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COMPARISON OF FOUR DIFFERENT WARM-UP TASKS, USING SPECIAL TOOLS ALSO

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SUMMARY. Introduction: In our investigation, we compared four different warming-up sections on the singing voice, always using the same task-melodies. In the first section, we used traditionally only "on vowel articulation based" – called vocalization – tasks. In the second section we used resonant tube, which is used for voice therapy mostly. In the third sections, the participants used the melodies for humming. In the fours we used - by us developed - unusual tool, called "nose-pipe" for singing voice warm-up. The theoretical basis of the first section is the so-called "linear-model" of the singing phenomenon, why the basis of the further three sections is the "non-linear" models as well as also the experiences of the SOVT (semi-occluded vocal tract) exercises, and practice. **Methods:** on all the four sections the same 33 people took part. 20 of them were females and 13 males. All the participants attended several years of classical singing education. We organized four independent sections one-week apart. The participants came on the sections without previous warming-up for the singing voice. Before the warming-up at first, we recorded three vowels – [y, u, ɒ] (according to IPA) – for females on G4, for males on G3 - sustaining for longer than 2 second-long, with comfortable volume, then came the 20'-25' minutes long warming-up procedures. After the procedure, we repeated the recordings of the same vowels on the same pitches. For every warming-up procedure we used the same melodies. Recording the sustained vowels we used TASCAM DR-07 MKII equipment. With the help of a stage, the microphones were held before the mouth of every participant, at the same – 10cm – distance. For generating the FFT figure of the sound image and for analyzing we used SIGVIEW 2.4., to appreciate the values of the parameters we used the SPSS 20 software. We analyzed one-second-long part – in sound level well balanced - of the records. The investigated parameters were: mean of the FFT signal between 0-21kHz, 0-12kHz as well as 2-4 kHz; number from the noise overriding overtones; the volume of f0, and H1→H7 overtones.

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We detected also during the warm-ups reached voice ranges. **Results:** according to our results all the sections have beneficial effects on the singing voice. Most of the significant effects on the analyzed parameters have the humming and the nose-pipe sections by every vowel. The reached voice range was the longest at the fours, nose-pipe section. **Conclusion:** we can enhance that each of the four sections is useful. The combined, conscious application of them is correct. Using the new tool – called nose pipe – has dominant preference for developing the voice range of the singing voice.

Keywords: vocalization, resonant tube, humming, nose-pipe, voice range

Introduction: since the professional singing business – appearance of music genders opera and oratorio in Baroque period - the different ways of vocalization received several scientific and practical publications. In the last four centuries, these publications were based on the so-called „linear model" of the singing phenomenon (mielo-aerodynamic, neuromuscular). It supposes that the voice source – larynx, vocal folds - stimulates the vocal tract, and its cavities reinforce those overtones of the primer sound which are close to their resonant frequencies. This collaboration can be symbolized like "source-filter". The vocalization warming-up practice uses different vowels and consonants within understandable or artificial syllables and texts. The melodies of the tasks aim to practice different musical purposes, difficulties in rhythm, tempo, ambit, pitch, distance, figuration. There stayed during the centuries also an opened dispute about the function of the skull cavities – nasal, facial, frontal, jugular cavities, and fibrosis labyrinth – in forming the singing voice – not only for forming the nasal [m, n, ɲ] consonants – without undesirable nasalization. The humming as warm-up task is used also since centuries, which shows the importance of the skull cavities. ([1]Adorján, [9]Balassa, [10]Bartalus, [13]Chapman, [14]Concone, [15]Dayme, [16]Farkas, [17]Forrai, [18]Garcia, [22]Hirschberg, [27]Kerényi,[28-29]Lamperti, [30]Langer, [31]Lütgen, [32]Marchesi, [35]Mihályffy, [36]Miller, [38]Moiret, [40]Sík, [42]Sundberg, [44]Vaccai, [45]Váginé)

