

NATS July 2022 Pedagogy Workshop Working Group Three Science-Informed Terminology and Definitions for Voice Pedagogy

First Update 10-24-22

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Information for Users of This Resource

The charge for this working group was to:

- Collect and collate a thorough list of science-informed voice pedagogy terminology and their definitions, and inclusive language (including inclusive language guidelines), for 21st century voice pedagogy.

The terms in this document are organized:

- Alphabetically
- Terms which contain several subtypes begin with the main entry, followed by the subentry separated by a comma and listed alphabetically; for example: *memory* is followed by *memory, explicit*.
- Definitions which contain terms that are listed alphabetically and defined separately are identified in *italics*.

Other Information Specific to this Resource

- Where appropriate and possible, terminology that is unique or personally associated with an individual author/researcher or historic school of singing, are noted as such.
- all abbreviations having to do with *harmonics*, *resonances*, and *formants* follow this seminal article: Titze, Ingo R., Ronald J. Baken, Kenneth W. Bozeman, Svante Granqvist, Nathalie Henrich, Christian T. Herbst, David M. Howard et al. "Toward a consensus on symbolic notation of harmonics, resonances, and formants in vocalization." *The Journal of the Acoustical Society of America* 137, no. 5 (2015): 3005-3007. DOI:10.1121/1.4919349

- Terminology associated with Gender-Inclusive, Gender-Equitable and/or Non-Sexist Language Resources were checked against or influenced by a number of resources, including:
 - [United Nations Guidelines for Gender-Inclusive Language](#) in English
 - American Psychological Association (APA) [Inclusive Language Guidelines](#)

A Final Note Common to All NATS Pedagogy Workshop Working Group Science-Informed Resources

Users of this resource should note that all of the definitions were assembled and edited by committee members who took care to seek out both “science-informed” as well as common and historic voice pedagogy terminology. Because of the desire to honor both the past and present while looking forward to the future of “science-informed” voice pedagogy, we ask that NATS members accessing these resources keep in mind the crowd-sourced environment in which they were assembled.

Finally, users should note that this resource is an evolving document. If you have a suggestion for a term and definition applicable to singing voice pedagogy to be added here, please submit it to: **link coming soon**

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A

abdomen. The part of the body between the thorax and pelvis.

abdominal breathing. Breathing which is evident primarily from abdominal movement, with abdominal expansion caused by the descent of the diaphragm plus release of abdominal muscles and displacement of the viscera for inhalation, alternating with contraction of abdominal muscles and compression of the viscera for exhalation. Also known as “belly breathing.”

abdominal muscles. See *rectus abdominis, external obliques, internal obliques, transverse abdominals.*

abduction. Vocal fold movement away from midline –i.e., opening or open vocal folds.

adherence. A medical term that refers to a patient following through with the recommendations prescribed by their caregiver. Adherence is a concept that can be adapted for use in the voice

studio. Research has shown that adherence is enhanced when the client believes their physician truly cares for them and their outcomes, and by setting goals that the client believes are both important and achievable. Formerly called *compliance*.

absolute spectral tone color (ASTC). A psychoacoustics concept introduced into voice pedagogy by Ian Howell used to describe human perception of frequency. According to Howell, absolute spectral tone color is defined as: “Any two or more simple sounds (e.g., a sine wave, single harmonic of a complex tone, or narrowly notch filtered band of noise) of identical frequency, regardless of their sources, will produce an identical tone color percept independent of other spectral fluctuations considered aspects of timbre. If these simple sounds are located within a complex sound, their inherent absolute spectral tone color is never lost or changed, only expressed or masked. These tone colors may be placed on a continuum and bear a meaningful similarity to several vowels.” Notation convention is a tilde preceding an IPA symbol, surrounded by pipes. For example, an [u]-like quality is |~u|. See Howell, Ian, Parsing the spectral envelope: toward a general theory of vocal tone color (DMA dissertation, New England Conservatory of Music, 2016).

acoustic analysis. Analysis of the voice based upon an audio recording. Acoustic analysis includes measurements such as voice range, vibrato rate, vibrato extent, vibrato jitter, voicing time, alpha ratio, habitual speaking pitch, spectral slope, duration of phonation, harmonic-to-noise ratio, cepstral peak prominence, jitter and shimmer, amplitude in dB, and usually involving examination of the audio waveform, power spectrum or spectrogram of an acoustic sample.

acoustic efficiency. (1) Shaping the vocal resonator in such a way as to provide an acoustic “boost” to the sound. Acoustic efficiency means getting the most “gain” with the least expenditure of energy. (2) Optimal transfer of aerodynamic power from airflow into acoustic energy through the oscillation of the vocal folds and the interaction of vocal fold vibration and the resonances of the vocal tract.

acoustic flow. Refers to pressure sound wave propagation, which travels at the speed of sound. Acoustic flow is what carries the sound signal to listeners.

acoustic phonetics. The study of the acoustic characteristics of speech sounds.

acoustic registers. The timbral transitions and range segments that occur as a result of harmonic/resonance interactions. All acoustic register transitions involve interactions of the lower numbered source harmonics with the first and/or second resonance of the vocal tract. See also: *close timbre*, *open timbre*, *voce chiusa*, and *voce aperta*, as well as ‘hoot’ timbre and ‘whoop’ timbre (the last two terms cited from Donald Miller and Ken Bozeman, respectively).

acoustic registration. Refers to the relationship of source harmonics to vocal tract resonances, and the resultant timbral migrations.

actuator. The power source for the sound. In singing (if upstream motivation for voicing is ignored) the physical actuator is the breath (exhalatory flow). See also vibrator and resonator.

adduction. Vocal fold movement toward the midline (i.e., closing or closed vocal folds).

aerodynamics. A branch of dynamics that deals with the motion of air and other gaseous fluids and with the forces acting on bodies in motion relative to such fluids.

AFAB. Acronym for “assigned female at birth,” or the gender identity initially assigned based on evident biological sex at birth; eventually determined by the adult individual.

affect. Emotive expression, relative to its role in motivating and organizing various aspects of phonation, from respiration to phonation to resonance tuning.

afferent transmission. Ascending or bottom–up processing. Information is projected from the sensory receptors (peripheral nervous system) to the brain (central nervous system) where it is transduced into neural information that may be interpreted and projected to consciousness. See *perception*.

affricate. A consonant that combines characteristics of a stop and fricative. Examples in English include /tʃ/ and /dʒ/.

AGAB. Assigned gender at birth. A socially constructed gender identity, initially assigned at birth based on evident biological sex, eventually determined by the individual.

airflow. Refers to the airstream which passes through the glottis and vocal tract, dispersing and declining in velocity rapidly upon leaving the mouth. It is not the carrier of acoustic energy. During phonation, the kinetic energy of the moving flow of air is converted into acoustic energy through the oscillation of the vocal folds.

Alexander Technique. A modality developed by F. Mathias Alexander (1869–1955) that focuses on efficient, balanced muscle function and weight transfer/balance in daily life and in performance.

alignment. The relationship of one body part to another at any given moment of movement; the balanced transfer of weight through aligned skeletal structures. Balanced alignment reduces the need for muscular bracing, freeing the torso to respond to the respiratory requirements of voicing.

allergy. Altered bodily reactivity (such as hypersensitivity) to an antigen in response to a first exposure. Allergies produce mucosal changes due to excessive histamine release on exposure to a trigger. This may result in laryngeal edema, inflammation and increased secretion production. Vocal quality may range from hoarseness to aphonia to changes in resonance.

allophone. Variant pronunciations of the same phoneme. A specific phoneme is not a single, invariant sound. Rather, it is a class of sounds that all serve the same linguistic function.

Allophones are phonetic variants of a single phoneme. Allophones do not change the meaning of a word.

alveolar. Pertaining to the alveolar ridge, the raised bony area of the *maxilla* or mandible where the sockets of the teeth are located. In singing, “alveolar” refers to the alveolar ridge of the maxilla. This is a place of articulation for many common consonants.

alveolar ridge. The bony ridge that contains the sockets of the maxillary teeth.

alveoli. Small, thin-walled sacs that serve as the site of gas exchange in the lungs. The force of air within the alveoli is referred to as “alveolar pressure.”

AMAB. Acronym for “assigned male at birth,” or the gender identity initially assigned based on evident biological sex at birth; eventually determined by the adult individual.

amplitude. The maximum extent of a vibration or oscillation, measured from the position of equilibrium. Amplitude also describes the measure of energy a wave carries (related to its intensity).

anatomy. The study of the structure of an organism and the components that are part of the structure.

anterior. In front, in reference to the anatomical position.

anticipatory control. The ability to consciously monitor planning processes for voluntary behaviors before they are executed. Neuroanatomically, it involves anticipatory signals that prime receptors for the fluid and effortless responses characteristic of elite performance.

aperiodic. Irregular, not sinusoidal; in reference to a pressure wave, one that is perceived as indefinitely pitched noise.

aphonia. Medical term for the inability to phonate. Aphonia is caused by a wide variety of conditions, including infection, severe inflammation, lesion of the vocal folds, functional problems, neurological impairment, and psychological impairment.

appoggio. A breathing strategy to manage the muscles of inspiration and expiration during phonation in a manner that optimizes laryngeal functional efficiency.

approximation. Bringing two segments together, as in bringing the vocal fold edges closer to each other.

articulation. The formation of distinct sounds in speech and singing. Also, the joint of two bones in the body. The temporal bone, for example, articulates with the mandible at the temporomandibular joint.

articulators. Any of the structures involved in creating speech sounds through movement. These include the tongue, teeth, lips, jaw, velum, and vocal folds.

articulatory phonetics. The study of how speech sounds are produced.

aryepiglottic sphincter. The upper portion of the laryngeal structure including the aryepiglottic folds and epiglottis. Narrowing the laryngeal inlet is thought to create the acoustic change of enhancing high spectral content.

