear model"- as the tool of singing warm-up is used since several centuries. The SOVT (semi-occluded vocal tract) exercises – based on the "nonlinear model" - are used for voice rehabilitation since 60 years and for warm-up the singing voice only in the last two decades ([1]Soviärvi, [4]Hirschberg, 2013). The beneficial effects both of the methods are proved. Enhancing the resistance in the mouth cavity, as the SOVT ([5]Antonetti, [8]Guzman, [9]Kang, [11]Mendes, [12]Mills, [13]Wistbacka) tasks do:

- are beneficial for forming high f0,
- for forming the so called "singer's–formant"
- are beneficial for register-balancing
- the cubage of the mouth and pharynx cavity - after long training with SOVT tasks - enlarges
- the phonation threshold pressure diminishes
- the fluctuation of the impedance has a beneficial massage effect on the vocal folds
- with the enhancement of the mouth pressure the voice source - it seems - can't be overloaded
- the function of the voice source becomes more effective

The role of the nasal cavities in singing:

- enclosing into the vocal tract the part of the nasopharynx has a beneficial effect on the voice quality ([2]Adorján, [6]Aura, [7]Gill)
- enclosing into the vocal tract the nose cavities amplify the "singer's-formant" (=intensification of overtones) ([3]Sundberg, 2007)

Our idea was, to enhance the resistance of the vocal tract not only with SOVT exercises but also with elongation of the nose cavities with special nose–pipe, combined, with resonant-tube. We agree in that scientific opinion, that connecting into the vocal tract the nasal and joint cavities have beneficial effect on the singing voice quality, helps keeping the clean intonation, enhancing the “singer’s-formant”. The undesirable nasalisation is avoidable. We tried out in our personal educational practice this tool – nose-pipe - with students since more than one year with advantageous effects.

Methods

We organised two independent occasions for singing voice warm-up. The participants were singing students, of JGYPK and the Music Secondary School Kodály, in Kecskemét. See Table 1.

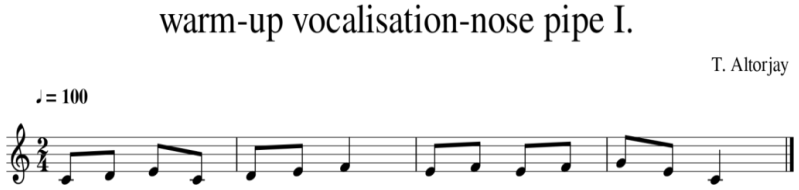
Table 1

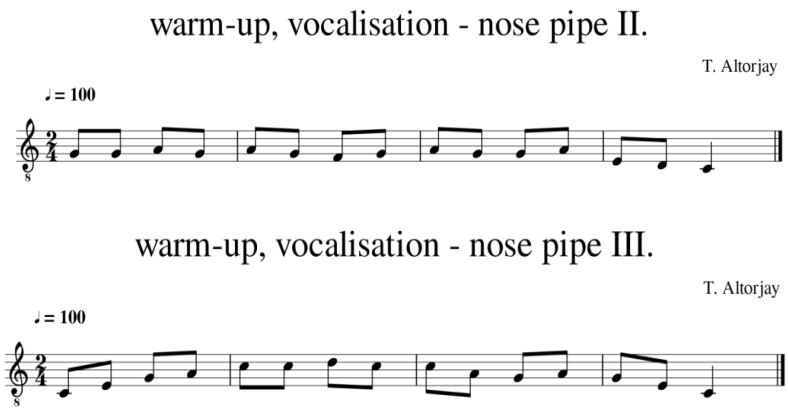
name and member of the groups	age		education	
	mean	SD	mean	SD
whole / 30 participants	21,70	5,96	2,67	1,97
females / 21	21,57	5,16	3,07	2,17
males / 9	22	7,87	1,72	,91
soprano / 11	20,55	3,98	2,86	2,00
mezzo / 10	22,70	6,24	3,30	2,43
tenor / 4	23,75	8,22	1,88	1,31
baritone / 5	20,60	8,23	1,60	,55

Sample characteristics

They came to the occasions without any previous singing warm-up. We recorded before and after the warm-up sustained [i, a, u] vowels with females on G4, with males on G3, sustaining longer than two seconds. The warm-up procedures lasted 20-25 minutes depended on the personal voice range of the participant. In the first section – called “vocalisation” - the participant sang every three melodies with syllable [ha] on their whole available voice range step by step, starting in the middle range. Look at Picture 1.