The so-called SOVT (semi-occluded vocal tract) exercises – resonance tube and straw phonation - were used for voice rehabilitation since the 1960s. In recent decades, extensive investigations are underway in connection with the SOVT practice, researching the effects of these on the speaking and singing voice. The theoretical background of this practice is the so-called "non-linear" model of the singing phenomenon. It supposes that the inertia resistance of the vocal tract reacts to the function of the vocal folds also. So, the voice source and the vocal tract interplay with each other. The most economical the phonation will be then if the resistance in the vocal gap and in the vocal tract is well balanced. There are two groups of phonation tasks

based on this model: tasks with a single pulsating source (humming, resonant tube, or straw phonation with free pipe end, forming nasal and non-nasal plosive consonants) and tasks with a double pulsating source (lip-trill, tongue-trill, hand-over mouth, resonant tube, and straw within water immersed free end). Both models well describe some elements and kinds of the function of the phonation but cannot comprise its complexity. ([7]Antonetti, [8]Aura, [11]Calvache, [12]Cardoso, [19-20]Gill, [21]Guzman, [22]Hirschberg, [23]Hoch, [24]Horacek, [25-26]Kang, [33]Manternach, [34]Mender, [37]Mills, [39]Nam, [41]Soviarvi, [43]Sundberg, [46]Wistbacka)

Since several centuries, and decades the advantage and usefulness of the different warming-up tasks for the singing voice was already proved. In our research we wanted to detect the special advantage of four tasks separately, using the same melody. The four tasks are as follows: vocalization, resonant tube phonation, humming and humming into a nose-pipe. The nose-pipe is by us developed, unusual tool. With this tool we can elongate the nose cavities and enhancing the resistance of the resonators within the skull during humming ([2-6]Altorjay).

Methods: We organized four independent occasions for singing voice warm-up. Between the occasions was one-week time distance. All the participants were singing students for more than one year, at the University of SZTE and at the Music Secondary School Kodály, in Kecskemét. See the statistical parameters of the participants in Table 1.