arytenoid cartilages. Structures within the larynx involved in vocal fold adduction and abduction; maintenance of approximation in resistance to the subglottal breath pressure is accomplished via action of the lateral cricoarytenoid and interarytenoid muscles. Abduction is accomplished via action of the posterior cricoarytenoids. Located superior to the posterior portion of the cricoid cartilage.

atmospheric pressure. The pressure exerted by the weight of the atmosphere, which at sea level has a mean value of roughly 14.7 pounds per square inch or 101.3 kPa.

attack. See onset.

attention. A component of learning; a complex cognitive process that is distributed throughout the brain. There are two main types of attention, *executive attention* and *default mode of attention*. Human attention is limited in both its capacity and its duration.

attention, default mode. A resting brain state in which the mind is fluid and thoughts are non-linear. Also called “mind-wandering mode” and “day-dreaming mode.”

attention, executive. the ability to actively process information in the environment while ignoring other stimuli.

attentional focus: in motor learning research, there are two possible areas of executive attention during motor learning and performance: *internal focus* (a focus on the body and mechanics of the movement) and *external focus* (a focus on movements’ goal or effect).. The question of which is most effective for motor learning and performance is called *attentional focus theory*.

automation. A function of information processing where transmission speed is increased as the result of myelination of an axon. Automated behaviors are well-learned, or overlearned, and can be managed unconsciously (i.e., automatically), without conscious reasoning-out or problem solving.

autonomic equilibrium. The balanced action of the parasympathetic and sympathetic divisions, or the anabolic gathering up energy and the responding catabolic expenditure of that energy. Often used interchangeably with homeostasis.

awareness. A state of consciousness involving perception of sensory events without necessarily understanding them. Self or bodily awareness is characterized by an ability to integrate sensations from the environment and the self with the immediate goal to guide behavior.

axial musculoskeletal structures. The axial musculature arises on the axial skeleton of the trunk. These core structures stabilize the vertebral spine and rib cage, assisting in respiration. The axial skeleton consists of the skull, vertebral spine, sacrum and coccyx, the ribs and sternum, as well as the hyoid bone and auditory ossicles.

B

back breathing. A breathing method that focuses on the expansion of the back in a way that reduces expansion in other areas. Restricting frontal abdominal expansion limits the descent of the diaphragm to some extent; similarly, offering some resistance to frontal abdominal release redirects expansion more to the back.

balance. (1) A relative intensity (volume) across two or more sections of an ensemble, based on the aesthetic intention of the conductor. (2) Physical equilibrium or stability produced by even distribution of weight along a vertical axis.

bandwidth. (1) the bandwidth is considered to be all those frequencies that lie within 3dB on either side of the peak value of a resonance. (2) The frequency range contour of a resonance. If the contour of the resonance is a tall, narrow peak, it is said to have a narrow bandwidth. If its contour is more of a bell curve shape, it has a wider bandwidth. A wide bandwidth will reinforce frequencies to either side of its peak frequency, but with less intensity. Vocal tract resonances can have a variety of bandwidths.

Bauchausenstütze. A method of breath management that limits the ability of the diaphragm to ascend during exhalation. The singer maintains abdominal expansion during exhalation, effectively locking the diaphragm in its low, contracted position, expelling the air by reducing thoracic volume by chest compression.

bel canto. (1) An Italian phrase meaning “beautiful singing” referring to a flexible, coloratura style of singing; used to describe florid operas which showcase the virtuosity of the singers. (2) A label for the specific brand of Italian opera that emerged at the beginning of the nineteenth century in Italy, featuring florid-style singing and legato Italian melodies. Gioacchino Rossini (1792–1868), Gaetano Donizetti (1797–1848), and Vincenzo Bellini (1801–1835) represent the apotheosis of the genre. (3) A school of vocal pedagogy roughly equivalent to the International Italian School. While the specific tenets that define bel canto pedagogy can be somewhat ambiguous and various among teachers who claim to subscribe to its ideal, a practical definition assumes a reverence for the treatises and method books of the great Italian pedagogues, with an emphasis on the central canon of Italian operatic repertoire.

belly breathing. A method of breathing that focuses on the outward movement of the abdominal wall during inhalation and compression of the abdominal viscera during exhalation, minimizing costal involvement.

belted. A type of singing with a longer closed phase of the vocal folds, higher subglottic pressure, greater thyroarytenoid activity, and a weaker fundamental frequency. A chest voice–dominant vocal quality used in many styles of musical theatre and contemporary commercial singing.

belt mix. An extension of beltlike timbre higher than the typical first resonance tracking of $2f_0$ characteristic of lower belt; somewhat analogous to close timbre (*voce chiusa*, in which $2f_0$ has surpassed the first resonance), but brighter and shallower in timbre than its classical counterpart, and typically coupled with more speech-like articulation. Usually accessed using bright, open vowels such as /æ/ or /e/ and a high tongue dorsum.

Bernoulli effect. The principle that moving (or more rapidly moving) air exerts less pressure laterally than stable air; based on *Bernoulli's Principle* (named after 18th c. Swiss physicist Daniel Bernoulli) which holds that an increase in the speed of a fluid is accompanied by a decrease in pressure, the Bernoulli effect plays a minor role in sustained vocal fold vibration by generating a closing force during the vibratory cycle.

bilabial. A consonant formed by fully or partially adducting both lips. Examples include /p/, /b/ and /m/.

bilateral. Affecting both sides of the body.

blending. (1) Striving for timbral consistency within an individual section of a choir or across sections of a choir. (2) Smoothing register transitions across a singer's range.

bodily–kinesthetic intelligence. Advanced awareness and facility in the use of somatosense to guide physical response toward an intended goal.

body mapping. A modality that focuses on a person's internal concept and understanding of their body and of how and where its parts articulate. Inaccurate mapping (called "mis-mapping") is thought to impede function, while accurate mapping leads to more efficient coordination.

Boyle's law. Principle of physics that explains how ventilation of the lungs occurs. Boyle's Law states that in a contained space, air volume and air pressure always remain constant. If volume increases, pressure decreases; conversely, if volume decreases, pressure increases. Elite singers manage air volume and pressure in the lungs for maximum advantage in producing the desired vocal phrase.

break. An interruption of tonal flow in the range, usually involving a skip in pitch; while it is a laryngeal event, it can be triggered by acoustic factors. See also *passaggio*.

breath management. the coordination of respiratory forces (development of pressure and flow) with phonation and resonance in order to efficiently and sustainably achieve the intended aesthetic output of the genre (also called breath coordination and/or breath "support").

breathy. A descriptor for a phonation in which some air passes through the oscillating folds unconverted into acoustic energy, often emerging as audible turbulence (perceived as a hiss); caused by incomplete closure of the glottis.

breath support. A historic term in English for breath management in singing (*appoggio* in Italian). It attempts to describe awareness of the relationship of respiratory and muscular sensations in the torso with efficient phonation and resonance. Now often supplanted by the terms *breath management* or *breath coordination*.

bronchi. The smaller air tubes present in the lungs after the division of the trachea.

bronchiole. The smallest and final division of tubes in the conducting zone of the lungs.

buccal. Relating to the cheek or the mouth cavity.

buccopharyngeal resonator. Designation of the vocal tract (excluding the nasal cavity) as the primary resonator of the voice.

C

cardinal vowels. A core set of vowels that represent fundamental sounds across Western languages. The number varies across the literature, ranging from three—the tongue is highest with no lip involvement on /i/, relaxed with no lip involvement on /a/, and relaxed with lips protruded on /u/—to eight: /i/, /e/, /ɛ/, /a/, /ɑ/, /ɔ/, /o/, and /u/. Merriam-Webster places the number of invariable sounds at sixteen. Cardinal vowels are also called “pure” and do not include *mixed vowels*; see *mixed vowels*.

cartilage. A firm, elastic tissue, forming part of the framework of the body, but not as rigid as bone.

catch breath. A rapid breath that must be taken so rapidly that the singer does not have time to take a normally deep breath. The recovery and inhalation stages need to be accelerated without introducing unnecessary tension.

central pattern generator. A neuronal circuit or network capable of generating a rhythmic pattern of motor activity that is essential to much of the spatial coordination and timing of muscle activation required for complex rhythmic movements—i.e., oscillations or reflexive resonance.

cepstral peak. A measurement in decibels obtained by advanced analysis of the spectrum of a vowel. It indicates how much periodicity is in the analyzed sound, with a higher “cepstral peak prominence” (CPP) indicating a more periodic signal and a healthier voice, while a lower CPP indicates a less periodic signal and possible pathology. CPP measurements as an indication of vocal health are a good index of overall change in voice quality, particularly for voices exhibiting harmonic structure.

central tendon. A three-lobed aponeurosis located near the central portion of the diaphragm caudal to the pericardium and composed of intersecting planes of collagenous fibers.