Picture 1





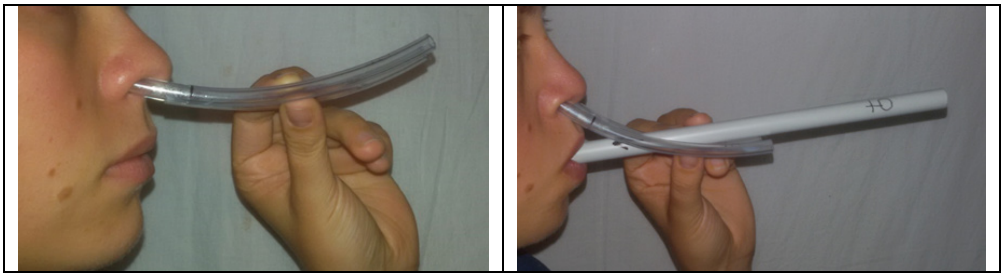
At the warm-up section used melodies

For the second section – called “nose” - we used the nose–pipe and the participants were humming into it using the first two melodies during their whole available voice range. At the third melody they were inhaling through the nose-pipe, and phonating [u] vowel into the resonant tube.

The size of the nose-pipe: the diameter was different applied to the participant’s own nostril size. The length - as the ordinary length of the vocal tract – was 14cm for females and 17cm for males. The material was silicon.

The resonant tube’s diameter is 11mm for females, 16mm for males. The length is – the ordinary length of the trachea – 24cm for females and 27cm for males. Its material was PVC. The PVC was not dangerous for the health, because the temperature of the tube was the same to the body. Look at Picture 2.

Picture 2



View of the tools

After both of the warm-up exercises we also surveyed the VRP (Voice Range Profile) of the participants on vowel [a]. We asked the participant to form from piano to forte sustained singing voice on every pitch of their daily available voice range.

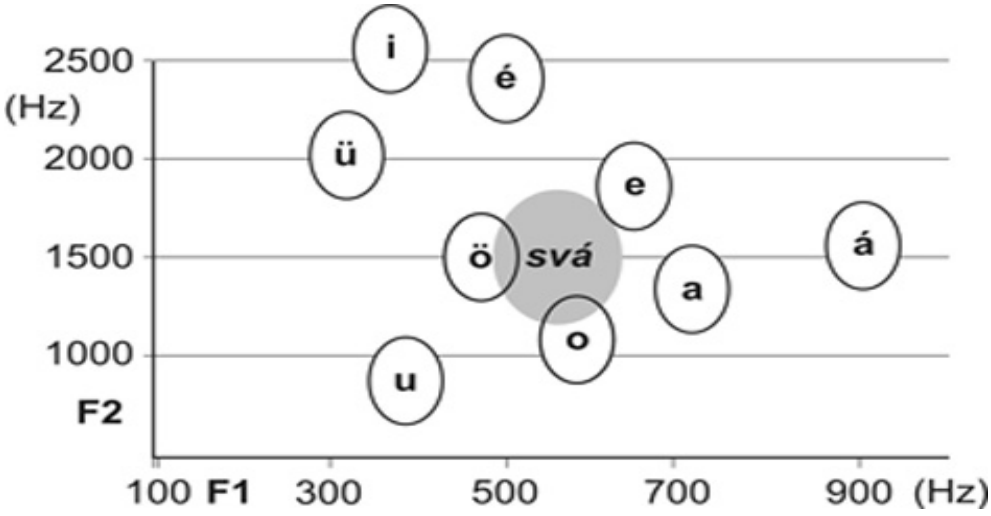
Picture 3

	We used for recording TASCAM DR-07 MKII equipment, fitted up with console for keeping space from the mouth of the participant. The distance could be permanently 10cm.

Recording equipment with console

For analysing the records we used SIGVIEW 2.4 acoustic program. We analysed one second long cut out part – well balanced - of the records. The investigated parameters were: *number* of - from the noise strengthened – overtones; the *mean* of the FFT (Fast Fourrier Transformation) diagram between *0-12kHz* for females, *0-9kHz* for males; the *SNR* (signal-noise ratio) of the FFT diagram at the same sections; the mean and the SNR of the FFT diagram between *2-4 kHz*; SPL (Sound Pressure Level=volume) of *f0* and *H1→H7* overtones. For analysing the effects of the sessions on the vowels is enough – according to our opinion – investigating only three – on the pitches of the “voicing triangle” located – of them, the [i, u, a]. Look at Picture 4.