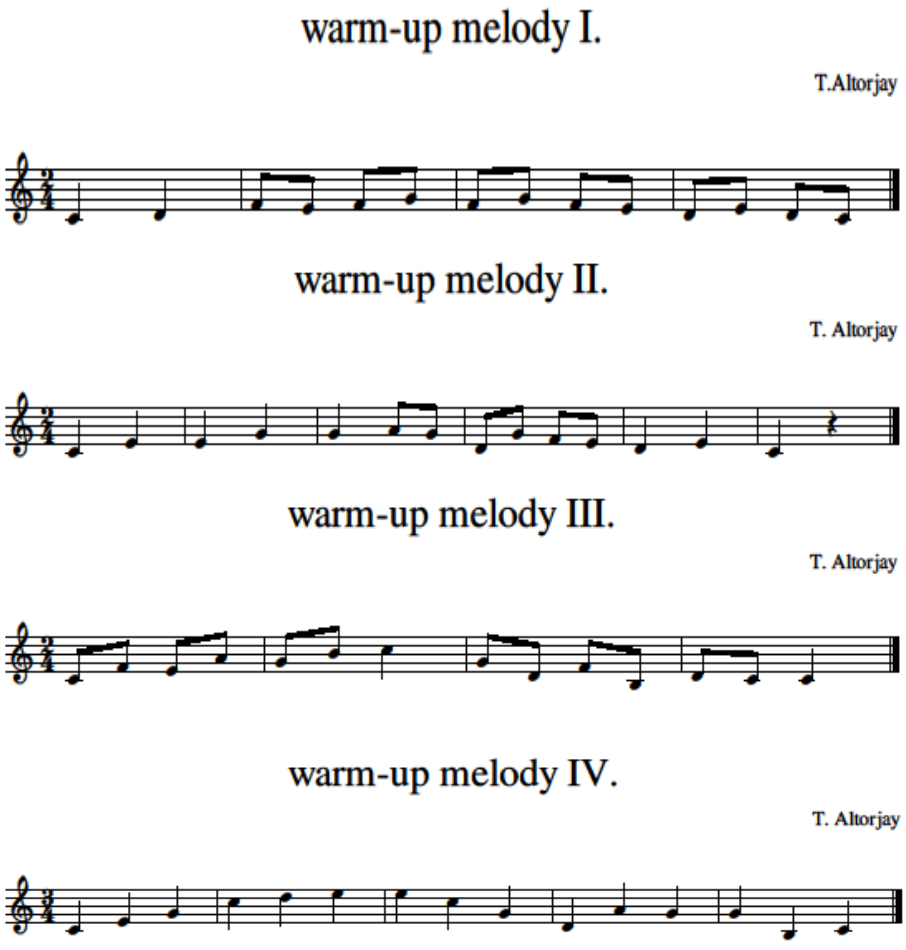
Table 1

Sample characteristics

name and member	age		education	
	mean	SD	mean	SD
whole 33 pr.	21,03	5,598	2,106	1,806
femal. 20 pr.	20,10	4,315	2,125	2,132
males 13 pr.	22,46	7,102	2,077	1,222
secon. 14 pr.	21,86	8,14	2,00	1,240
univ. 19 pr.	20,42	2,63	2,184	2,161
sopr. 12 pr.	20,17	3,46	1,75	1,138
br. – bs. 8 pr.	20,38	6,022	2,125	1,188

The participants came to the occasions healthy and without any previous singing warm-up. We recorded before and after the warm-up sustained [y, u, ɒ] (according to IPA) vowels with females on – comfortable middle pitch - G4, with males on G3, sustaining longer than two seconds. The warm-up procedures lasted 20-25 minutes depending on the personal, flexible, daily available voice range of the participant. Look at E.g. 1.

E.g. 1



At the warm-up sections used melodies

The principle of the melodies build-up is: gradually enlarge the intervals and the achieved voice range.

- First-occasion (vocalization): the participants sang: - the I. melody with [y], - the II. melody with [u], - the III. melody with [ɒ], - the IV. with [y, u, ɒ] repeatedly in every beat.
- Second-occasion (phonation into resonant tube): the participants sang the three vowels into the tube in the same order as on the first occasion. It was possible, because all the chosen vowels were “labial” (lip-rounded)!
- Third occasion: humming the melodies in the above-described order.
- Fourth occasion: humming the melodies into nose-pipe in the upper order.

The resonant tube's diameter was 11mm for females, 16mm for males. The length was – 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 E.g. 2.

The size of the nose-pipe: the outer diameter was 8mm. The length – as the ordinary length of the vocal tract – was 14cm for females and 17cm for males. The material was silicon. Look at E.g. 3.

E.g. 2

View of the tubes

E.g. 3

View of the nose-pipes

In E.g. 4 you can see the method of using the tools.

E.g. 4

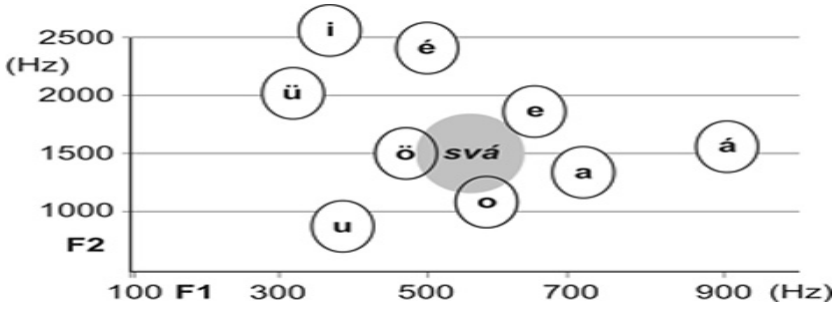
The use of the tools

E.g. 5

We used for recording TASCAM DR-07 MKII equipment, fitted up with a console for keeping space from the mouth of the participant. The distance could be permanently 10cm. (E.g. 5.)
We have chosen these three vowels, because on the “formant-triangle” figure of the Hungarian vowels these are close to the triangle pitches and are “labial”.as well. So, we supposed that it is possible to typify every vowel by them. (E.g. 6.)