CCM (contemporary commercial music). An umbrella term, coined by Jeanette LoVetri, identifying styles of singing utilized in popular music, including musical theater works in a pop style.

chest register (mode 1). Thyroarytenoid (TA)–dominant phonation. Characterized by high closed quotient, increased vertical-phase difference, and high amplitude of vibration. The lower, louder, heavier quality of sound, often associated with the cis male voice, lower part of the cis female voice, and speech. Chest register is the laryngeal register of speech for most people and involves a shorter, thicker vocal fold and looser cover.

chest resonance. Traditional term suggesting that mode 1 phonation is influenced by resonance in the chest cavity. The tracheal/bronchial tree does have a resonance frequency which may influence vocal fold oscillation, and singers do have sensations of conductive vibration in the chest for the low register of the voice, but these sensations are essentially private biofeedback and not a part of the radiated sound.

chesty. The timbral percept associated with chest register, indicative of high spectral content and characterized by some degree of auditory roughness or “buzziness”—buzzier is perceived to be “chestier.” This percept can be somewhat independent of actual laryngeal register.

chiaroscuro. An Italian term meaning “bright–dark” or “clear–dark” borrowed from art history to describe an ideal resonance balance between low and high frequency components in Western classical singing. It is usually accomplished (in middle and lower ranges) by some balance in power between the first formant and the singer’s formant cluster, or possibly between the first and second formants.

chink. archaic term in voice science literature that refers to a glottal chink, or incomplete posterior closure of the vocal folds between the arytenoids. See also *mutational chink* but note that the term “chink” is considered a slur; the preferred term is *gap*, as in *glottal gap*.

choir. A musical ensemble of singers, sometimes indicating a smaller, a cappella, or sacred ensemble in contrast to a chorus.

chorus. A musical ensemble of singers, sometimes indicating a larger, symphonic, or secular ensemble in contrast to a choir.

chorus acoustics: all acoustic parameters and considerations relevant to choral settings—the effect of numbers on cumulative intensity levels, spacing of choristers, relative positioning of parts, self to other ratios, tuning of upper voices to harmonics of lower voices, vowel matching/balancing strategies, etc.

chorus effect. When individual sounds within a vocal ensemble (if in synchronous rhythm and pitch) converge and are perceived as being unified.

cisgender. Denoting an individual whose gender identity corresponds to their biological sex apparent at birth. The term *cis* is short for cisgender.

clavicle. Bone extending between the shoulder and the breast bone (sternum); the collar bone.

clavicular breathing. A breathing method where the upper chest rises during inhalation and falls during exhalation. Also known as “upper-chest breathing.” This breathing method is less efficient, inhibiting the descent of the diaphragm, and often transmitting unnecessary tension to the neck and laryngeal muscles.

closed quotient; see *contact quotient*, below

close timbre. A vocal sound in which the second harmonic has risen above the first resonance, causing the voice to shift, what some pedagogues call “cover” or “turn over.” Also termed *voce chiusa* in Italian.

close vowel. A vowel with a low first resonance such as /i/ and /u/ and an inherently convergent resonator shape. Often called “closed” vowels in lyric diction resources.

closed vowel. See close vowel.

cognition. the mental process of acquiring knowledge via thought, experience, and sensation; the mental process of knowing, judging, thinking, learning, and imagining. Cognitive tasks include the perception and interpretation of sensory information, such as the comparison and association of new information with existing knowledge and experience. Cognitive processing occurs both consciously and unconsciously. Higher-level cognitive functions, or *executive functions*, include the ability to integrate motor responses into a meaningful sequence and the ability to project one’s self into the past and the possible future from an internal, or autobiographical, perspective.

collagenous. Any of a group of fibrous proteins that occur in vertebrates as the chief constituent of connective tissue fibrils and in bones.

collar, laryngeal Refers to the upper boundaries of the larynx, consisting of the aryepiglottic folds and the structures of the epiglottis. The collar of the larynx can be narrowed somewhat, which affects the ratio of its diameter to the diameter of the laryngopharynx, the larger tube within which the smaller laryngeal tube is situated. See aryepiglottic sphincter.

commissure. (1) A point or line of union or junction especially between two anatomical parts, such as adjacent heart valves. (2) A connecting band of nerve tissue in the brain or spinal cord.

compliance. see *adherence*.

compliant inertance. See *inertive reactance*.

complemental breath. Air which may be inhaled in addition to tidal breath, by effort.

compression. Description of the density of air molecules in a pressure waveform. Compression is a concentration of air molecules which alternates with rarefaction in a pressure waveform.

consonant. A speech sound that is not a vowel and is formed with partial or full obstruction of airflow.

constriction. In reference to physical efficiency, constriction is a pejorative term referring to excessive, unnecessary closure of the vocal tract; in reference to acoustics, a possibly beneficial narrowing along the vocal tract to enhance resonance tuning.

contact quotient. The percentage of vocal fold contact in a given vibratory cycle, used to estimate laryngeal register and *closed quotient* (i.e. the percentage of time in one vibratory cycle that the glottis is closed). While electroglottography (EGG) displays contact quotient reliably, inferring closed quotient from this may be less reliable.

continuant. A consonant sound that is produced by partial closure of the vocal tract, allowing the sound to be prolonged for as long as there is air flow to produce the sound.

conus elasticus. The lower membrane that extends from the anterior arch of the cricoid cartilage to the vocal ligaments.

convergence. A downstream narrowing of a resonator; as in an inverted megaphone.

convergent resonator. A vocal tract shape that for the vowel being produced is relatively more open near the glottis and narrower near the lips. Sometimes referred to as “the inverted megaphone,” this resonance strategy is typical of Western classical singing and *voce chiusa*.

corniculate cartilages. Two small horn-shaped cartilages that are positioned on top of the arytenoid cartilages and are embedded in the aryepiglottic folds.

cornu. A horn-shaped anatomical part. Inferior and superior cornua are found on the thyroid cartilage, while lesser and greater cornua are found on the hyoid bone.

costal breathing. Breathing with emphasis on rib cage expansion. Use of the external intercostal muscles to expand the rib cage circumference, with particular attention on the sides and back. The transversus abdominis remains contracted during the entire breathing cycle. (see rib breathing, thoracic breathing)

costae/costal. Of the ribs.

coup de glotte. A term coined by Manuel García II to describe a vocal onset in which the glottis closes completely, but gently just prior to the application of air for phonation; a subtle glottal

stroke onset. Thought to be the most acoustically efficient onset, activating immediate, complete timbre (immediate presence of high spectral content).

cover, covered. The timbral shift that accompanies the first resonance: second harmonic ($f_{R1}:2f_o$) crossing: when the second harmonic rises above the first resonance; also called turning over or closing, causing the timbre to sound less exposed, more internalized. (see: close timbre)

CPP. Cepstral peak prominence.

creaky voice. A phonation related to vocal fry which can occur at higher frequencies and is characterized by a perception of roughness and the presence of sub-harmonics in the glottal waveform. Creaky voice acquires its name because it gives the perception of a creaking door. It can be used to train competent glottal closure in M1 or M2.

cricoarytenoid. (see *posterior cricoarytenoid* and *lateral cricoarytenoid*)

cricothyroids. Muscles in charge of stretching and thinning the vocal folds to increase fundamental frequency (pitch).

critical band. The small range of frequencies within which a second tone will interfere with the perception of the first tone, either masking it or causing an auditory roughness.

crooning. A speech-based, lyric, quieter way of singing requiring amplification, using lighter breath pressure and vocal fold closure/resistance, typical of big band era genres.

cuneiform cartilage. Paired laryngeal cartilages that are embedded within the aryepiglottic folds and sit laterally and anteriorly to the corniculate cartilages. Their primary role is to maintain airway patency.

cyst. A collection of material surrounded by a membranous sac. Vocal fold cysts can occur in the superficial lamina propria. While phonotrauma may contribute to their formation, many cysts occur spontaneously.

D

damping. (1) Reduction in vibration amplitude of an object in oscillation, or the reduction in amplitude of a wave in an elastic medium; ; (2) noise reduction.

density. The degree of concentration of a material's particles. Mass per unit of volume.

depth. A perceptual description of a sound with ample low frequency content; the *oscuro* part of a *chiaroscuro* timbral balance.

diaphragm. The primary muscle of inspiration; dome-shaped; arches up inside the ribs, dividing the thoracic cavity from the abdominal cavity; normally involuntary in respiration, but

recruitable to some extent as an antagonist to exhalatory muscles during phonation. See *lotta vocale*.

digastric. Muscles found in the floor of the oral cavity, formed of two bellies. It elevates the hyoid bone and helps the lateral pterygoid muscles open the mouth by depressing the jaw.

Dysphonia. Commonly called hoarse voice, dysphonia results from atypical contraction of muscles during phonation. It can be primary or secondary, depending on a number of factors.

diphthong. The combination of two vowels in a single syllable, in which the sound begins as one vowel and moves toward another. Diphthongs in English include /aɪ/, /aʊ/, /ɛɪ/, /ɔɪ/, and /oʊ/.

distal musculoskeletal structures. Distal structures, such as our hands, can produce fine motor action. Together, the proximal and distal structures form our appendages.

divergence. A downstream relative widening of a resonator; megaphonelike.

divergent resonator. In voice, a resonator shape that is smaller in the pharynx and more open nearer the lips. Open back vowels such as | a | are inherently divergent in shape. This resonance strategy is beneficial high in the range of treble singers and in musical theatre and some world music singing styles.

dorsum. The portion of the tongue that sits inferior to the soft palate and anterior to the root of the tongue.

downstream resistance. A narrowing, obstruction, or vibration ‘downstream’ from the vocal folds (i.e. nearer the lips) such as a lip/tongue trill or other SOVT articulation.

dysphonia. Difficulty with phonation. May be either functional—a problem with the voice that has no anatomical, physiological or neurological cause—or organic—a problem with the voice caused by a known anatomical, physiological or neurological condition. Commonly called hoarseness.

E

edema. A swelling of biological tissue. Specific to voice, edema refers to swelling of the vocal fold tissue or tissue surrounding the folds.

efferent transmission. Descending or top–down processing. Information is projected from various levels in the brain through the central nervous system to the peripheral nervous system to effect action.

