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Head and Chest Resonators

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ABSTRACT

The article provides a brief overview of the singer's vocal apparatus, the musical abilities of the head and chest resonator, the sense of rhythm, intonation and vocal range. Differences between the upper chest resonator and the upper resonator and their role in vocal performance.

KEYWORDS: *Singer, sound power, romance, musician, composer, music, singing, melody, range, register, intonation, decibel, amplitude, aperture, mutation*

In vocal pedagogy the terms "chest and head resonators" are commonly used. A voice is said to be well established in singing when it is "coloured by thoracic and head resonance" throughout its range. In many schools 'hitting the head resonator' is considered to be the cornerstone on which organizations of the singing sound are built. From the sensations of sound resonation in the head and chest the voice registers - head and chest - got their name. Indeed, when singing, there are clearly felt vibrations both in the area of the face part of the head - head resonation, sometimes called 'mask' - and in the chest. The voice with good head resonance is bright, ringing, and metallic. In the thorax it is rich and "meaty". In some cases these feelings can be very strong. Thus, with some notes, especially well taken, singers feel so strong vibrations in the front part of the head, that they feel dizzy. When the voice resonates well the vocalization is especially easy. It seems that these feelings and the physical phenomena that cause them play a significant role in the singing voice. The voicing "in the mask" is one of the indicators of the correct organisation of the singing sound. However, it should be noted that the majority of singers have an excellent sound of the singing voice, but in others this sensation is very weak, and in some, though rare, the head resonance is absent altogether. Thus, although the sensation of head resonance is a characteristic of a good sounding singing voice, it is not necessary in all cases.

The place where the resonance of the head is felt is not the same for the singers. Some feel a head resonance in the area of that part of the facial skeleton, which is covered with a masquerade mask (hence the term - the mask of singers, to sing in a "mask"); others - at the front teeth of the upper jaw (Mikisha, Moran); the third - in the area of the frontal sinuses (Deisha-Sionitskaya), and the fourth - in the area of the crown or hard palate.

The place of the greatest vibration usually does not remain constant throughout the entire voice range scales. Most often at lower notes - it is felt in the front - in the area of the front teeth or the front of the palatine vault (Moran's point). As the sound rises, the sensations are often mixed more posteriorly and on the upper notes of the sound are felt somewhere in the crown of the head. These sensations also vary depending on the technique of sound production: with one technique - some sensations, with another - others. Breast resonance is of a diffuse nature and can be expressed to a very different degree depending on the register, the nature of the voice, and the section of the range.

In order to clarify the question of where resonance phenomena can occur in the vocal apparatus and what role this resonance can play in the sound, voice, let us recall what we learned about resonance and resonators.

A resonator in acoustics is understood as the volume of air enclosed in elastic walls. A characteristic property of a resonator is that it echoes - resonates - to a sound of a certain pitch, coinciding with its own tone or its overtones. The smaller the size of the resonator, the smaller the volume of air, the higher the natural tone of the resonator, to which it resounds.

If we look at the airways from the point of view of acoustic concepts, then we can find there numerous cavities, tubes, channels filled with air and having sufficiently elastic walls for resonance phenomena to arise in them. The fact that among the cavities there are also those whose walls are not bone or cartilaginous, but muscular, that is, relatively soft, is insignificant - resonance phenomena can also develop in them. A clear proof of this is the formation of vowels due to the resonance of sound in the oral and pharyngeal cavities, which have soft walls. Thus, resonance phenomena can develop in all parts of the airways. Let's consider all these cavities from the point of view of resonance.

As we have already mentioned, the resonance of the oral and pharyngeal cavity, which changes in volume depending on the language, is the reason for the formation of vowels. No other resonator phenomena occur in this part of the vocal tract. The resonance of the laryngeal cavity is associated with the design of the “high singing formant, which appears as the marginal tone of the ligaments. There remain cavities located below the glottis: the tracheal tube and bronchi and cavities located above the palatine vault, that is, the nasal cavities and nasopharynx, as well as the so-called accessory nasal cavities. They are usually associated with the idea of enriching the timbre due to the head and chest resonance.

