บทความวิชาการ (Academic Article)

The Use of Consonant Sounds in Vocalization: Background, Questions, and its Importance for Singing

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Abstract

Many singers vocalize to improve their vocal skills. Vowels and musical notation are essential in the structure of vocalization, but consonants initiate the flow of breath that produces the sound. A more detailed understanding of the qualities of consonants will ensure that the singer accesses the correct vocal timbre and avoids misinterpretation. The use of articulators to phonate consonants also adjusts breath flow for sound production. This paper explains the role of consonants and their correlation to muscle movement in four areas of vocal technique: 1) breath management / balance onset / dynamic, 2) vocal register / blending / going through passagio, 3) resonance or tone quality, and 4) agility and releasing tension. Practicing these groups of consonants will help eliminate muscle action that interferes with airflow, as well as unlocking tense muscles to improve accuracy and precision. This paper will show how to use consonants in vocalization, helping singers combine consonants with vowels and notation to improve technique, and sharpen problem-solving skills.

Keywords: vocalization, consonants, singing, vocal technique

Introduction

The purpose of vocalization is to enhance tone. As painters use shade and color to achieve emotional affects, tone colors also convey a variety of emotions. Vocalization improves a singer's stamina and durability. There are hundreds of books offering methods of vocalization. Years of reading and vocalizing have sparked the authors' interest in how consonants shape vocal technique. This paper describes:

1. the importance of vocalization, and combining consonants with vowels and notation to improve vocal technique
2. problem-solving skills and the use of consonants in vocalization

This article "The Use of Consonant Sounds in Vocalization: Background, Questions and its Importance for Singing" draws on several textbooks of vocal pedagogy: 1. *The structure of singing: system and art in vocal techniques* by Miller, R. (1986), 2. *A Modern Guide to Old World Singing: Concepts of the Swedish-Italian and Italian Singing Schools* by David L. (2017), and 3. *Singing for Dummies* by Philips, P. (2011). The paper focuses on the elements of vocal production including 1) the source of power (breath), 2) the source of vibration (vocal fold), 3) the source of resonance (vocal tract), associated with the principle of vocal pedagogy, and 4) vocal health (tension-release).

There are a variety of approaches to voice instruction: 1) breath management / balance onset / dynamic, 2) vocal register / blending / going through passagio, 3) resonance or tone quality, and 4) agility and tension release.

The author's method is based on principles of vocal production and elements of vocal technique. Vocal sound production consists of four major components:

1) the power source, relevant to breathing management / balance onset / dynamic topic, which subjects from rhythm and resistance of the breath pressure;

2) the vibrator source, relevant to vocal register / blending / going through passagio topic, where the actions are happening / adjusting by the vocal cord;

3) the resonator source, relevant to the resonance or tone quality topic which is the operation of the waveform filter to support pitch and timbre; and

4) vocal health, the basis of most vocal pedagogy books, relevant to agility and tension release as of the vocal precision functions from healthy vocal organs.

Following are relevant illustrations of the organs used in voice production:

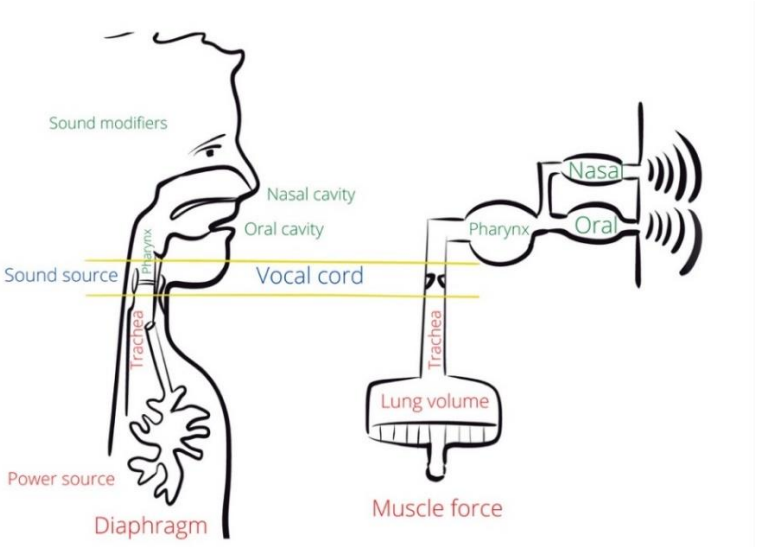

Figure 1 The physiology of sound production

Source: the author

Note. Red indicates the power, or muscle force. Blue indicates the vibrating elements, the source of the sound. Green indicates resonators, or sound modifiers