EGG. see *electroglottography*.

elasticity. The tendency of a material to return to its state of resting equilibrium. Elasticity is especially relevant to the biomechanics of self-sustaining vocal fold oscillation and to management of lung volume. See *passive elastic recoil*.

electroglottography (EGG). A method for monitoring vocal fold contact area, fundamental frequency of vibration and vibration regularity (perturbation) during phonation by measuring a change in electrical impedance across two electrodes placed on either side of the thyroid cartilage at the level of vocal folds. As the vocal folds vibrate, variable resistance to the electrical current is measured and displayed. The slopes on EGG waveforms can be used to estimate open and closed phases. Typical EGG quotients are determined with algorithms applied to the EGG waveform expressing the closing, closed, opening, and open phases as ratios.

electroglottograph (EGG). The device used for noninvasive measurement of vocal fold contact.

embodied cognition. a broad topic in cognitive neuroscience, a theory of human behavior that captures the manner in which the human mind and body mutually interact and influence one another; the opposite of *dualism*, also known as “the mind body split” in philosophy.

ensemble. A group of singers arranged with one or two singers per part.

epilarynx. A term for the supraglottal tubelike structure situated within the laryngopharyngeal area of the vocal tract, comprised of the epiglottis, arytenoids, and aryepiglottic folds.

epithelium. A membranous cellular tissue that covers a free surface or lines a tube or cavity of an animal body and serves especially to enclose and protect other parts of the body, to produce secretions and excretions, and to function in assimilation.

equilibrium. See autonomic equilibrium, and postural equilibrium.

esophagus. Passage through which food and drink pass into the stomach.

excursion. Also called extent, in reference to the size of oscillation above and below the target frequency of a vibrato cycle.

executive function. Refers to a complex cognitive construct underlying controlled goal-directed responses to novel or difficult situations. Executive functions coordinate goal-directed behavior and mediate conscious experience. They are characterized by novelty, choice, and the ability to voluntarily influence consciously and unconsciously mediated actions.

executive ignorance. Inaccessible to consciousness. For example, top-down motor signals—the neural events that not only monitor and correct our behavior but also initiate bodily movements—are inaccessible to consciousness.

exhalation. The act of breathing out air. During exhalation, the diaphragm relaxes and moves upward both from passive recoil and abdominal contraction, causing compression of the lungs and an outward flow of air.

expiratory reserve volume. The amount of air still present in the lungs above residual volume after expiration; the air volume that could have been exhaled in a given cycle, but was not..

extensor. A muscle that effects spinal extension. Spinal extensors include the splenius erector spinae, and semispinalis muscles. A function of the spinal erectors is to maintain posture by steadying the spine on the pelvis while standing, walking, and singing.

extent. See excursion.

external intercostals. One of three groups of muscles between the ribs. They pull the ribs upward and outward and are inhalatory in effect.

external obliques. A term for one of the sets of abdominal muscles: the external oblique abdominals are exhalatory, as are all abdominal muscles, pulling down on their insertion on the lower ribs.

exteroception. Sensitivity to stimuli that are outside the body, resulting from the response of specialized sensory cells called exteroceptors to objects and occurrences in the external environment. Compare with *interoception*.

external (exogenous) perspective. Perceptual images generated from an external (exogenous) point of view where the agent takes the view of the spectator (e.g., mirrored image).

F

Fach. A German term for specific voice categories—such as soubrette soprano, Heldentenor, lyric baritone, e.g.—that are determined by the tessitura capacity and timbre of a voice. The overall location of vocal tract resonances, as well as the specific location of the singer's formant cluster are significant factors associated with voice qualities and therefore the *Fach* of a singer. (Plural: *Fächer*.)

falsetto. A term used for the thin vocal fold, vocal ligament vibration in voice science; equivalent to treble head voice. Sometimes used interchangeably with mode 2 or head register.

false vocal folds. See *ventricular folds*.

fascia. A connective tissue that envelops almost every structure in the body, providing structural integrity to the skeletal system as well as some protection to the viscera. Fascia can change with repetitive movements and with abnormal movements, resulting in restriction of the structures involved.

faucial pillars. Two lateral folds of tissue located in the posterior oral cavity that are formed by the palatoglossus and palatopharyngeus muscles.

feedback. In motor learning, simply any and all information received by the learner. Feedback is considered by motor learning researchers to be the second most important variable in motor learning, bested only by practice itself. There are many divisions of feedback; the most significant are:

- **feedback, intrinsic:** also called *inherent feedback*, this type is produced by the learners' own bodies that provide them with sensory information when executing a motor skill.
- **feedback, extrinsic:** this type of feedback provided by an outside source; also called *augmented feedback* (see *feedback, augmented, dimensions of*). Extrinsic feedback can be provided by a coach or trainer, or by an artificial source; in voice training, artificial extrinsic feedback is typically provided by a video recorder or computer voice analysis.
- **feedback, augmented:** Information provided by an outside source, often verbal feedback proffered by a teacher; sometimes called *extrinsic feedback*. There are many *dimensions of augmented feedback* studied in motor research, which include:
 - **concurrent** (given during movement) versus **terminal** (given after movement)
 - **immediate** (given immediately after movement) versus **delayed** (delayed in time)
 - **knowledge of performance.** A type of augmented feedback about the quality of an action but which does not indicate success in meeting a targeted goal. An example is a teacher telling a student, "Your jaw was tight on the high note." Also called *kinematic feedback* in motor learning research.
 - **knowledge of results.** A type of augmented feedback about the success of an action relative to its goal, without providing feedback on the process. An example is a teacher telling a student, "You sang the pitches of that phrase accurately."

feedforward processing. Anticipated sensory consequences of movement that should occur if the movement is correct, or meets the performer's expectations or goals. Feedforward signals are top-down anticipatory motor impulses retrieved from the performer's memory, sent to prepare a motor plan of action before a movement is executed. The feedforward mechanism is thought to help prepare the motor system to perform; also called "tuning" in motor learning literature.

Feldenkrais Method. A system of guided body movements intended to increase bodily awareness and ease tension. Named for its inventor, Moshe Feldenkrais (1904–1984), a Ukrainian-Israeli engineer and physicist.

fioritura. An Italian term meaning "flourish" or "flowering"; used to describe the florid embellishment of a melodic line.

flageolet voice. The highest register in the vocal range, usually occurring at the pitch of C6 or higher where the fundamental frequency rises above the first resonance of any vowel. While technically an extreme end of the cricothyroid-dominant register (and not a truly unique laryngeal register), the flageolet register resembles other cricothyroid-dominant production, although more acute and extreme. In flageolet register, only the edges of the vocal folds are approximated, and there is high subglottic pressure and considerable longitudinal tension in the vocal ligaments. Only a small portion of the opera and art song repertory requires frequent use of the flageolet register, although it can be accessed and practiced beneficially by all classical sopranos. See also *flute register, whistle register*.

flow glottography. A modality that measures airflow through the glottis, variation of the glottis, and approximate spatial opening of the glottis across time.

flow phonation. The term for a phonation in which transglottal breath pressure difference, airflow through the glottis, and glottal resistance are in an ideal balance for the particular pitch and intensity situation. Flow phonation is modeled as transglottal pressure/airflow = glottal resistance (ideally in a $1/1=1$ balance). First coined by Johan Sundberg, the term *flow phonation* has been defined in the literature as a phonation type produced with the largest peak-to-peak flow amplitude, where the minimum still reaches zero.

focus. A traditional voice pedagogic term descriptive of a clear and resonant tone. Perceptual clarity is enhanced via efficient, balanced flow phonation with well-organized high spectral content. While sound cannot be actually placed, focused, or projected, it may be helpful to use such descriptors as desirable auditory targets.

forced/conductive resonance. The type of resonance that operates under the principle of mass and compliance. Stringed instruments operate under this principle: The vibration of the strings transfers through the bridge to the body of the instrument.

forgetting hypothesis. Refers to the notion that producing motor skills in a random, non-sequential format enhances learning and retention.

formant. A frequency peak in the radiated spectrum of a sound. Note: Some earlier writers defined the term formant as ‘a resonance of the vocal tract.’ It is important to differentiate characteristics of the resonator’s sound transfer potential from characteristics of the radiated sound at the mouth opening, which is a result of the interaction of both the voice source and the resonator. Sound transfer potential and the radiated sound may diverge significantly in higher sung sounds where harmonics are widely spaced.

formant detuning. The tuning of a resonance frequency peak away from a harmonic to weaken its formant effect. Used with F_2 in cis female and/or treble upper range to reduce shrillness and with F_1 in cis male voices to avoid $f_{R1}:1f_0$ tracking on close vowels; what some pedagogues call ‘whoop’ or ‘hoot’ timbre.

formant tuning. Formant tuning refers to reshaping the vocal tract by means of articulation to adjust its resonances to obtain better matches between tube resonances and available source harmonics.

formant tracking. The tuning of a resonance to follow or track a specific harmonic, such as $f_{R1}:1f_0$ tracking of what some pedagogues call ‘whoop’ or ‘hoot’ timbre (upper treble voice strategy) or $f_{R1}:2f_0$ tracking of the yell or of belting.

Fourier transform. A mathematical function that deconstructs a waveform into the inherent sine tone frequencies of which it is composed.

free/sympathetic resonance. The type of resonance that occurs as the result of vibrations of air molecules and reflections of sound waves within a void. Singers utilize free resonance (as opposed to forced resonance, which depends on a mechanical connection from a vibrator to a resonator). To function as a free resonator, a structure must be hollow, have volume, and have an opening through which sound waves can exit. All wind instruments, including organs, also operate according to free resonance principles.

frequency. The rate at which something occurs or is repeated over a particular period of time; the rate at which a vibration occurs that constitutes a wave, as in sound waves. A single frequency is referred to as a sine tone; most sounds are composed of multiple frequencies; clearly pitched tones contain a harmonic set of frequencies, all of which are multiples of the lowest, fundamental frequency.

fricative. A continuant consonant produced when air passes through a narrowed opening between two articulators. Fricatives can be voiced or unvoiced. Common examples include /f/ and /v/.

front–back vowel dimension. A description either of a physical articulatory characteristic (a fronted tongue hump versus a tongue hump further back), or of an acoustic characteristic (a sound with a high second formant and stronger high partials, i.e., a front vowel; or a low second formant and weaker high partials and potentially stronger low partials, i.e., a back vowel).

fry. The lowest vocal register, produced through a loose glottal closure that permits air to bubble through slowly with a popping or rattling sound of a very low frequency. Also called M0 (mode zero) or pulse.

fullness. A typical descriptor of a sound with significant strength in its lowest harmonics, as featured in the first formant. Other similar terms are depth, warmth, roundness.

functional residual capacity. The total amount of air in the lungs below resting level; it includes both expiratory reserve and residual volumes.

fundamental frequency. The lowest frequency of a periodic waveform; its lowest harmonic (H_1 or $1f_0$), more or less equivalent to the perceived pitch.