The head resonator of singers is sometimes understood to include all cavities above the larynx, i.e. it includes not only the nose, nasopharynx and nasal appendages, but also the oropharyngeal canal. We consider this inclusion unjustified, since the resonator function of the mouth and pharynx is not the cause of the vibration in the "mask" region, and serves only for the formation of vowel formants. By head resonators, we propose to understand only the cavities located above the palatine vault, in the facial part of the head, in the area of the "mask".

It should be noted straight away that all the cavities that make up the upper resonator concept are enclosed in bony or cartilaginous walls, i.e. are incapable of changing their

volume and hence their resonator properties. Once given to man, they remain unchanged during his life. Only the nasopharynx, due to the mobility of the soft palate, is able to change its volume and have varying degrees of communication with the pharyngeal cavity.

The nose and its appendage cavities (sinuses), which are located in the area of the face actually covered by the mask, are air-filled spaces of a very small volume. For example, the largest nasal cavity - maxillary or maxillary sinus - has dimensions of about 3 смdiameter. Consequently, these cavities can resonate to the high overtones of the voice. A tube of length 3 смopen at one end, resonates with a frequency of about 3000 hertz, i.e. in the region of high singing formant. Thus, phenomena of resonance in the facial part of the skeleton during quality singing may occur, and they will be pronounced strongly in the case when the timbre of the singing sound, passing through the extension tube, through the oropharyngeal canal cavities, will contain in its composition many high-frequency overtones. The nasal cavities can 'respond' to these overtones. The sound of the singing voice passing through the oropharyngeal canal diminishes greatly in strength as most of its energy is transmitted to the cavity walls, where it is gradually damped. Through the hard tissues of the facial skeleton it certainly reaches the nasal appendages as well. By shaking them, it causes the air there to "sway in time", i.e. the phenomenon of resonance.

The sound does not enter the nasal cavity, much less its appendages, directly through the airways. It is well known that the frequent vowel sounds of the Russian language are usually pronounced when the soft palate completely overlaps the passage into the nasopharynx. If the palatine curtain is raised poorly, the voice acquires a nasal tinge - nasality. A good singing sound therefore involves either the soft palate completely overlapping the nasopharyngeal passage, or a completely insignificant communication.

However, this does not mean that the head resonator is the cause of a good sounding voice. The fact is that the resonance phenomena that develop in the cavities that make up the upper resonator cannot reach the listener's ear, as the resonator cavities are not connected to the outside air space. They are resonators, closed on all sides. The fine passages communicating the nasal appendages with the nasal cavity are very narrow and, as we have written, clogged with mucus. It is not necessary to think that the sound energy accumulated in resonators may find an exit through the air environment, i.e. through nasal passages, into the outer space and reach the ear of a listener. Experimentation has shown that this energy, like the energy of nasal resonance, has little or no effect on the outside environment and therefore plays no role in the listener's ear. Practically speaking, the sound of the voice does not escape through the nostrils.

The simplest experiment in this direction can be performed by anyone. If one pronounces the vowel a loud and clear with equal force, for example, alternately with and without the nostrils clamped, the listener will not notice any significant change in the character of the sound. Only the experimenter will subjectively perceive this difference. This simple experiment shows that the resonance sound energy of the nasal cavity and its appendicular sinuses does not exit into the outer space through the nostrils. The singer has no exit through the nasopharynx back into the oral cavity, as the passage to the nose is blocked by the raised soft palate.

The energy accumulated in the head resonator, with no outlet through the airways to the outside space, causes shaking of the resonator walls, i.e., strong vibrational vibration of the facial part of the head. This vibration is perceived by the singer as a sound that has "entered the resonator", a sound "sent into the mask".