Recording equipment with console

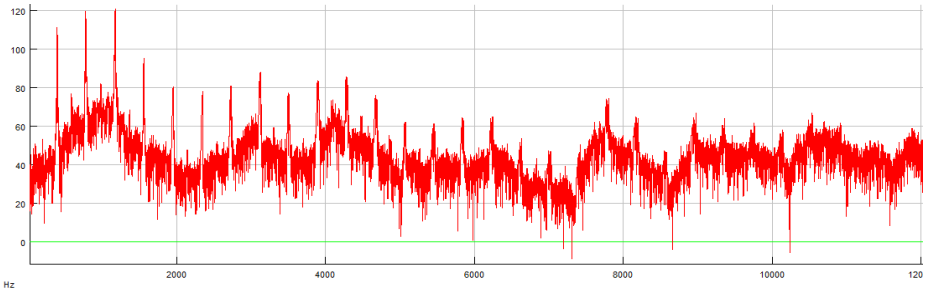
E.g. 6



Formant-triangle of Hungarian vowels ([ü=y; u=u; a= ɒ])

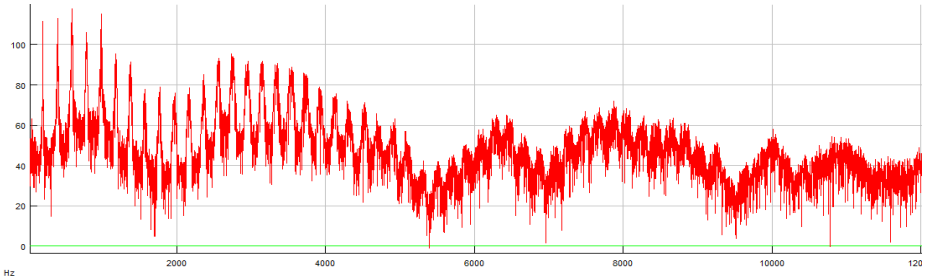
For analyzing the records, we used SIGVIEW 2.4 acoustic program. We analyzed one second long – well balanced – excised part of the records. With SIEGVIEW we could form the FFT diagram of the records. The analyzed parameters were: - mean of the FFT diagram between *0-21kHz, 0-12kHz, 2-4kHz;* - *number* of - from the noise strengthened – overtones on the 0-12kHz part of the FFT diagram; - the SPL (Sound Pressure Level=volume) of *f0* and *H1→H7* overtones. We have chosen these parameters, because with these is possible to typify the first, active part of the FFT figure, where most of the overtones protrusion from the noise can be observed. Look at E.g. 7. and 8.

E.g. 7



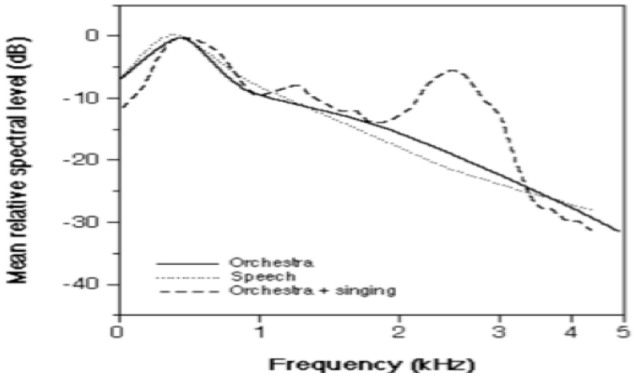
FFT 0-12kHz female (sustained vowel)

E.g. 8



FFT 0-12kHz male (sustained vowel)

E.g. 9

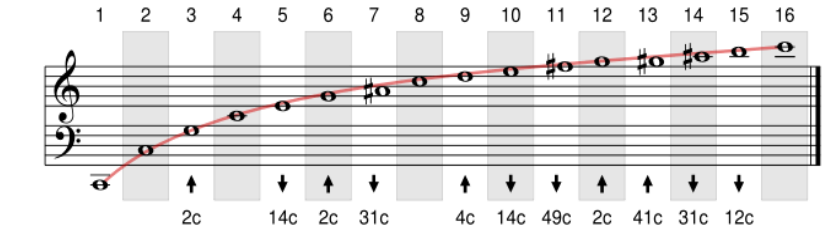


"Singer's formant figure

We analyzed the 2-4kHz part of the FFT figure, because on this section appears the so-called "singer's formant" phenomenon. Look at picture 9.

Besides f0 the H1-H7 overtones were chosen for analyzing because these strengthen and stabilized the tonality of the fundamental frequency. Look at E.g. 10.

E.g. 10



Overtone list of tone C

During the occasions, we also observed, and noted in semitones the flexible available maximal voice range of the participants.