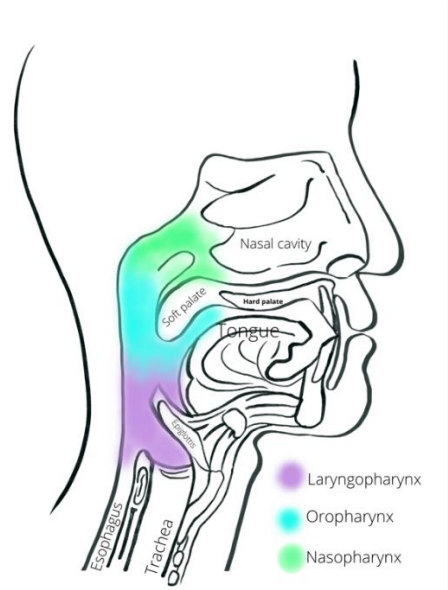

Figure 2 The vocal tract channel

Source: the author

Note. Purple indicates the space from the glottis to the tongue root. Blue indicates the space from the tongue root to the soft palate. Green indicates the space from the soft palate to adenoid.

The resonating areas of the vocal tract range from the glottal to the lips, with the oral cavity serving as the primary output channel. The nasal cavity can alter the timbre of a sound, but because it is small, it is not active in boosting volume. The vocal tract resonator must include one side opening tube, which means that the other part without an opening side does not act as a sound modifier, but vibrations can be felt through the bones in the surrounding areas such as the chest and forehead.

The explanation and use of consonant sounds will be represented by their phonetic alphabet forms. Vocal warmups tend to have a structure that includes notation, alphabetic sounds, consonants, and vowels. Vowels are the primary source of resonance since they can be produced with no air obstruction. However, not all vocalizations need to start with consonants. When only vowels are used, some singers do not have a clear sense of the tone color they are preparing to sing with. The use of an initial consonant sound ensures the correct manner, placement, and movement of the articulators that voice each consonant, and produce the correct tone. These articulators adjust the tone and improve vocal technique.

Consonant sounds are formed when the lips, tongue, teeth, teeth ridge, hard palate, soft palate and glottis interrupt the flow of air through the vocal tract. Placement refers to the location of resonance in the vocal tract. Manner refers to the partial or complete interruption of the flow of breath, including the stop-plosive, fricative, nasal, lateral, glide, and combination. Consonant voicing refers to the sound produced with ("voiced") or without ("unvoiced") vocal fold vibration.

The Use of the Consonant Sounds in Vocalization: Background, Questions and its Importance for Singing

The application of consonant sounds in the phonetic alphabet will be used to develop vocal technique in the following areas:

1. Breath management / balance onset / dynamics

1.1 Breath management

Try the following sounds to engage your diaphragm in phonation.

1.1.1 Vocalizing with the consonant /r/, starting from the tongue blade to the hyoid region, helps loosen the muscles in the area, engaging your body's natural support systems. A free trill requires a non-stop flow of air, which shows the volume of breath support the body requires in each pitch range. The rolling action increases awareness of the necessary lateral abdominal support. Making a rhythmic pattern of the voiced consonants /ʒ/ /v/ /z/, focusing on airflow, helps support the breath with the abdomen.

1.1.2 Making a rhythmic pattern of the unvoiced consonants /t/ /p/ /ʃ/ /f/ /h/ /k/, while focusing on airflow, helps get the breath working with abdominal support. Voiced and voiceless sounds are distinguished by the amplitude (loudness) of the larynx pulse. Using unvoiced consonants helps activate the muscles in order to enunciate in the higher dynamic range.