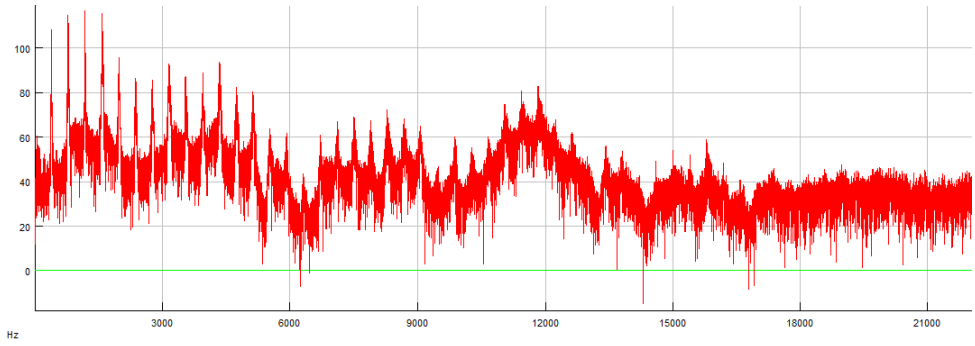
Picture 4



Voicing triangle

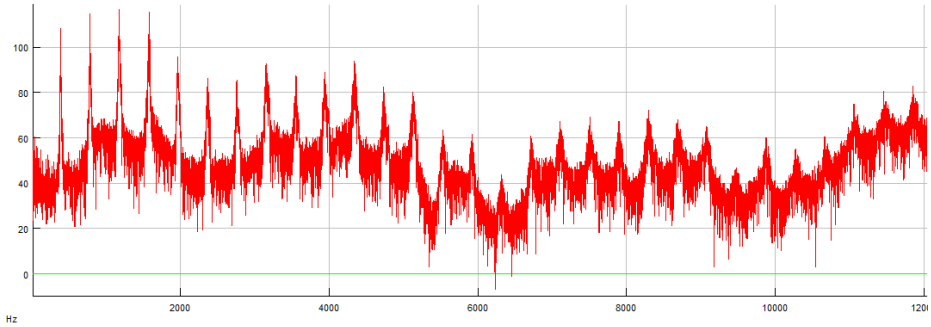
It is also observable, that the first part of the FFT figures, is well articulated. The overtones emerge from the noise content of the singing voice. This “active” part of the FFT figures is longer for females – in general from 0 to 12 kHz – then for males – in general from 0 to 9kHz - because the distance of the overtones is double for females than for males. See Picture 5-8.

Picture 5



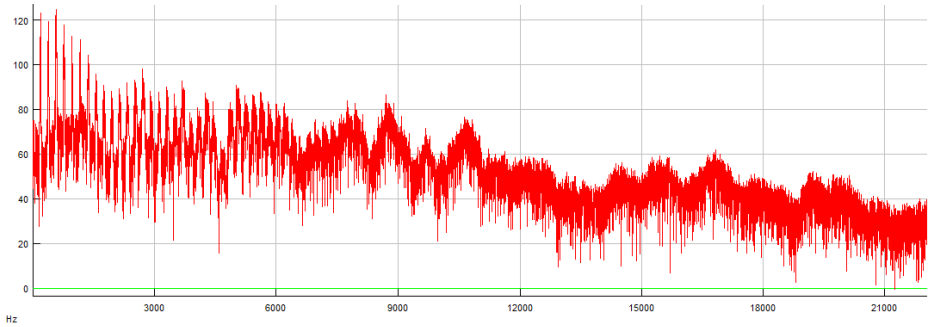
The active part of FFT from 0-21 kHz for female (soprano)

Picture 6



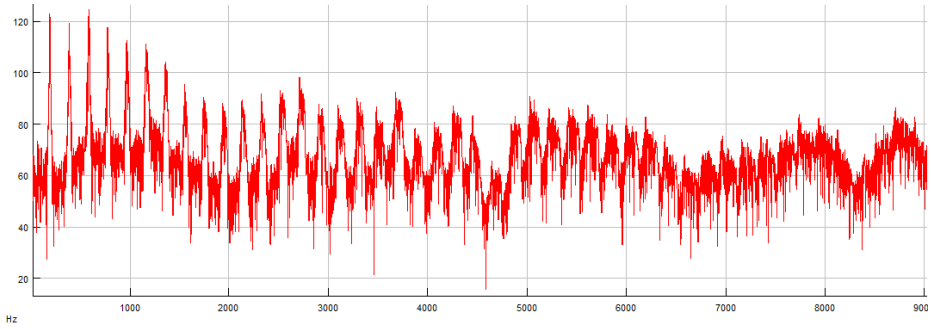
The active part of FFT from 0-12 kHz for female (soprano)