Results: We compared the parameters – analyzed from the records, made sections before and after - value with SPSS 20 program calculating paired-samples t-test. We demonstrate the result of the whole group and the largest two subgroups, females, and university students (21 and 19 people). In the tables below are collected the results of every four sections together: for vowel [y] table 2-4, for vowel [u] table 5-7, for vowel [ɒ] table 8-10. We highlight the significant “p” values with bold numbers.

Table 2

Paired-samples results, whole group, [y] vowel

[Y] whole	vocalization		tube		humming		nose-pipe	
	t	p	t	p	t	p	t	p
0-21	-4,091	**,000**	-1,605	,118	-4,025	**,000**	-3,124	**,004**
number	-1,760	,088	*,000*	1,000	*,718*	,478	-3,288	**,003**
0-12	-4,509	**,000**	-1,450	,157	-4,573	**,000**	-2,613	**,014**
2-4	-3,538	**,001**	-2,003	,054	-3,106	**,004**	-3,768	**,001**
f0	-1,069	,293	-2,352	**,025**	-2,908	**,007**	-3,139	**,004**
H1	-2,201	**,035**	-1,278	,210	-1,833	,076	-3,554	**,001**
H2	-2,084	**,045**	-2,937	**,006**	-2,687	**,011**	-2,624	**,014**
H3	-2,499	**,018**	-2,735	**,010**	-3,726	**,001**	-3,033	**,005**
H4	-1,776	,085	-2,238	**,032**	-3,554	**,001**	-2,357	**,025**
H5	-3,096	**,004**	-2,722	**,010**	-3,778	**,001**	-1,878	,070
H6	-2,142	,040	-1,360	,183	-2,796	**,009**	-3,019	**,005**
H7	-3,094	**,004**	-3,058	**,004**	-3,429	**,002**	-2,733	**,010**

For the whole group by vowel [y] the order of effect intensity was: 1. humming, 2. nose-pipe, 3. vocalization. 4. tube.

Table 3

Paired-samples results, female subgroup, [y] vowel

[Y] females	vocalization		tube		humming		nose-pipe	
	t	p	t	p	t	p	t	p
0-21	-3,212	**,005**	-,067	,947	-4,034	**,001**	-2,807	**,012**
number	-,709	,487	-1,410	,175	-,697	,494	-2,365	**,029**
0-12	-3,781	**,001**	-,646	,526	-4,000	**,001**	-2,013	,059
2-4	-2,955	**,008**	-1,728	,100	-3,049	**,007**	-2,697	**,015**
f0	-1,055	,305	-2,330	**,031**	-2,128	**,047**	-3,569	**,002**
H1	-2,217	**,039**	-,923	,368	-2,114	**,048**	-3,222	**,005**
H2	-1,619	,122	-2,010	,059	-2,315	**,032**	-2,371	**,029**
H3	-2,711	**,014**	-2,758	**,013**	-3,730	**,001**	-4,234	**,000**
H4	-,824	,420	-,945	,357	-2,254	**,036**	-2,503	**,022**
H5	-1,967	,064	-2,139	**,046**	-3,807	**,001**	-2,325	**,032**
H6	-1,436	,167	*,003*	,998	-2,221	**,039**	-3,293	**,004**
H7	-2,049	,055	-2,257	**,036**	-2,493	**,022**	-3,091	**,006**

For the female subgroup by vowel [y] the order of effect intensity was: 1. nose-pipe, 2. humming, 3. vocalization, 4. tube.

Table 4

Paired-samples results, university student's subgroup, [y] vowel

[Y] uni.	vocalization		tube		humming		nose-pipe	
	t	p	t	p	t	p	t	p
0-21	-3,733	**,002**	-,220	,828	-3,470	**,003**	-1,995	,063
number	-1,455	,163	-,509	,617	*1,41*	,890	-1,979	,065
0-12	-3,731	**,002**	-,194	,848	-4,516	**,000**	-1,435	,170
2-4	-2,220	**,039**	-1,020	,321	-3,733	**,002**	-2,050	,057
f0	-1,053	,306	-1,282	,216	-2,436	**,025**	-1,891	,077
H1	-2,368	**,029**	-1,187	,251	-2,670	**,016**	-3,114	**,007**
H2	-1,387	,182	-2,045	,056	-2,154	**,045**	-1,571	,136
H3	-2,052	,055	-2,033	,057	-3,648	**,002**	-1,401	,180
H4	-1,532	,143	-1,631	,120	-4,087	**,001**	-2,022	,060
H5	-2,159	**,045**	-2,056	,055	-3,600	**,002**	-,899	,382
H6	-1,138	,270	-,578	,571	-2,439	**,025**	-1,103	,286
H7	-2,185	**,042**	-2,361	**,030**	-3,161	**,005**	-1,074	,299