G

gap, glottal; *see mutational chink*

gender. A socially constructed identity, initially assigned at birth based on biological sex, eventually determined by the individual. According to the American Psychological Association, *gender* “refers to the attitudes, feelings, and behaviors that a given culture associates with a person’s biological sex.” (APA, 2012).

gender dysphoria. A feeling of discomfort, anxiety or distress that can occur when an individual's sense of personal identity conflicts with the gender/sex they were assigned at birth.

gender nonconforming. A gender identity that describes individuals whose gender presentation may not conform to social expectations for assigned male or assigned female at birth individuals.

generalization. In motor learning, refers to the ability to apply past learning to novel settings.

genioglossus. An extrinsic muscle of the tongue; the largest and strongest of the extrinsic tongue muscles making up the bulk of the tongue. Attaches primarily to the inside back of the chin and secondarily to the hyoid bone.

geniohyoid. Muscle under the chin that originates on the inside back of the chin and inserts into the mandible. The geniohyoid lifts and fronts the hyoid bone during mastication; it also assists with jaw opening.

GERD. Gastroesophageal reflux disease; occurs when stomach acid flows back up into the esophagus. This backwash is called *acid reflux*, and can irritate the lining of the esophagus. See also *laryngopharyngeal reflux disease*.

globus. The feeling of a lump in the throat.

glottal flow resistance. Describes the slowing or stoppage of air as it flows through the glottal space—i.e., the space between the vocal folds.

glottis. The space between the vocal folds.

gola aperta. Italian for “open throat.” *Gola aperta* is considered an ideal in historic Italian pedagogy for full, efficient sound; a condition with no unnecessary constriction or narrowing of the laryngopharynx beyond that necessary for tuning resonances and vowel identity.

granuloma. Non-cancerous growths on the vocal folds comprised of cells and substances often found in sites of inflammation (inflammatory tissue). They reflect a response to irritation or injury. The granulomas are usually found near the back portion of the vocal folds over the vocal process of the arytenoid cartilages at the site of contact during vocal fold closure. They can be bilateral or unilateral in nature. They often appear pale or sometimes red.

H

hard palate. The bony anterior part of the palate forming the roof of the mouth.

harmonics. Individual frequency components of a periodic waveform; also refers to the harmonic series, a set of frequencies all of which are multiples of the fundamental frequency.

harmonic-to-noise ratio (HNR). Measures the ratio between periodic and non-periodic components of a voiced sound. It is used in acoustic analysis to diagnose pathologic voices.

Hashimoto's thyroiditis. An autoimmune disease that affects the thyroid gland and impairs its ability to produce thyroid hormones. Hashimoto's thyroiditis may lead to an increase in fluid in the lamina propria and subsequent increased vocal fold mass. This may result in hoarseness, vocal fatigue, reduced pitch range, decreased average vocal pitch and globus sensation. Hashimoto's Thyroiditis is the most common cause of hypothyroidism. Also called Hashimoto's disease.

head register (mode 2). Cricothyroid (CT) dominant phonation. The higher, softer, lighter quality of sound, often associated with the cis female voice and children. Not usually used in speaking. In head register, the vocal folds are stretched thin and vibrate more on the upper edges.

heady. The timbral percept associated with head register, characterized by a lesser degree of auditory roughness (buzziness). This percept can be somewhat independent of actual laryngeal register.

heavy cover. Deliberate lowering of the first resonance and its resultant formant by tube lengthening and/or vowel closing to precipitate a more dramatic or lower "turning" of the voice. Strategies used include lowering the larynx, lip rounding and/or trumpeting, and vowel darkening. Usually not recommended except as a training tool.

heavy mechanism. A term associated with chest voice or mode one (1) laryngeal register.

Helmholtz resonator. A hollow enclosure having a small opening consisting of such dimensions that the enclosure resonates at a single frequency determined by the dimensions of the space and the opening. The larger the contained space and the smaller its opening, the lower the frequency of the resonator, and vice versa.

hemorrhage. Bleeding from a ruptured blood vessel. A hemorrhage in the vocal folds usually means bleeding in the superficial lamina propria, which disrupts the vibratory pattern of the vocal folds leading to dysphonia.

Hertz (Hz). A unit of frequency equal to one cycle per second (cps).

high-speed videoendoscopy. An evaluative modality that records vocal fold vibration in real time under a steady light source at sampling rates high enough to capture the movement of the vocal fold vibratory cycles regardless of frequency (i.e., 4000 Hz and higher). The examiner is presented with a montage of still images captured along a vibratory cycle. Visualization does not rely on vibratory periodicity. Typically, only small segments of vocal fold vibration are analyzed using this technology since it is time and data consuming.

HNR. Harmonic-to-noise ratio.

homeostasis. Refers to the state of our internal environment. We might experience homeostatic equilibrium (internal balance) as a sense of well-being or calm. Homeostasis acts as a coping mechanism that seeks to maintain a condition of balance within our internal environment when

dealing with changes in stimuli under varying degrees of stress. The three major systems that maintain homeostasis are the autonomic nervous system, the neuroendocrine system, and the limbic system, which is also described as our motivational state. Often used interchangeably with equilibrium.

Hoot. See *whoop timbre*.

Hormone replacement therapy. The medical intervention in which a person uses sex-specific hormones; a therapy in menopausal biological females to replace the diminishing production of hormones such as estrogen. Also prescribed to individuals for the purpose of aligning their physiological characteristics with their gender identity.

HRT. Hormone replacement therapy.

hyoglossus. The muscle that originates at the hyoid bone and attaches to the sides of the tongue. The hyoglossus depresses and retracts the tongue and is also involved in hyoid and laryngeal elevation.

hyoid. A horseshoe-shaped bone located in the superior region of the neck, suspended superiorly by the suprahyoid muscles including the mylohyoid, anterior digastric, hyoglossus, stylohyoid and geniohyoid. The hyoid can be depressed by contraction of the omohyoid, thyrohyoid and sternohyoid. The hyoid serves as the base of the tongue. Elevation of the hyoid during swallowing simultaneously elevates the larynx.

Hyperfunction. Phonation that recruits the muscles of the larynx in a manner that is more taxing or straining than necessary to produce speech or singing.

Hz. Hertz.; times per second.

I

illium. See pelvis.

image. most commonly defined as either a mental representation of a stimulus that has been experienced or a mental construct of what can be imagined as the result of a stimulus that has been experienced. Thus, an image is not limited to the visual sense, but is the product of any or all senses. Imagery is the phenomenal product of our imagination and is considered by cognitive science to be one of the highest of human cognitive abilities.

implicit memory. Memory formed without awareness. Also called *nondeclarative memory*.

inferior. Lower, or below.

inertance. When the energy is kinetic (due to motion), as in the inertial energy stored in the velocity of the air flow at a constriction in the vocal tract, the reactance (resistance to the flow motion) is referred to as an inertance. See also *impedance*, *inertive reactance*.

inertive reactance. If an impedance imposes a time delay or advance to a system's response, the impedance has a reactive component. Reactance can be inertive or compliant. Inertive reactance results from a delay in response.

inguinal. The ligaments that run obliquely from the iliac spine to the pubic symphysis.

inhalation. The inflow of air to the alveoli resulting from dimensional changes to the lungs.

inhalatory capacity. The capacity of air volume inhalable above resting level; it includes resting tidal and inspiratory reserve volumes.

innervation. The nerve supply to a specific body part

insertion. The typically more movable point of attachment for a muscle. Most muscles are named with the more stable origin first and the place of insertion second. (For example: The thyroarytenoid muscle originates at the thyroid cartilage and inserts at the arytenoid cartilages.)

inspiratory reserve volume. In an inhalatory cycle, the additional volume of air that could have been inhaled above tidal volume but wasn't.

interarytenoid muscles. Adductor muscles of the vocal folds, they run between the arytenoid cartilages and aid in the closure of the posterior glottis. Because of this, the IA muscles play a significant role in controlling subglottic pressure during phonation.

intercostals. The sets of muscles between the ribs. Can refer to either the external, internal or innermost intercostals.

internal intercostals. One of the sets of muscles between the ribs. They are exhalatory, pulling the ribs downward.

internal obliques. An inner layer of abdominal muscles; exhalatory by pulling down on the ribs.

International Italian School. A term coined by Richard Miller (1926–2009) to denote an inclusive, unofficial international school of classical voice pedagogy. Strongly associated with bel canto traditions and the *appoggio* breathing technique.

interoception. The perception of sensations arising from inside the body. Interoception helps an individual understand how they sense their internal state of being. Sensations arising from inside the body inform our knowledge of our place in space (proprioception) and movement through space (kinesthesia), and include the bone-conducted vibrations that inform our knowledge of our own voice while singing. Compare with exteroception.

intraoral pressure. Air pressure measured within the mouth. Intraoral pressure is essential for producing plosive, fricative and affricative consonants. It is reduced when the velopharyngeal port does not seal completely and allows pressure to leak into the nasal passages.

intrinsic laryngeal. A muscle that has both attachments (origin and insertion) within the structure of the larynx.

intuition. Involves the ability to arrive at a solution without reasoning, to directly access knowledge (cognition) without evident rational thought, or inference. Intuition is the product of innate knowledge (e.g., the ability to cry or phonate) and learning.

impedance. Acoustic impedance in any sound transmission element is defined as the ratio of pressure to flow. Because there can be time delay or time advance in the flow response, impedance is quantified by a complex number. The real part is called “resistance” and the imaginary part “reactance.” Reactance, in turn, can be positive (inertive) when there is time delay or negative (compliant) when there is time advance. See inertance, inertive reactance.