Some believe that the vibrations of the front part of the head, resulting from the resonance of the cavities in the upper resonator, may be directly transmitted to the air and thus reach the listener's ear. In this case, the front part of the head would act as a deck, transmitting vibrations to the outer space. As it was said before, energy emitted from the front part of head, as well as from the thorax, is so small, that it practically does not add anything to the sound of the voice, i.e. does not reach the listener.

The only source of the singer's voice radiation is his sweat. Only the energy that radiates from the mouth reaches the listener's ear. The head resonator, separated from the course of sound waves running through the oropharyngeal canal by the palatine vault, can add nothing to their energy. Consequently, no matter how strong the resonance phenomena may develop in the cavities within the concept of the head resonator, they have no way of reaching the listener's ear.

A strange contradiction arises. On the one hand, when the singer has a good sounding of the upper resonator, the "mask", the voice gets the most important qualities: fullness of metal, brightness and ringing of the sound, and the singer himself subjectively becomes easier to sing. On the other hand we can definitely say that the upper resonator cannot add anything to the sound, as it does not communicate with the outer space.

The head resonator and the small cavities of the front part of the head resonate when the initial sound coming out of the larynx contains many high overtones, when it has a pronounced high singing formant. We already know that the brilliancy and metallicity of the voice depend on the presence of a high singing formant, which is formed in the larynx thanks to the tight closure of the vocal cords and the resonance of the overlapping laryngeal cavity.

So the brilliance and metallicity of the voice do not depend on resonator phenomena in the cavities of the upper resonator, but on the formation of the original laryngeal timbre. The upper resonator only responds to this sound quality.

As a matter of fact, many singers feel this way about the upper resonator, clearly understanding that the cause of resonance is in the larynx. For example, La Scala soloist, bass Ivo Vinko, has stated that the cause of the resonator sensation "in the mask" is the larynx. An even clearer definition of the cause of thoracic and head resonance, was given by the soloist of the same theatre, baritone Rolando Panerai: "The resonators in a singer are not made, not fabricated, they cannot be made artificially. They depend on the natural construction of the facial skeleton, they form an integral part of the anatomical structure of the vocal apparatus... The nature of resonance in a particular singer stands in relation to the size and shape of the facial resonators: in one they are large, in another small. Therefore both the inner feelings of the singers and the properties of

their voices are different. If a young singer learns, starts to form the sound correctly, then the resonators begin to respond (my emphasis. - L. D.)... A singing voice is born in the vocal cords. If you have learned to produce a singing sound in the correct position in the depth of the throat, then the resonances appear which are characteristic of the voice, a beautiful voice emerges.

It does not follow, however, that resonator sensations in the head resonator are of no importance to the singer. We have already noted that they are the strongest exciter of vocal function and, therefore, 'getting into the resonator', i.e. the response of the resonator to the correct formation of the primary timbre of the larynx, leads to an easier process of sound formation. This is a direct, direct assistance that the head resonator provides to the singer.

In addition, we know that the singer himself hears himself in relation to the timbre incorrectly and, as a rule, does not recognize his voice when listening to it in the recording. The resonator sensations are very bright, and they signal the singer well whether there is a high singing formant in his timbre, that is, metallicity, sonority, or not. When the timbre of the singer's voice is formed correctly (it has sonority, metal and sound has good flightiness), this is signaled to him not only by hearing, but also by bright resonant sensations.

The head resonator is the most important indicator for the correct singing sound of the voice. The development of resonator sensations in students should be given the utmost attention. Not all pupils understand these sensations at the beginning of lessons, and in order for them to know what they are aiming for, many teachers use techniques that lead to these sensations.

The techniques associated with singing in consonantal "mooing" and "whining", when the mouth is closed and all sound comes through the nasal passages, results in a strong shaking of the upper resonator cavity walls, even when the high frequencies are weak. These techniques help the student to understand the sensation to be achieved when singing.