For the university student's subgroup by vowel [y] the order of effect intensity was: 1. humming, 2. vocalization, 3. nose-pipe, 4. tube.

Table 5

Paired-samples results, whole group, [u] vowel

[U] whole	vocalization		tube		humming		nose-pipe	
	t	p	t	p	t	p	t	p
0-21	-3,235	**,003**	-2,665	**,012**	-5,582	**,000**	-2,925	**,007**
number	-,794	,433	*1,074*	,291	-1,240	,224	-1,518	,140
0-12	-4,364	**,000**	-3,057	**,004**	-5,264	**,000**	-2,988	**,006**
2-4	-2,665	**,012**	-2,110	**,043**	-3,126	**,004**	-2,853	**,008**
f0	-3,591	**,001**	-3,269	**,003**	-3,113	**,004**	-1,969	,058
H1	-3,121	**,004**	-2,887	**,007**	-2,929	**,006**	-2,453	**,020**
H2	-,699	,490	-,516	,610	-3,139	**,004**	-3,116	**,004**
H3	-3,679	**,001**	-2,252	**,031**	-2,157	**,039**	-5,255	**,000**
H4	-1,012	,319	-1,615	,116	-2,196	**,035**	-1,433	,162
H5	-1,517	,139	-1,905	,066	-1,871	,070	-,505	,617
H6	-,598	,554	-2,947	**,006**	-2,826	**,008**	-,264	,794
H7	-1,562	,128	-1,456	,155	-3,229	**,003**	-2,299	**,029**

For the whole group by vowel [u] the order of effect intensity was: 1. Humming, 2. Nose-pipe, 3. Tube, 4. Vocalization

Table 6

Paired-samples results, female subgroup, [u] vowel

[U] females	vocalization		tube		humming		nose-pipe	
	t	p	t	p	t	p	t	p
0-21	-3,165	**,005**	-1,260	,223	-4,398	**,000**	-2,232	**,039**
number	-1,751	,096	*,948*	,355	-2,500	**,022**	-2,189	**,042**
0-12	-4,422	**,000**	-2,184	**,042**	-4,258	**,000**	-3,304	**,004**
2-4	-1,850	,080	-1,196	,246	-3,660	**,002**	-2,350	**,030**
f0	-4,018	**,001**	-2,594	**,018**	-1,778	,091	-1,153	,264
H1	-2,887	**,009**	-2,466	**,023**	-2,407	**,026**	-1,984	,063
H2	-,258	,799	*,756*	,459	-2,726	**,013**	-2,822	**,011**
H3	-4,287	**,000**	-1,389	,181	-2,118	**,048**	-5,393	**,000**
H4	-,873	,393	*,028*	,978	-2,675	**,015**	-3,002	**,008**
H5	-1,318	,203	-,965	,347	-2,324	**,031**	-1,670	,112
H6	-,443	,663	-2,471	**,023**	-3,733	**,001**	-2,037	,057
H7	-1,124	,275	-,627	,538	-2,556	**,019**	-2,563	**,020**

For the female subgroup by vowel [u] the order of effect intensity was: 1. humming, 2. nose-pipe, 3. vocalization, 4. tube.