J

jaw. a single unpaired bone, also called the *mandible*, that serves multiple functions in the body, mainly mastication (or chewing) as well as an aid for articulation in speech. A common misconception is the idea of an “upper” and a “lower” jaw; humans have one jaw, and the *maxilla* (erroneously referred to as the “upper jaw”). Teachers who espouse body-mapping in their pedagogy hold that “mis-mapping” this error can have significant negative effects on singing.

jitter. A measure of cycle-to-cycle variation (perturbation) in an acoustic signal. Jitter specifically refers to variation in frequency. Compare with shimmer.

JND. Just noticeable difference.

just noticeable difference (JND). The minimum level of change in stimulation that a person can detect. Also known as the difference threshold, JND is relevant to various kinds of perception: pitch, timbre, somatosense, etc.

K

kinesthesia. One’s perception of their body in motion, including how it moves, where it moves, and the quality of the movement; a general sense of body movement resulting from information arising from mechanoreceptors distributed throughout the body, such as those in the skin, muscles, and joints. See sensory modalities.

kinesthetic awareness. One’s ability to sense what a body part is doing relative to the environment in which it exists.

kymography. A technique wherein the laryngoendoscopic camera only captures a single horizontal line of vocal fold vibration, usually at the glottal midpoint. Vibratory characteristics can be analyzed in real time regardless of the periodicity of the vocal fold vibration.

L

labial. Relating to the lips. In phonetics, labial refers to the use of the lips in forming the sounds of speech.

labiodental. Speech sound using both the lips and teeth, such as /f/ or /v/.

lamina propria. One of three layers constructing the mucosa. The lamina propria is the connective tissue found between the epithelial layer and the muscularis mucosa.

laryngeal placement. Vertical positioning of the larynx per genre or style. CCM styles of singing typically utilize a neutral to higher laryngeal placement, in contrast to the neutral-to-lowered positioning of western classical singing.

laryngeal register. Registers delineated by differences in the vibratory pattern of the vocal folds. These are primarily due to the relative participation of the thyroarytenoid (TA—shortening, thickening) and cricothyroid (CT—stretching, thinning) muscles. Laryngeal registers include pulse (M0), modal (M1), falsetto (M2), and whistle (M3).

laryngitis. Vocal fold inflammation that impedes phonation. During the healing process from a viral or bacterial infection of the vocal folds, the vocal folds become swollen secondary to the body's response to the infection from increased blood flow, etc., hindering vibration. Phonation threshold pressure becomes so high that it impedes sound production. Voice changes can range from mild hoarseness to laryngeal dryness to aphonia, evoking hyperfunction during attempts at phonation.

laryngopharynx. That lowermost part of the pharynx that surrounds the epilaryngeal tube.

Laryngopharyngeal reflux disease (LPR); When acid repeatedly “refluxes” from the stomach into the esophagus alone, it is known as *gastroesophageal reflux disease* (GERD). However, if the stomach acid also spills into the pharynx and/or larynx, it is known as laryngopharyngeal reflux (LPR); see also GERD.

larynx. A cartilaginous structure that houses the vocal folds, and performs two biologic functions: (1) protecting the lungs and airway from foreign bodies (food, liquids, etc) with the help of the epiglottis; and (2) creating torque via thoracic fixation in order to lift heavy objects or push things out of the body (childbirth).

lateral. Of or relating to the side.

lateral cricoarytenoids. A muscle pair of the larynx that arises from the lateral upper margins of the arch of the cricoid cartilage and inserts into the muscular outer processes of the arytenoid cartilages. When contracting, these muscles assist in partially closing the glottis by rotating the vocal processes of the arytenoids inward, narrowing or approximating the membranous vocal folds from the vocal processes forward (medial compression).

latissimus dorsi. The widest muscle of the body, the latissimus dorsi is found in the superficial layer of the extrinsic back muscles. This muscle is involved in arm rotation, adduction, extension and may assist in respiration.

learning. The vital question of cognitive science, learning has many definitions. One of the simplest is, ‘a process that results in a permanent change in behavior as a result of experience (for declarative learning) or *practice*, for *motor learning*.

lift notes. A traditional voice teaching term referring to specific pitches in an individual singer’s range where a noticeable register transition occurs. In some voice pedagogy literature, the locations of lift notes or transition pitches are indicative of voice type.

ligament. A band of tough connective tissue joining two bones or cartilages. In the three-body vocal fold model (TA muscle, ligament, mucosa), the vocal ligament is the second part, responsible for stretching, thinning, and stiffening within the vocal folds. It forms the thin edge of vocal fold contact in mode two, head voice laryngeal registration.

light mechanism. A term associated with head voice or mode two (M2) laryngeal register.

linea alba. Meaning “white line”; the linea alba is a fibrous band that runs vertically down the center of the abdominal wall. It originates at the xiphoid process of the sternum and inserts at the pubic symphysis. The linea alba serves as a place of attachment for several abdominal muscles.

linear source–filter model. A model of speech and voice production primarily developed by speech scientist Gunnar Fant that is spatially linear, that is, that postulates a power source (breath) providing airflow to a vibrator (vocal folds), bringing them into vibration, generating a voice source signal (sound wave) containing harmonics, which are then selectively resonated by a filter (resonator; vocal tract), which transfers the filtered harmonics to the outside world through the lips. Now superseded by the *nonlinear* source–filter model.

lingua/lingual. Pertaining to the tongue.

lip trills. Voiced or unvoiced vibration of the lips via a rather generous airflow; an SOVTE.

loft register. The term often used by speech language pathologists for M2, falsetto register.

Lombard effect. The tendency of a speaker or singer to involuntarily increase vocal effort and the volume of their own sound to be heard above others or background environmental noise.

long-term average spectrum. (LTAS) A plot of amplitude as a function of frequency averaged over a period of time. The averaged power spectrum is created by a fast Fourier transform. Because the LTAS represents an average, it can represent the glottal contributions of a speech signal as opposed to those contributions from articulation even if many different articulatory gestures are included.

lotta vocale. An Italian bel canto term describing control of breath emission via the checking of exhalatory forces during phonation by some continued inhalatory resistance effort. Called *lutte vocale* in French.

loudness. Human perception of intensity, which varies by frequency since human hearing sensitivity varies by frequency, peaking between 2000 and 4000 Hz. It is adjusted by the threshold of human hearing (10 decibels higher than sound level measures).

lumbar. The five largest vertebrae of the spine. Designated as L1–L5, found in the lower back, superior to the fused sacrum and inferior to the thoracic vertebrae.

lutte vocale. See *lotta vocale*.

M

M0. Mode zero. Used to indicate the lowest laryngeal register (fry, pulse).

M1. Mode one. Used to indicate modal/chest, TA-dominant phonation.

M2. Mode two. Used to indicate loft/falsetto/head, CT-dominant phonation.

M3. Mode three. Used to indicate the highest register (whistle/bell/flageolet).

mandible. see *jaw*.

mask. See *masque*.

masque. French word for “mask” related to the concept of placement in vocal technique. The masque— or masque resonance (as the concept is often taught)—is a purely subjective concept, as it deals with perceived sensations related to the zygomatic and nasal regions of the face. As sensation may differ from singer to singer, many teachers prefer to forgo this concept altogether, instead focusing on vowel modification and formant tuning to achieve optimal resonance. (These voice teachers may feel that “placement” is essentially the same thing as vowel modification and formant tuning. However, placement is a result, not a cause, of a specific production/coordination).

massage therapy. A modality that focuses on the manipulation of soft tissue, including muscles,

connective tissue, tendons, ligaments, and skin, with varying degrees of pressure, performed by a licensed practitioner, with the benefits of increasing circulation, releasing endorphins, relaxing and lengthening muscles, and the goal of reducing tissue tension and restoring tissue/muscle to its resting length.

masseter. A strong muscle involved in chewing. The masseter originates at the zygomatic arch and inserts at the mandibular ramus, elevates the mandible, and has some involvement in protraction of the mandible.

maxilla. Skull bone that forms much of the roof of the oral cavity. The maxilla has a large body and four projections: the frontal process, the zygomatic process, the palatine process, and alveolar process. Therefore, this structure plays a significant role in the floor of the nasal cavity, the roof of the mouth, and holds the upper teeth; sometimes (erroneously) called the “upper jaw;” see *jaw*.

maximum area declination rate (MADR). How rapidly the glottal area changes (declines) during the closing portion of the vibratory cycle. A high value for MADR indicates the glottis closes very rapidly, shutting off the airflow.

maximum flow declination rate (MFDR). How rapidly the rate of airflow changes (declines) from peak flow to zero flow. A large MFDR increases high frequency spectral content.

mechanoreception. The somatosense of touch.

mechanoreceptors. Sensory receptors that respond to mechanical pressure or deformation, detect the degree (amplitude) and speed of their displacement over time (frequency rate) and inform the calculation of the force of changes in our position, or movement. Mechanoreceptors in skin, joints, muscles, and tendons are among those most often categorized as proprioceptors, or self (proprio) sensors, whose cortical projections may be interpreted as the immediate position of any or all of our body parts. (See *proprioception*.)

medial. In the middle or central (i.e., “toward the midline”). This term is used when speaking of body parts in relation to the anatomical position.

melisma. Numerous notes sung on one vowel. (Plural: melismata.)

memory. activation and reactivation of the same neurons creates a neural pathway, or memory, of the episode or action.

- **memory consolidation.** The process of encoding *working memory* to *long-term memory*, involves the transferral of information from one brain area to another. Consolidation is dependent on the association of information with existing knowledge and an essential intervening rest phase.
- **memory, episodic.** An episode is an event or a group of events occurring as part of a larger sequence and its broader associative network, thus episodic memory is a conscious

recollection of previous experiences, together with their context in terms of time, place, and associated emotions. It often unfolds sequentially and is experienced from an internal or autobiographical perspective.