Another technique, aimed at creating a head resonator, is the use of the vowel sound and. As we have already mentioned, the formants of this vowel are 400 and 3000 Hz, i.e. in a purely pronounced sound and there is always a group of overtones amplified at about 3000 Hz, to which the upper resonator resonates. By using the vowel sound and, we will more easily evoke the phenomena of cephalic resonation as compared to other vowels, which do not have high-frequency formants in their spectrum.

Finally, a tighter closure of the vocal cords and proper organisation of the laryngeal work results in a greater metallicity and brightness in the timbre, which immediately causes a response in the head resonator. The activation of the larynx, whether by attack or breath support, leads to the emergence of high frequencies in the sound, and with this the head resonance.

All these paths: through "mooing" and "nagging", through the vowel and by activating the closure of the ligaments, lead to the appearance of head resonance, and the student begins to understand what kind of sound one should strive for, what sensations accompany a high-quality singing voice.

Gradually accompanying good professional sounding sensations of head resonance "mask" become familiar to the singer, and then he begins to see the reason for the good sounding of the voice. This is how the psychology of the singer is formed, who believes that the main task in the formation of a professional singing sound of the voice is "getting into the head resonator", "directing the sound into the mask." Meanwhile, as we have already noted, not all singers have vivid resonant sensations even with an excellent sounding of the singing voice, which can be explained by the individual characteristics of the shape, size and condition of the accessory cavities of the nose. In some individuals, they are very poorly developed, in others, on the contrary, these cavities are numerous and large in size. Therefore, the resonator properties of the upper resonator of different singers are not the same.

What has been said about the upper resonator does not at all contradict singing practice, but, on the contrary, is daily confirmed by it.

So, for example, the leading soloist of the Coliseum, Honored Artist of the Republic N., when asked about the head resonator, told us that the resonator sensations he had with the correct formation of the singing sound were very bright. Usually he feels that the entire facial part of the head and especially the area of the "mask" vibrates strongly during singing and in this state it is especially easy and comfortable to sing, and the sound has the greatest volatility, rushes well into the audience. But sometimes I had to sing in a state of coryza, when the nose was completely blocked up and there could be no question of any echo of the head resonator. In these cases, it was subjectively difficult to sing, since as a result of singing, the usual sensations of head resonance did not arise, however, neither partners, nor friends, nor the audience ever noticed any deterioration in the sound of the voice. Naturally, not getting the necessary, familiar sensations, that is, when some feedbacks were violated, singing was difficult for the singer himself. I had to use other sensations that remained unaffected by the painful state to control sound production (muscle, auditory, etc.). There was no stimulation of the voice function from the upper resonator. All this subjectively made it difficult for the singer to sing. But the voice also sounded round and metallic, loud, as always, despite any lack of head resonance. This once again confirms that the closeness, metallicity, sonority and flightiness of the singing sound do not depend on the "coloration of the sound in the upper resonator", but on the work of the larynx.

We think that the case of an acute coryza is so common that it should not be further commented on. This state and the need to sing, being sick, overwhelms most singers, who can attest that the voice retains its sonority for the audience. The above, of course, does not apply to chronic rhinitis complicated by inflammation of the paranasal sinuses, etc. In these cases, the vocal function can be sharply impaired as a result of the reflex, suppressive effect of inflammatory purulent processes on the vocal cords.

Regarding the thoracic resonator, it can be said that thoracic resonance, i.e. sensations of distinct vibrations in the thoracic region, accompanies all sound formation throughout the one and a half octave range of the male voice and in the lower and central parts of the female voice. The resonator in the acoustic sense of the word here may be the trachea and the large bronchi. They are the only air cavity-tubes that exist in the chest. As we know, the lung tissue itself, which

constitutes the main mass of the lungs, is an elastic spongy tissue and is therefore an excellent sound absorber.