Table 7

Paired-samples results, university subgroup, [u] vowel

[U] univer.	vocalization		tube		humming		nose-pipe	
	t	p	t	p	t	p	t	p
0-21	-2,765	**,013**	-1,944	,068	-5,021	**,000**	-2,160	**,046**
number	-1,482	,156	*1,155*	,263	-1,419	,173	-2,627	**,018**
0-12	-3,859	**,001**	-2,385	**,028**	-5,408	**,000**	-1,941	,070
2-4	-2,654	**,016**	-1,681	,110	-4,848	**,000**	-2,012	,061
f0	-3,249	**,004**	-2,843	**,011**	-1,502	,150	-1,983	,065
H1	-2,801	**,012**	-2,445	**,025**	-2,061	,054	-2,415	**,028**
H2	-2,291	**,034**	-,639	,531	-2,296	**,034**	-2,627	**,018**
H3	-4,288	**,000**	-1,413	,175	-2,130	**,047**	-3,871	**,001**
H4	-1,393	,180	-,865	,398	-1,691	,108	-1,799	,091
H5	-1,727	,101	-1,399	,179	-,932	,364	-,999	,333
H6	-1,942	,068	-1,852	,080	-1,721	,102	-,471	,644
H7	-1,680	,110	-,847	,408	-2,578	**,019**	-1,824	,087

For the university subgroup by vowel [u] the order of effect intensity was: 1. vocalization, 2. humming, 3. nose-pipe, 4. tube.

Table 8

Paired-samples results, whole group, [ɒ] vowel

[ɒ] whole	vocalization		tube		humming		nose-pipe	
	t	p	t	p	t	p	t	p
0-21	-4,043	**,000**	-2,400	**,022**	-4,221	**,000**	-5,278	**,000**
number	*,419*	,678	-1,010	,320	-,605	,549	-2,463	**,020**
0-12	-4,597	**,000**	-2,321	**,027**	-3,477	**,001**	-5,046	**,000**
2-4	-3,239	**,003**	-2,132	**,041**	-3,077	**,004**	-3,603	**,001**
f0	-1,351	,186	-2,380	**,023**	-1,351	,186	-2,995	**,005**
H1	-2,562	**,015**	-2,021	,052	-2,073	**,046**	-2,964	**,006**
H2	-1,858	,072	-2,874	**,007**	-2,067	**,047**	-2,625	**,014**
H3	-2,264	**,030**	-,545	,589	-1,493	,145	-1,606	,119
H4	-2,907	**,007**	-1,502	,143	-2,887	**,007**	-2,236	**,033**
H5	-2,004	,054	-1,938	,061	-1,599	*,120*	-2,292	**,029**
H6	-1,933	,062	-2,449	**,020**	-1,609	,117	-2,850	**,008**
H7	-2,143	**,040**	-1,488	,146	-2,479	**,019**	-3,822	**,001**

For the whole group by vowel [ɒ] the order of effect intensity was: 1. nose-pipe, 2. vocalization, 3. humming, 4. tube.

Table 9

Paired-samples results, female subgroup, [ɒ] vowel

[ɒ] females	vocalization		tube		humming		nose-pipe	
	t	p	t	p	t	p	t	p
0-21	-3,618	**,002**	-1,794	,089	-3,846	**,001**	-3,468	**,003**
number	-1,312	,205	-1,753	,096	-,719	,481	-2,707	**,014**
0-12	-4,054	**,001**	-1,916	,071	-3,610	**,002**	-3,017	**,007**
2-4	-3,128	**,006**	-2,277	**,035**	-2,855	**,010**	-2,904	**,009**
f0	-1,564	,134	-1,403	,177	-1,262	,222	-1,843	,082
H1	-3,935	**,001**	-1,806	,087	-2,233	**,038**	-2,435	**,026**
H2	-3,128	**,006**	-3,060	**,006**	-2,909	**,009**	-1,784	,091
H3	-2,335	**,031**	-,007	,995	-2,203	**,040**	-1,308	,207
H4	-2,360	**,029**	-,714	,484	-2,921	,009	-1,476	,157
H5	-1,943	,067	-1,673	,111	-1,936	,068	-2,494	**,023**
H6	-2,221	**,039**	-2,437	**,025**	-1,840	,081	-3,541	**,002**
H7	-2,353	**,030**	-1,211	,241	-2,679	**,015**	-3,630	**,002**

For the female subgroup by vowel [ɒ] the order of effect intensity was: 1. nose-pipe, 2. vocalization, 3. humming, 4. tube.