- **memory, explicit.** Memory formed with awareness. Also called *declarative memory*.
- **memory, long term.** The result of the act of learning, or *memory consolidation*. Unlike *short-term memory* which causes short-lived biochemical changes in the brain via the release of neurotransmitters, long term memory changes the brain's structure due to repetition or practice.
- **memory (perceptual–motor processing).** Higher-level and later-stage perceptual tasks consist largely of the reactivation of memory networks by internally or externally generated sensory stimuli.
- **memory, procedural.** Also called motor memory. The representation of how motor acts and behaviors are executed. Lying beneath the cortex, it is subject to executive ignorance, and most often is considered implicit or nondeclarative. For this reason, it may require prompting. To assure retrievability for voluntary guidance as explicit or declarative memory, it must be formed with meaningful associations, such as mnemonic tagging.
- **memory, working.** Term used in cognitive science for the dynamic act of learning itself. Causes biochemical changes in the brain via the release of neurotransmitters. Also called *short-term memory*.

messa di voce. Literally, “placing of the voice.” *Messa di voce* exercises usually crescendo (increase volume) and decrescendo (diminish volume) on a sustained pitch (tone) from soft-to-loud-to-soft dynamic levels, usually in the “mixed” lower range of the treble voice and upper range of nontreble voices. *Messa di voce* exercises require skillful coordination of the TA and CT laryngeal muscles, subglottic breath pressure, and vowel modification.

metamonitoring. Consciously monitoring the unconscious mediation (monitoring and correction) processes of our actions, where metacognition is thinking about how we think.

middle voice. a traditional voice teaching term that refers to the middle third of the treble voice register. The traditional approach to training the young treble voice often begins with this middle area, working with the student to use a perceptual combination of “chest” and “head” voice to create functional efficiency, followed by extending the vocal range down into the “chest” register and up into the “head” register. (see *mixed registration*)

mindfulness. The practice of maintaining a nonjudgmental state of heightened or complete awareness of one's thoughts, emotions, and/or sensory experiences on a moment-to-moment basis.

mixed registration. A perceived mixture between chest (modal) registration and falsetto/head voice (loft) registration, mechanistically and/or acoustically. It is useful for register transition if

sudden voice quality (timbre) changes are not desirable. It is not a separate laryngeal register, rather a laryngeal function influenced by nonlinear acoustic feedback factors which square the vocal fold contact behavior. Acoustically, a version of close timbre (*voce chiusa*). Also known as balanced, blended, or coordinated registration.

mixed vowels. A vowel sound in which the tongue is in a middle position (neither high nor low) such as *schwa*, or one that utilizes both tongue position and significant lip rounding, such as the German vowel umlaut *ü* or French | *eu* |.

mnemonic cues. Memory triggers, including lexical information such as solfège, notation, and even tonal information such as pitch frequencies and sequences.

modal. See chest register (mode one).

mode of phonation. A way of categorizing the ratios of the three elements of a phonation: breath pressure (generated below the glottis), airflow (through the glottis), and glottal resistance (vocal valve closure force). Although these can vary along a continuum, they can be modeled by representative numbers in a phonation equation as follows: breath pressure/airflow = glottal resistance. One of three ratios of pressure, flow, and glottal resistance of a phonation: breathy (excess airflow: $1/2 = .5$); pressed (excess glottal resistance or glottal closure force: $1/.5 = 2$); flow (a balance between pressure, flow, and resistance: $1/1 = 1$). Not to be confused with vibrational mode.

morpheme. The smallest unit of language that carries a semantic meaning. For example, “cat” is a single morpheme, whereas “cats” contains two morphemes (cat + s).

motor learning. Refers to the process of physical, neurological changes that occur as a result of practice (repetition) and experience leading to relatively permanent changes in behavior, i.e., motor skills. According to the model by Fitts and Posner (1967), involves three stages: *cognitive*, *associative*, and *autonomous*.

motor memory. See *memory*, *procedural*

motor performance. Refers to the result of a performer executing a motor skill.

motor output. The largely unconscious response of passive and active motor controls to a stimulus or plan of action.

motor learning, stages of. According to the model proposed by psychologists Paul Fitts and Michael Posner (1967), motor learning occurs in three distinct stages: 1) the *cognitive stage*, in which the person’s motor learning is heavily based on cognitive or verbal processing, 2) the *associative stage*, in which there are still errors but the learner is becoming more skilled, requires less extrinsic feedback, and 3) the *autonomous stage*, in which skills become more automatic; processing is rapid and movements are fluid and efficient. It should be noted that this model, while often quoted in academic literature, is considered outdated by some researchers

(in light of gains in neuroscience) and is under scrutiny in current motor learning research; see *embodied cognition*.

MTD. See *muscle tension dysphonia*.

mucosa. The top layer of the vocal folds.

mucosal wave. A vibratory pattern that occurs on the cover of the superior surface of the vocal folds during phonation. A normal mucosal wave is a salient feature of a healthy singing voice.

muscle function. Primarily to contract and effect movement. Principle functions include cooperative agonist and antagonist pairings, e.g., biceps and triceps for bending our arm, the cricothyroids and thyroarytenoids for pitch control. Muscles may also serve stabilizing functions to facilitate action, e.g., postural stabilization to support respiratory action.

muscle tension dysphonia (MTD). See *dysphonia*; MTD is a type of functional dysphonia. MTD is often diagnosed when no organic problems of speech or singing are discovered but dysphonia is still present.

muscular process. Posterolateral projection of the (short, rounded, and prominent) lateral angle of the base of the arytenoid cartilage. The muscular process gives insertion to the posterior cricoarytenoid muscles behind, and to the lateral cricoarytenoid muscles in front.

musical tone. A term sometimes used in reference to periodic sounds, in contrast to noise or aperiodic sounds. However, music makes use of both periodic and aperiodic sounds.

multimodal perception. Simultaneous cues from two (or more) sensory modalities can enhance the salience of a stimulus and eliminate ambiguities about its identification.

musculoskeletal structures. The muscular and skeletal structures that provide and organize alignment, balance, and movement. See axial, proximal and distal musculoskeletal structures.

mutational chink. a reference to the typical gap in the posterior third of the glottis in the adolescent voice. The mutational chink is typical of changing voices during puberty. It results in a necessarily breathy tone, and is the result of the fast changes in the proportions of the laryngeal structures during adolescence. See also *chink* but note the preferred term is *gap* or *glottal gap*.

myasthenia gravis. An autoimmune disorder that causes rapid fatigue in muscular contraction once contraction is initiated due to antibodies that block acetylcholine receptors in the muscles. The overall quality of voice and speech declines rapidly as strength of muscular contractions are reduced during continuous or repeated activity.

mylohyoid. A paired muscle that originates at the mylohyoid line of the mandible and inserts at the body of the hyoid bone and the mylohyoid raphe. These muscles elevate the hyoid bone, raise the floor of the mouth during swallowing, and also help to open the jaw.

myoelastic. A characteristic that accounts for those muscular and elastic recoil properties of vocal fold tissue that contribute to vocal fold oscillation.

myoelastic-aerodynamic theory. The theory of phonation that attributes sustained oscillation of the vocal folds to both acoustic/aerodynamic and muscular elastic recoil factors.

N

nares. Either of the pair of openings of the nose or nasal cavity.

nasal. A sound that includes velopharyngeal opening, allowing some degree of airflow and sound through the nares. Opening the velopharyngeal port can actually dampen a singer's voice; the larger the VPO, the more muffled the resultant sound. However, a small VPO increases intensity of high frequency content radiated from the mouth and decreases the intensity of low frequency content by broadening the bandwidth of the first formant.

nasalance. A measure of the relative acoustic output of the nares versus that of the mouth.

nasality. Perceptual awareness of nasalance in a sound; the timbral term most associated with this term is nasal twang; considered undesirable in Western classical timbre, but valued in a variety of other genres.

nasopharynx. The uppermost part of the pharynx behind the nasal cavity.

neutral vocal tract. The configuration of the tongue, lips, jaw, velar position and other articulators at rest. The configuration is determined by genetics, cultural/linguistic background, and the moment-to-moment shifts in equilibrium. While there is not much one can change regarding hardwired genetic factors, there are many alterations that can be made to cultural/linguistic characteristics through reprogramming related to accent reduction, accent shift, and other speech pattern training.

neural. Of, relating to, or affecting a nerve or the nervous system.

neural oscillations. The synchronous and rhythmically repetitive firing patterns of neuronal interplay. When the action of two or more neurons is synchronized, it mathematically represents a single neural oscillator. For example, a neural oscillator describes the synchronized action of motor neurons that generate the phonatory oscillations associated with vibrato rate.

neural transmission. The transmission of signals in the nervous system. See afferent and efferent transmission.

neuron. A specialized cell of the nervous system (neuronal cell). A neuron may be further categorized as a sensory neuron, a motor neuron (motoneuron), or even an interneuron that transmits information between neurons within the central nervous system (i.e., from a sensory neuron to a motor neuron), with increasing specification of function.

neuroplasticity. The capacity for continuous alteration of the neural pathways and synapses of the living brain and nervous system in response to experience or injury. Neuroplasticity comprises not only the formation and storage of memories, but also such phenomena as neuromodulation and sensory adaptation to environmental changes. Mechanisms contributing to neural plasticity include rewiring of neuronal circuits, generation of new neurons, remodeling of dendrites, synaptic plasticity, and plasticity of neuronal excitability.

node. A term from physics meaning a point, line, or surface of a vibrating body or system that is free or relatively free from vibratory motion.

nodule. Symmetrical fibrous masses that occur on the anterior third of the vibrating margin of the vocal folds. Nodules are typically the result of phonotrauma.

noise-to-harmonic ratio. See harmonic-to-noise ratio.

nonbinary. A gender identity that describes individuals whose identities are neither specifically masculine nor feminine and which may include aspects of both.

nondeclarative memory. See implicit memory.

nonlinear source–filter theory. A source–filter model of vocal resonance with the added component of possible interactivity between the filter and the source, such that certain resonance postures of the filter cause feedback on the vibrator that alters the function and contribution of the vibrator, ideally by assisting its efficiency.

nontreble. A voice classification such as tenor, baritone, or bass whose primary range lies within the bass clef; the opposite of *treble*, thus “non-treble.” This term has been suggested to avoid gendered terminology in voice classification; however, some have found it pejorative and have posited the classification *TTB* (*tenor/baritone/bass*) for use in its place.

nucleus. A group of neurons (nerve cells) that bear a direct relationship to a particular nerve (transmission pathway) and share both proximity and broad function. A nucleus is dedicated to processing information specific to a task, such as audition or vision. Sensory nuclei are distributed throughout the brain from the brain stem (hind brain) to the uppermost hub, the thalamus.