Picture 7



The active part of FFT from 0-21 kHz for male (bariton)

Picture 8

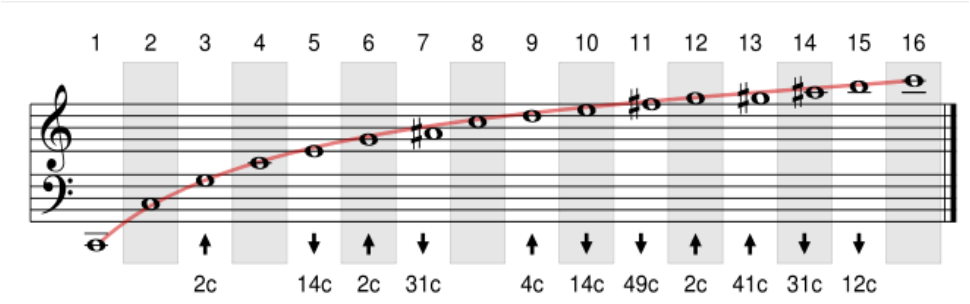


The active part of FFT figure from 0-21 kHz for male (bariton)

We investigated also the *mean* and the *SNR* between 2 to 4 kHz, because the so called “singer’s-formant” phenomenon can be detected also there. It appears – depending on the voice category – from 2,4 kHz (for basses) till 3 kHz (for altos). ([3]Sundberg, 2007)

The f0 and the first seven H1-H7 overtones were chosen for investigating not only because of belonging to the “active-part” of the FFT figure, but also because we used for warming-up well-tempered piano, and the difference between the natural and tempered intonation is less among these overtones. Look at Picture 9.

Picture 9



Overtone list of C

Results

Both of the warm-up sections – first using vocalisation, second using nose-pipe - are effective for every parameter, but the impact of the second section for every parameter and at every vowel is stronger. The second is also more significant considering the whole group and the females’ group as well (see Table 2-5).

Table 2

whole group 30 person			num.	0-9. mean	0-9. SNR	2-4 mean	2-4 SNR	f0
[i]	voca.	t	+,25	-3,29	-,68	-3,35	-3,73	-,08
		p	,807	***,003***	,499	***,002***	***,001***	,934
	nose.	t	-3,09	-5,10	-1,47	-4,18	+,45	-4,09
		p	***,004***	***<,001***	,152	***<,001***	,656	***<,001***
[a]	voca.	t	-,42	-4,13	-2,17	-4,25	-1,59	-1,33
		p	,678	***<,001***	***,038***	***<,001***	,123	,195
	nose.	t	-2,24	-5,25	-1,18	-4,41	-2,05	-3,78
		p	***,025***	***<,001***	,246	***<,001***	***,050***	***,001***
[u]	voca.	t	+,21	-3,62	-1,28	-2,05	+,83	-3,52
		p	,834	***,001***	,209	***,049***	,414	***,001***
	nose.	t	-3,00	-4,64	-,42	-2,66	-,87	-5,51
		p	***,005***	***<,001***	,679	***,013***	,393	***<,001***

Paired-samples analysis, whole group

Table 3

whole group 30 person			H1	H2	H3	H4	H5	H6	H7
[i]	voca.	t	-2,19	-3,03	-2,05	-2,40	-2,07	-3,03	-1,13
		p	***,037***	***,005***	***,050***	***,023***	***,047***	***,005***	,268
	nose.	t	-3,90	-3,11	-4,41	-2,89	-3,72	-2,86	-3,91
		p	***,001***	***,004***	***<,001***	***,007***	***,001***	***,008***	***,001***
[a]	voca.	t	-2,44	-2,58	-1,65	-1,98	+,13	-2,19	-2,02
		p	***,021***	***,015***	,109	,057	,896	***,037***	,053
	nose.	t	-3,6	-4,12	-3,57	-2,64	-3,25	-2,59	-2,47
		p	***,001***	***<,001***	***,001***	***,013***	***,003***	***,015***	***,020***
[u]	voca.	t	-3,19	-3,14	-1,61	-2,15	-4,03	-3,24	-2,10
		p	***,003***	***,004***	,118	***,040***	***<,001***	***,003***	***,044***
	nose.	t	-5,68	-2,70	-4,59	-4,62	-4,74	-2,89	-3,66
		p	***<,001***	***,011***	***<,001***	***<,001***	***<,001***	***,007***	***,001***

Paired-samples analysis, whole group

The meanings of the abbreviations: voca. – vocalisation, first section; nose. – nose pipe, second section; num. – number of overtones emerged from the noise on FFT figure; the mean and SNR of FFT diagram between the marked parts; the SPL (volume) of f0 and H1→H7 overtones.