1.1.3 Vocalizing with the sibilants /s/ and /ʃ/ improves consistency of airflow.

1.1.4 Use of the unvoiced labiodental fricative /f/ improves abdominal control awareness in breath management. Begin with /f/, with diphthong vowels, and conclude with /v/, as

in “five”, to help maintain a constant flow of breath, which helps those who struggle with legato singing.

1.1.5

1.2 Balance Onset

The vocal onset exercise uses the glottis to coordinate breath pressure. Every phase of sound production begins with a vocal onset or “attack.” This starting tone affects the vocal color of the spoken or sung phrase. There are three approaches to the vocal onset: coordination (or “balance”) onset, glottal onset (or “pressed phonation”), and aspirate (or “breathy onset”) resulting from a looser closure of the glottis.

“Coordination onset,” meaning the simultaneous or synchronized closure of the glottis with the start of airflow, results in a balanced tone. Use of these consonants in vocal exercises helps stabilize air pressure and generate a resonant sound in phonation.

Try the following sounds to improve balance onset in vocalization:

1.2.1 /h/, a glottal fricative, softens the pressure, and /ʔ/, a glottal plosive, hardens the pressure. When put in front of a word, these consonants helps create appropriate resonance and a synchronized onset.

1.2.2 /z/, a voiced alveolar fricative, and /v/, a voiced labiodental fricative, helps darken a breathy tone. As a reaction to the occluded posture, the air pressure in the mouth rises.

1.2.3 /θ/, an unvoiced fricative dental, helps release extra subglottic pressure.

1.2.4 /d/, a voiced alveolar stop plosive, enhances subglottal pressure as the stream of air is stopped by the pressure of the tongue. This increases awareness of the vocal folds.

1.2.5 /b/ and /m/, voiced bilabial stop plosives, are produced by lip closure that differ solely in the soft palate region. Practice of these consonants helps reduce breathiness. The air pressure behind both lips as a response to the laryngeal pharynx helps the vocal folds vibrate more smoothly and with less effort, reducing the amount of

escaping air. Vocal fold vibration with the lips closed can reduce muscular strain, minimizing a pressed sound.

Miller (1986) described the benefits of using bilabial consonants for breath support:

> In all bilabial acoustic events, breath is stopped by the lips, with breath pressure accumulating behind them. The sudden release of the lips often brings the perception of tone that is produced at the lips. (p.97)

If sung as a nasal, the /m/ will bring a sensation of pressure in the total pharyngeal tube.

> Additional benefits from using "humming" sounds (i.e. the same action as producing bilabials) are found in the heightened support sensation experienced in the torso, which is the result of total or partial closure of the mouth that occurs during the production of nasals. (p.89)

1.2.6 /j/ and /w/ link vowels when a vocalization is made up of two pure vowel sounds. The sound of /w/ helps link back-placed vowels produced with rounded lips. The sound of /j/ helps link forward vowels or vowels produced by the tongue.

1.3 Dynamics

Try the following sounds to improve your dynamic control for specific articulations:

When practicing dynamics, you may choose a group of consonants in the same placement and alter phonemes from one to the other. Use /l/-/t/-/d/ to practice a "loud-soft-loud" dynamic shape, while /p/-/m/-/b/ helps in practicing crescendos by changing the amplitude in subglottic pressure. Singers will feel pressure shifts while remaining connected to the support in their bodies.

Ladefoged (1998) has explained the differences in amplitude of voiced and voiceless sounds. Voiceless sounds do not have a periodic waveform with a well-defined fundamental frequency or pitch. Some sensations of pitch accompany the variations in air pressure caused by the turbulent airflow that occurs during a voiceless fricative, or in the release phase of a voiceless stop. This is because the pressure variations are far from random. There is also a difference in the average amplitude of the wave form in different voiceless sounds. All voiceless sounds have much less energy, that is,

a smaller amplitude, than voiced sounds pronounced with the same degree of effort. Voiced and voiceless sounds also have a distinct amplitude, or loudness, of the larynx pulse.