It should not be thought that the entire thoracic cavity, i.e. the space enclosed by the chest, can resonate. The entire chest cavity is filled with lungs, and therefore only absorbs sound from the vocal cords through the airways. Valid resonance here can only develop in the tracheal tube and large bronchi, and this system of tubes, being relatively long, resonates to low tones. For example, the trachea, being about 15 cмlong, should resonate at a frequency of about 500 Hz. It is this frequency that gives the voice a rounded, fleshy, thoracic flavour.

However, this place of formation of the low singing formant is indicated only presumably. Other authors attribute its emergence to the resonance of the lower pharynx.

The resonator sensations in the chest are clearly felt by the singer if he puts his hand to any part of it. However, these thorax vibrations are also useless to the listener (as in the case of the head resonator). Sound does not spread from the chest walls, and the walls cannot play the role of decks of musical instruments. Therefore it is indifferent for the listener whether the singer sings wearing a boyar coat tightly covering his torso with the sound-absorbing material, or whether he sings with a bare chest. The sound of the voice does not depend in any way on the degree of covering of the chest with the suit. What reaches the listener's ear only comes out of the singer's mouth.

If one thinks that thoracic resonation is capable of changing anything in the character of the singing sound, one must assume that this resonance is included in the general sound of the voice, going along the course of the airways. Resonating at frequencies of the order of 500 Hz, this tone of the trachea, being mainly spent in shaking its walls and only slightly penetrating through the vocal slit, is partially mingled with the general sound born in the vocal closure and, coming out of the mouth, reaches the listener.

It should be noted that the trachea and large bronchi are not resonators of completely unchanged volume. The trachea and bronchi extend somewhat in length during a deep inhalation, and due to contraction of the smooth muscles they may also change the size of their lumen within small limits. Thus, the thoracic resonator in this respect is not like the head resonator, where the walls of the cavities are perfectly stable, here there is a certain possibility of adaptation.

Thoracic resonation is strong when the vocal cords work on the thoracic type of their vibrations. When they are falsetto, the thoracic resonator does not respond. This is due to the size of the trachea being able to respond to relatively low frequencies, and resonance therefore only appears in the thoracic resonator when there are reasonably well defined low frequencies in the cords. It is more likely that the tremor phenomenon developing in the tracheo-bronchial system should not be regarded as true resonance, but rather as a forced oscillation originating from the working vocal cords.

For the singer, thoracic and head resonance are indicators of the correctness of the singing sound, so the resonance sensation should be the focus of the student's attention. The finer the student differentiates his or her resonator sensations, the more accurately he or she will be able to control the work of the vocal apparatus. It should only be remembered that thoracic and head resonance are the consequence of a correctly organised singing sound, and not the cause of it.

In conclusion, it must be noted that if only the head or chest resonation is carried away, without taking into account the other moments of the singing voice, the voice can degenerate. The preoccupation with head resonation, however important it is, can gradually lead to an inhibited voice, a 'shoddy' sound, and a loss of sound organism. The singer begins to sing, as they say in the practice, "just the top", the sound becomes incomplete and the singing becomes difficult. La Scala soloist Ivo Vinko told us about this phenomenon very convincingly: "I have tried throughout my career to 'send my voice into the mask', as they say, 'keep it in the mask'. But I came to the conclusion that sending your voice in a 'mask' all the time is not necessary and, in the end, a useless thing. Such a singer who keeps his voice in a 'mask' all the time during his singing career will eventually see that the voice, instead of developing fully, gradually becomes narrower and narrower. And after a dozen years the artist realises that his or her voice cannot serve him or her any more. The singer cannot sing any more. A crisis sets in. The infatuation with the "mask" finally leads to an inability to sing. Then you have to learn to sing again and seek the development of the voice, the opening of the sound with the whole body, the whole body, especially with the thorax.

Abuse of thoracic resonation can also lead to a degradation of the voice. The voice becomes heavier, register transitions become noticeable, and the upward movement of the voice becomes more difficult. The voice gradually becomes heavier and heavier, it starts to wobble and detonate. Thus, abusing only the head or chest sound can be detrimental to the voice.

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