Table 4

female group 21 person			num.	0-9. mean	0-9. SNR	2-4 mean	2-4 SNR	f0
[i]	voca.	t	+,90	-2,51	-,69	-2,77	-3,52	+,41
		p	,377	***,021***	,500	***,012***	***,002***	,690
	nose.	t	-3,14	-4,35	-1,49	-3,64	-,23	-4,18
		p	***,005***	***<,001***	,151	***,002***	,818	***<,001***
[a]	voca.	t	-,27	-2,88	-2,33	-2,64	-2,28	-,97
		p	,792	***,009***	***,030***	***,016***	***,034***	,344
	nose.	t	-1,97	-3,64	-1,42	-3,93	-3,35	-2,52
		p	,063	***,002***	,171	***,001***	***,003***	***,020***
[u]	voca.	t	-,48	-2,47	-1,43	-,921	-,339	-3,17
		p	,636	***,023***	,169	,368	,738	***,005***
	nose.	t	-2,71	-4,23	-,926	-2,60	-1,81	-4,25
		p	***,014***	***<,001***	,366	***,017***	,085	***<,001***

Paired-samples analysis, females' group

Table 5

female group 21 person			H1	H2	H3	H4	H5	H6	H7
[i]	voca.	t	-,84	-2,53	-1,37	-1,72	-1,03	-1,48	+,44
		p	,410	***,020***	,187	,100	,315	,156	,662
	nose.	t	-3,47	-3,13	-4,08	-3,35	-3,67	-2,36	-3,39
		p	***,002***	***,005***	***,001***	***,003***	***,002***	***,028***	***,003***
[a]	voca.	t	-1,94	-2,35	-,78	-1,02	-1,93	-1,77	-1,47
		p	,067	***,029***	,445	,320	,067	,093	,156
	nose.	t	-2,89	-3,09	-2,16	-1,77	-2,27	-1,27	-1,48
		p	***,009***	***,006***	***,043***	,092	***,035***	,220	,155
[u]	voca.	t	-2,52	-2,67	-1,23	-1,18	-3,25	-2,35	-1,31
		p	***,021***	***,015***	,234	,253	***,004***	***,029***	,206
	voca.	t	-4,19	-2,03	-3,41	-4,20	-4,38	-2,12	-3,29
		p	***<,001***	,056	***,003***	***<,001***	***<,001***	***,047***	***,004***

Paired-samples analysis, females' group

Pay attention to the number and the values of the significant “p” results. The number of the significant effects is higher at both of the groups at every vowel, and the values of the “p”-s are lower, which proves the stronger, beneficial effect of the second warm-up section. We could observe only one exception. The value of SNR at the “active” part – 0-9/12kHz - of the FFT becomes higher after the first – vocalisation - warm-up section.

We have to highlight that the reached voice range at every group and sub-group available during the second warm-up is significantly longer then during the first one. The VRP is also higher after the nose-pipe warming-up, but at the sub-groups mezzo, tenor, baritone - with low number - is not significant yet. Look at Table 6.

The meaning of the abbreviation: voca-nose – comparing the values after vocalisation to after nose-pipe warming-up.

Table 6

		whole	females	males	soprano	mezzo	tenor	baritone
range voca - nose	t	-8,933	-7,951	-4,462	-5,787	-5,303	-5<,001	-3,062
	p	***<,001***	***<,001***	***,002***	***<,001***	***<,001***	***,015***	***,038***
VRP voca - nose	t	-3,324	-2,518	-2,401	-3,204	-,685	-1,321	-2,049
	p	***,002***	***,020***	***,043***	***,009***	,511	,278	,110

Paired-samples analysis, comparing voice range and VRP

Conclusions

Both of the sections are useful. We offer the combined application of them ([10]Kang). The first - called vocalisation - is beneficial for practicing the unimpeded flooding of the singing voice, and also for stabilisation the absolute colour – F1, F2 - of the vowels. The second – using the nose-pipe and resonant tube – helps for extending the voice range and the VRP, and strengthening the higher overtones, so making the voice more colourful, shiny, radiant, bright.

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