2. Vocal Register / Blending / Going through Passaggio

Imbalance in registration can be caused by uneven breath flow, jaw and tongue tension, and hyperextension of the sternum (incorrect posture), all of which can lead to over-compression of the breath. Singers can make more space by raising the soft palate in order to accommodate higher pitches. Although the use of consonants does not help correct posture directly, it can help balance out-breath flow, create proper space in the vocal tract, and release tension in the jaw and tongue.

Try the following sounds to train laryngeal muscles to sing through your passaggio:

2.1 /w/, as a voiced bilabial and a glide, or "semi vowel", has a liquid character. It sounds similar to back-placed vowels and distinguishes them from other bilabials like /b/ and /p/. This should be produced with a raised soft palate, a low larynx, and a wide tongue root. Start vocalization in the middle register, descending from the upper register to the lower register. Note that the "weight" of the tone will decrease with the openness in the vowels being sung. The vocal folds line up during transition when using consonants with high glottal pressure.

2.2 The nasal consonants /m/ /n/ /ɲ/ /ŋ/, close the oral cavity and balance resonation in the following vowels when transitioning from the lower to upper register. It combines the regions of the oral pharynx and nasal cavity.

2.3 /m/ and /n/, voiced nasal consonants, can be sung in a hum before song lines beginning with consonants /b/ or /d/, which require a reduction in subglottal pressure while singing in the upper register. Be mindful of pressure fluctuations.

2.4 /n/, a voiced alveolar nasal is preferable higher in the register. /n/ helps the vocalist release a small, steady flow of air through the larynx, which is required while passing through passaggio to the upper register. However, /n/ is preferable to /m/ for creating space in the upper range when tuning high frequencies. As a bilabial, /m/ is less useful for this purpose.

2.5 /l/ and /n/ are voiced alveolars which require the singer to move the tongue and jaw independently in order to maintain an open throat. The use of dental consonants helps the tongue work independently from the jaw. When using consonants /l/ or /n/ to vocalize, be sure to begin with a puff of air while maintaining a strong sense of openness. Try placing /k/, an unvoiced alveolar stop plosive, *in front of* the set of dental consonants /l/ or /n/. When the jaw is released, it can reach into the upper register.

The jaw release is essential to reaching the upper register. Peter N. Ladefoged (1998) mentioned that in using laterals, when the oral tract itself is obstructed in the center, the side branches alter the relative amplitudes of the formants.

Jones offers tips to singers who struggle with registration blending while singing each consonant in the middle register:

> Sliding the jaw back gently after each consonant [helps] set the larynx in the neutral position, especially while singing in the middle register, in order to maintain multiple overtones possible in the vocal tract, accompanying a small change of vibratory pattern in the vocal folds. When vocalizing, the degree of opening the jaw is completely related to registration. The famous opera singer, Placido Domingo, wraps his jaw back gently after each consonant when he sings text. When singing in the middle register, the singer should not open the mouth too much and wait to open toward the upper passagio. This will keep high overtones present in singing medium-lower pitches. (2017, p.63)

3. Resonance and Tone Quality

The consonants alter and adjust the shape of the resonator tube and form the timbre. The choice of consonant can help achieve the correct sound quality in the resonator tube. When the vocal cords obstruct the air during phonation, a complex motion is set up consisting of the fundamental tone and a large number of overtones in the vocal cavities, modifying the spectrum of energy by force on the vocal cord as determined by the size and shape of the vocal tract. Some of the consonant sound helps promotes high overtone and a rich vocal timbre by coupling the acoustical spaces.

Sundberg (2005) said that the vocal tract resonators determine, in part, the quality of the sound. A resonator is any system that has weight and can be compressed.

> When the mouth is open the voice has greater intensity as it leaves the body. This is best achieved by focusing on the position of the tongue, its base, the palate, and the lips. (p.275)

The tongue, palate, lips, teeth, jaw, gum ridge, and the pharyngeal wall are the articulators directed in order to form consonants. The following consonants help maximize tone quality. To improve tone quality for the desired timbre, vocalize using the following sounds:

3.1 The /ŋ/ voiced velar stop is created by the close contact of the soft palate and the tongue. This produces a vibrating sensation with a high placement, enhancing the clarity of the sound. When this voiced velar stop is used to initiate vowels, it opens an acoustical space behind the tongue root, causing the nasopharynx and oral cavity to couple as a resonator.