Table 10

Paired-samples results, university student's subgroup, [ɒ] vowel

[ɒ] univ.	vocalization		tube		humming		nose-pipe	
	t	p	t	p	t	p	t	p
0-21	-2,924	**,009**	-1,859	,080	-4,449	**,000**	-3,354	**,004**
number	-,428	,674	-,643	,529	-,451	,657	-1,420	,175
0-12	-3,763	**,001**	-1,782	,092	-3,927	**,001**	-3,142	**,006**
2-4	-2,908	**,009**	-1,790	,090	-3,578	**,002**	-2,891	**,011**
f0	-1,042	,311	-1,923	,070	-1,638	,119	-2,368	**,031**
H1	-2,561	**,020**	-1,476	,157	-1,476	,157	-1,890	,077
H2	-2,013	,059	-1,846	,081	-1,856	,080	-1,884	,078
H3	-3,217	**,005**	*,122*	,904	-1,691	,108	-,971	,346
H4	-2,732	**,014**	-1,013	,324	-2,057	,054	-1,129	,276
H5	-1,666	,113	-1,196	,247	-1,331	,200	-1,337	,200
H6	-2,172	**,043**	-2,013	,059	-1,447	,165	-1,792	,092
H7	-1,521	,146	-1,084	,293	-1,826	,084	-2,138	**,048**

For the university subgroup by vowel [ɒ] the order of effect intensity was: 1. vocalization, 2. nose-pipe, 3. humming, 4. tube.

Summarization the order positions of the four sections can be seen in table 11. The facts in connection with the warming-up tasks are: in practice generally used method for singing warm-up is the “vocalization”. The “humming” is not so current. The “resonant tube” and the “nose-pipe” are new, not so widespread tools in warming-up practice. Even so according to our result the most effective are the humming and the nose-pipe for every vowel and for analyzed parameters. The vocalization is most effective for vowel [ɒ], and for university student’s subgroup.

Table 11

Overall table of the order positions of the sections

section	order position				mean
	1.	**2.**	**3.**	**4.**	
Humming	4	2	3	-	1,888
Nose-pipe	3	4	2	-	1.888
Vocalization	2	3	3	1	2,333
Tube	-	-	1	8	3,888

We also compared in pairs the flexible available maximal voice range of the participants. Look at table 12.

With “nose-pipe” could the participants reach significantly longest voice range than during the other three sections! The “humming” was also highly effective, but the “nose-pipe” – compared with “humming” – was also significantly more effective than it.

Table 12

Paired samples result of voice range

	Whole group		**female subgroup**		**university subgroup**	
	t	**p**	**t**	**p**	**t**	**p**
vocalization - tube	-1,234	,226	-1,365	,188	+,261	,797
vocalization – humming	-5,488	**,000**	-5,416	**,000**	-4,802	**,000**
vocalization – nose pipe	-11,752	**,000**	-9,539	**,000**	-7,911	**,000**
tube – humming	-4,236	**,000**	-4,129	**,001**	-4,607	**,000**
tube – nose pipe	-10,143	**,000**	-8,492	**,000**	-6,896	**,000**
humming – nose pipe	-7,418	**,000**	-8,060	**,000**	-3,975	**,001**

The expansion of the voice range appeared in both directions and the standard deviation stayed moderate of it. Look at table 13.

Table 13

Voice range expanse in both directions

sect.	whole group				female subgroup				university subgroup			
	low		high		low		high		low		high	
	me.	std	me.	std	me.	std	me.	std	me.	std	me.	std
voc	5,8	1,8	15,2	2,6	5,9	**1,4**	15,6	**2,6**	6,3	2,1	15,4	**2,6**
tube	6	2,2	15,7	3,7	6,3	2,1	16,8	3,1	6,9	2,4	16,3	4,3
hum	6,7	1,8	17,1	3,3	6,9	1,5	18,3	3,5	6,8	2,2	17,8	3,1
pipe	**7,1**	**1,8**	**17,8**	**2,6**	**7,4**	1,9	**18,6**	2,7	**7,4**	**1,9**	**18,2**	2,7

Conclusions: according to our experiences we may enhance, that all the sections have a beneficial effect on the singing voice, but for intensifying the overtones and strengthen the so-called “singers-formant” the “humming” and the use of “nose-pipe” are most effective! Furthermore, we have to highlight that for developing and extending the flexible available voice range, the use of “nose-pipe” is the most effective.

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