> 2) If /s/, the unvoiced sibilant, is sung in front of a /ŋ/ and followed by an unvoiced glottal fricative such as [sʌŋ.hɪ], the abdominal control in /s/, and the vibration in the front of the face from /ŋ/, as well as the increased airflow from /h/, will all project from the mask.
>
> 3) sung with various vowels, brings the tongue to home position which helps produce high overtones.

David (2017) describes how the voiced velar stop /ŋ/ increases resonance in the vocal tract and balances the vocal weight to navigate vocal registration.

> Strengthening the thin-edge function of the vocal fold while encouraging the /ŋ/ tongue position is key in the development of higher overtones throughout the voice. The purpose of threading the different vowels on the /ŋ/ ring was also to drop vocal weight while sustaining a light yet body-connected tone. (p.122)

3.2 The /ɲ/ voiced palatal stops produce a “twang”. The narrowing of the pharynx and the centering of the vibration in the mask behind the nose will result in high-frequency formants, creating an “edgy” sound. The consonant should be used with back-and front-placed vowels, resulting in a

more balanced sound. Compare the receiving timbres of those different vowel placements and practice them to produce a consistent sound.

Pamela (2011) urged caution in mixing ideas of nasal resonance with nasal vowels. When singers produce the nasal consonant sounds, the air may spill out from the nose in some cases, but it shouldn't happen while the vowels are being sung. Consider the following before using nasal consonants in front of all the vowels in order to achieve the best resonant effect.

> Nasal resonance is different from nasal sound. Nasal resonance involves taking advantage of the sound resonating in the nasal passages. Air shouldn't be moving out of your nose unless you are humming or for the split second it takes for you to make initial consonants /m/ /n/ /ɲ/ to help you feel the sounds of nasal resonance and feel the air moving out of your nose, but not while you are singing a vowel sound. If air comes out of your nose while you are singing a vowel, you create an undesirable nasal sound which doesn't take advantage of all the resonators. (p.89)

3.3 The /g/ voiced alveolar stop plosive is a reflexive consonant, encouraging more efficient closure of the vocal cords. Using this consonant in an exercise may help singers who struggle to raise the soft palate. It may also develop the sensation of openness in the channel between the oropharynx and oral cavity, which occurs when the back of the tongue elevates and presses against the soft palate. If the practitioner seeks a stronger sensation of openness and lower body resistance, try the unvoiced alveolar stop plosive /k/ as it releases more air to the pharyngeal to produce the same volume.

In order to vocalize with /k/, follow it with a diphthong to enhance the sustenance of air, such as /ɪʊ /, as in [kɪʊ]. These vowels also require both lips, like /w/, boosting back pressure. Furthermore, adding in the second vowel, based on the desired timbre via vowel formant frequency selection. For a strong middle voice choose /ɛ/.

David (2017) suggested pairing consonants /k/ with /w/ followed by the phoneme "ex''. This combination can reflect the sound of a person's natural vocal timbre, as "ex' initiates the ring sound in their open pharyngeal space.

> "Kiu – ex" is an exercise designed to open the acoustical space (pharynx) and release the jaw while the tongue moves forward out of the pharynx. The jaw releases, the

larynx drops slightly which opens the acoustical space, and then the tongue moves forward to make the "ex'' sound, bringing in the ring factor. (p.131)

Other voiced consonants such as stops and approximants, or semivowels such as /w/ or /j/, are similar to vowels in that they can be in part of the resonant frequencies and the formants of their vocal tract shapes.

3.4 /w/, the voiced bilabial glide, creates a warm tone that requires additional resonance in the oropharynx. Vocalizing this consonant with bright vowels balances the bright and dark color in the sound and enhances the rounded sound quality, creating more interest in the singer's tone.

3.5 The /j/ voiced palatal approximant increases forward resonance in sounds followed by back vowels.

3.6 Voicing the interdental fricative /ð/ produces a sensation in the upper jaw which raises the muscles surrounding the cheekbones, producing a more resonant sound for singers that struggle with raising the soft palate.

4. Agility and Releasing Tension

Rich resonance will be produced when the root of the tongue is freed so that it does not dampen the overtones. The movement of the jaw and tongue can release tension. Raising the soft palate, lowering the larynx, and dropping the jaw should not be done excessively. Excessive jaw-dropping restricts the airflow in the nasal cavity. So, while tuning an acoustic in a word consisting of nasal continuants (/m/ /n/ /ɲ/ /ŋ/), the jaw must be opened to achieve balance. When the jaw is in a narrow posture, the gag reflex at the tongue interferes with the airflow, creating too much pressure on the glottis.

To achieve accuracy and precision, try the following sounds to release your muscular tension:

4.1 /m/, a voiced bilabial stops, releases tension in the tongue and soft palate. Note that the tongue must make contact with the lower teeth without falling to the floor of the mouth. /n/ can be used for those who tend to pull their tongues back.

4.2 /n/, the voiced alveolar nasal, /l/, the voiced alveolar lateral approximant, and /t/ and /d/, the voiced and unvoiced alveolar stop plosive, prompt an independent function of the jaw and tongue. When starting to vocalize, the mouth, tongue, lips, and jaw must all remain in the same position for all phonemes. This technique helps maintain the same timbre when practicing legato singing.

Singers must avoid rapid movement of the jaw or the mouth cavity and practice using the tongue without moving other articulators. It will harmonize the timbre of all vowels in the phrase.

4.3 The unvoiced consonant set /p/ /t/ /k/, and the voiced consonant set /b/ /d/ /g/, develop agile articulators. This can produce more precise rhythms with varying tempo.

4.4 Vocalizing a rolled /r/ sound can reduce muscular tension around the neck, develop flexibility of the tongue, and create more breath energy.

Miller (1986) showed that the dominant function of the tongue point trill relates to vocal training topics.

> The tongue point trill exercise has two specific goals: 1) to induce freedom in the larynx and tongue, and 2) to increase awareness of good breath management. (p. 94)

4.5 Vocalizing /j/, the voiced palatal approximant, has the benefit of stretching the tongue. Vocalize with a sound that lacks focus due to an initial high tongue position.

4.6 /l/, a voiced alveolar lateral approximant, rehabilitates a tight tongue muscle by using the abdominal region to intensify sound energy and release tongue tension caused by the pronunciation of certain languages, including Thai. The /l/ preceding vowels does not require much jaw movement, allowing the tongue tension to be released from the tip to the root, resulting in purer vowel acoustics.

Conclusion

The sounds of speech form the basis of vocal technique. The effectiveness of this method varies with the language background affecting the articulation and pronunciation. Understanding the use of consonants in vocalizing helps reach the goals of vocal practice. Because singers require expertise in controlling the articulator to modify their instrument tube, vocalizing will always be the only way to develop an ideal vocal timbre. The following examples offer solutions for these problems. All solutions depend heavily on the pronunciation of certain consonant sounds.

In the table below, the author has provided a ready-to-use table of 24 features of the sounds for International Phonetic Alphabet. To use it for vocalization, select the sound based on its problem-solving function, and combine it with vowels that correlate with muscle movements in relation to these four topics:

1. Breath management / balance onset / dynamic

This group of consonants enhance and distinguish overall core muscle movements, enabling them to be well controlled.

2. Vocal register/ blending/ going through passagio

This group of consonants enhance the perception of the matching pressure moving steadily and solidly across each pitch range.

3. Resonance or tone quality

This group of consonants prompt a sensation of air resistance in various sections of the vocal tract, resulting in a different timbre.

4. Agility and releasing tension

This group of consonants helps eliminate muscle action that interferes with airflow, as well as unlocking tightened muscles in order to achieve accuracy and precision.

Table 1. Summarization of "The Use of Consonants in Vocalization"

*Placement		1) breath management/ balance onset/ dynamic	2) vocal register/ blending/ going through passagio	3) resonance or tone quality	4) agility and releasing tension.	*Manner
Bilabial (both lips)	/p/					Stop plosive
	/b/					
	/m/					nasal
	/w/					glide
Labiodental (lip and teeth)	/f/					fricative
	/v/					
Interdental (between teeth)	/θ/					
	/ð/					

Table 1. Summarization of "The Use of Consonants in Vocalization" (Cont.)

*Placement		1) breath management/ balance onset/ dynamic	2) vocal register/ blending/ going through passagio	3) resonance or tone quality	4) agility and releasing tension.	*Manner
Alveolar (teeth ridge)	/t/					Stop plosive
	/d/					
	/n/					nasal
	/l/					lateral
	/s/					fricative
	/z/					
Palatal (palate)	/ʃ/					
	/ʒ/					
	/j/					glide
	/r/					rhotic
Velar (soft palate)	/k/					Stop plosive
	/g/					
	/ɲ/					nasal
	/ŋ/					
Glottal (laryngeal)	/h/					glottal
	/ʔ/					
Benefits		Consonants strengthen all the core muscles and nerves (voicescience works, n.d.)	Consonants strengthen all the laryngeal muscles and nerves (O'Concer, n.d.)	Consonants lengthen and uniformize the vocal tract, boosting multiple overtones. (voicescience works, n.d.)	Consonants help eliminate laryngeal muscles stiffness and injury (O'Concer, n.d.)	

Source: the author

Note. *Placement refers to the place of articulation, i.e., the location of the obstruction in the vocal tract. *Manner is the configuration of articulators that maximizes resonance.

Effective Problem-Solving Strategies (Discussion)

My experience singing for 17 years has shown that voice training is physical. Although the tone of the voice is musical, learning to sing does not appear to be different from the ways athletes learn to control their movements. The movement of articulators is directly related to tone perception. However, the total acoustic aesthetic comes from the vowels, which are not mentioned in this article. The author has seen the problems that arise when vowels are used for vocalization while lacking good tone conception.

The author's intent is to help practitioners initiate the desired tone with a correct concept where muscle placement is being used, but singers need to be aware of certain limits:

- Unvoiced consonants are not helpful for producing a strong onset, although they can aid with the flow of air.
- Fricative, plosive, and sibilant consonants close off the nasal cavity, causing the sound to resonate in the oral cavity only, so increasing projection vibration-type singers have to make adjustments to their resonance.
- Consonant blend can be beneficial when merging bilabial and dental consonants and releasing tension in the jaw and tongue, but be careful with the vocal weight when vocalizing in the high range.

There are also a number of useful tools:

- The use of dental and flipped consonants will result in the independent function of the tongue and jaw.
- The group of nasal continuant consonants is an interesting solution for increasing vocal tract flexibility and creating acoustic sympathetic resonance.
- Total or partial closure of the mouth cavity helps find the "support" sensation felt in the torso.

Furthermore, the singer should equalize airflow across the consonant-vowel connections. When the singers have mastered the entire process, the tone of their instrument will be simply and naturally created by their feelings.

References

Breath. (n.d.). *Voicescienceworks*. Retrieved from https://www.voicescienceworks.org/breath.html.

Jones, D. (2017). *A modern guide to old world singing*. Lighting Source.

Ladefoged, P. (1998). *Consonants Formant: encyclopedia of Britannica*. https://www.britannica.com

Miller, R. (1986). *The structure of singing: system and art in vocal techniques*. Schirmer Books.

O'Concer, K. (n.d.). *The larynx structure and function*. Singwise. Retrieved from https://www.singwise.com/articles/the-larynx-structure-and-function.

Philips, P. (2011). *Singing for dummies*. Wiley Publishing.

Sundberg, J., & Staloff, T. (2005). *Professional voice: the science and art of clinical*, 3rd ed. Plural Publication.

Vocal tract. (n.d.). *Voicescienceworks*. Retrieved from https://www.voicescienceworks.org/vocal-tract.html.

Wall, J. (1989). *International phonetic alphabet for singer*. Pacific Isle Publishing.