O

occlusion. To close or shut off.

omohyoid. A paired muscle located in the front of the neck. One of the infrahyoid muscles, it originates at the scapula and inserts into the hyoid bone. It is primarily involved in depressing/retracting the hyoid and larynx.

onset. The initiation of voicing. Onset is sometimes called “attack” and is related to the *coup de glotte*.

openness–closeness dimension. As a vowel characteristic, either referring to the relative openness of the oral cavity of a vowel, or the frequency height of the first formant: the lower the vowel's F_1 , the closer vowel; as an acoustic registration characteristic, the relative relationship of a pitch's harmonic set to the first resonance of the vowel being sung. The more harmonics there are below the first resonance of the vowel being sung, the more open-timbred the sound. See *voce chiusa*, close timbre, close vowel, *voce aperta*, open timbre, and open vowel.

open phase. The length of time that the glottis is open during one vibratory cycle

open quotient. The ratio of glottal openness to the entire period of oscillation.

open timbre. A vocal sound in which two or more harmonics are at or below the first resonance of the vowel being sung. Open timbre is sometimes also used to describe a generally divergent resonance shape strategy. Termed *voce aperta* in Italian.

open vowel. A vowel characterized by a relatively low tongue position, a high first formant, and an inherently divergent resonator shape, such as /a/.

optimal performance. Smooth coordination and expert execution of a complex sequence of events such as singing. It relies on a state of equilibrium where the resources of the moment are equal to the purpose of the moment: having all the information and energy needed when it is needed, such that the task at hand is executed accurately, efficiently, healthily, and expressively (if desired).

oral cavity. Also known as the buccal cavity, refers to the mouth.

oropharynx. The middle section of the pharynx directly behind the oral cavity, easily viewable through an open mouth.

orifice. An opening.

oscillation. Movement away from and towards a central equilibrium point. Aspects of oscillation include the rate of oscillation, the amplitude of oscillation from the equilibrium, the duration of the oscillation, whether the oscillation is self-sustaining or damped, and the regularity of both the rate and amplitude.

ossify. The process by which cartilage hardens into bone.

overtones. The designation for frequency components of a sound that lie above the fundamental frequency. Overtones usually refer to harmonic frequencies. The first overtone is the second harmonic.

palate. The roof of the mouth separating the mouth from the nasal cavity divided into two general regions (hard and soft).

palatoglossus. A thin muscle that arises from each side of the soft palate and inserts into the sides and dorsum of the tongue.

palatopharyngeus. A muscle that originates at the hard and soft palate and inserts at the thyroid cartilage. The palatopharyngeus elevates the pharynx, closing the nasopharynx from the oropharynx during swallowing.

pallesthesia. The human sense of vibration; vibrotactile sensation, limited to approximately 50Hz to 1000Hz.

paralinguistic. Gestures that denote the nonlexical elements of communication expressed in facial, postural, and phonatory behaviors. For example, expressive phonatory gestures involve the unconscious production of rapid-fire and often subtle variations in pitch (inflection) and tone.

paranasal sinus. Air-filled area that surrounds the sinus cavities.

paralysis. Immobility due to nerve damage. Vocal fold paralysis may be unilateral or bilateral and is typically the result of damage to the recurrent laryngeal nerve due to injury, infection, pressure or inflammation. Stroke and neurological diseases may also contribute to vocal fold paralysis.

paresis. Muscular weakness attributed to nerve damage; partial paralysis.

pars obliqua. Along with *pars recta*, the more “horizontal” of the two main types of cricothyroid muscles.

pars recta. Along with *pars obliqua*, the more “vertical” of the two main types of cricothyroid muscles.

partial. A term for frequency components of a sound; partials may also refer to nonharmonic frequencies, i.e., frequencies that are not multiples of the lowest frequency component.

passaggio. A commonly used classical voice pedagogy term for the acoustic and/or physiologic transitions between registers. Sometimes referred to as a break when less smoothly executed.

passive elastic recoil. The movement from various forces (tissue elasticity, orientation to gravity) that restores an anatomical system, such as the respiratory system, to its resting level.

passive vowel migration/modification. Change in vowel quality that results from retaining the vocal tract shape (and its resonance locations) while moving the pitch with its set of harmonics. The change in vowel quality results both from the migrations of the tone colors of the pitch’s harmonic set and from the changing relationships and interactions between moving harmonics and stable resonances.

peak performance. A performance accompanied by a sense of inner calm and a high degree of concentration, a feeling of effortless control, and a heightened sense of awareness. This ideal performing state is reported to promote uninterrupted focus and concentration as well as an ability to regulate anxiety and arousal during performance. Also known as ‘flow’ in the writings of psychologist Mihaly Csikszentmihalyi.

pectoralis muscles. Muscles of the upper chest involved in lifting the rib cage. Divided into two categories (major and minor).

pelvis. A large structure near the base of the spine consisting of three bones, the ilium, ischium and pubis. The pelvis serves as an attachment point for many muscles as well as the lower extremities.

percept. A mental representation (image) of that which has been perceived.

perception. The state of becoming aware of something via the brain’s processing of signals from the physical senses. The process by which we take the information received from our senses and organize and interpret it, which in turn allows us not only to see, taste, smell, hear, and feel events in our internal and external environments, but also to do so as meaningful and recognizable experiences with clear locations in space and time.

perspective. Perceptual images of our intended actions generated from an internal point of view. Where, in expert performance, our percepts are *inverted* from feedback images to feed-forward intentions.

pharyngeal voice. Historic designation of a vocal production employing a thin, mode two vocal fold shaping with very efficient closure and a longer closed phase, resulting in high spectral content (exaggerated brilliance) at low transglottal pressure differences. Usually accomplished by closing the pyriform sinuses to eliminate the pyriform notch (an antiresonance at 4000–6000Hz). Also called *voce di strega* (witch voice).

period. A single cycle of vibration. The mathematical inverse of vibration frequency.

periodicity. The regularity or sameness of the cycle-to-cycle glottal waveform. It is perceptually associated with a clean, nondistorted (noiseless) tone.

pharynx. The muscular tubular passage of the vertebrate digestive and respiratory tracts extending from the back of the nasal cavity and mouth to the esophagus. Commonly known as the throat, the pharynx connects the oral and nasal cavities to the esophagus and larynx. The pharynx is divided into three parts: the *nasopharynx*, *oropharynx*, and *laryngopharynx*.

phonation. Vibration of the vocal folds to generate sound. Phonatory characteristics from signals obtained externally include sound pressure level, fundamental frequency, formant and harmonic energy for sustained phonation and connected speech. Signals can also be analyzed for

perturbation values, spectrography, voice onset time, vibrato rate, and vibrato characteristic (extent, frequency, or jitter).

phonation threshold pressure (PTP). The minimum subglottal pressure required to initiate phonation.

phoneme. A basic sound segment that has the linguistic function of distinguishing morphemes. For example, the words “cat,” “fat,” and “hat” comprise a single morpheme and vary only in the initial phoneme.

phonetics. The study of the perception and production of speech sounds

phonotrauma. A broad term indicating damage to the vocal folds. A variety of pathologies impacting vocal fold function may fall under the umbrella of phonotrauma. This includes, but is not limited to, vocal fold nodules, polyps, and cysts.

phrenic. The nerve that provides motor supply for the diaphragm.

physiology. The study of how anatomy functions in health and disease.

Pilates. A modality that focuses on strengthening the (abdominal) core and lower back; a popular method of training for dancers.

pitch. Human perception of the frequency of a periodic waveform. Deduced from the lowest eight harmonics of a complex periodic sound.

pitch of turning. In the pedagogical writings of some pedagogues, the pitch at which a voice ‘turns over’ perceptually, moving from open to close timbre, just inside of an octave below the pitch of the first resonance of the vowel being sung; i.e., the pitch at which the second harmonic ($2f_0$) crosses above the first resonance (f_{R1}) of the vowel being sung.

placement. The observation that tonal sensations can seem localized in the body. Though vocal sound cannot actually be “placed,” these sensations are common and vary by range, register, and individual. The concept of placement (while a result, rather than a cause, of specific coordinations of body alignment, respiratory function, vocal fold adjustment, and vocal tract shaping), may be useful for anticipated, intentional targets in the discovery of desirable vocal function and timbre. Forward placement is a common example.

planning voluntary behavior. A cognitive process that involves predicting outcome. It is an executive function involving the ability to manipulate novel and existing information to form strategies for achieving a behavioral goal; to construct possible outcomes at a rapid-fire pace according to our willed purpose of the moment or intentions, e.g., expressing our thoughts and feelings overtly with our singing voice. Planning expertise requires accurate definition of our immediate goal for the task at hand, as well as the ability to recall knowledge and generate a mental representation, or image, to guide intuitive performance of that task. Moreover, artistic

performance requires the ability to mentally manipulate that image for a phenomenal (one of a kind) experience.

pleura. The delicate serous membrane that lines each half of the thorax of mammals and is folded back over the surface of the lung of the same side. The pleurae link the lungs to the interior surface of the ribcage and the superior surface of the diaphragm via airtight seals between the layers.

physical therapy. A modality that includes soft tissue manipulation, electrotherapy, additive devices, therapeutic exercise, patient education and training performed or guided by a licensed practitioner with the goal of restoring mobility, stability, and physical function impaired by disease, injury, or disability.

plosive. A consonant characterized by complete closure of the breath passage in the course of articulation. Examples of plosives include /b/, /p/, /t/, /d/, /k/, or /g/. Also known as a stop.

polyp. A fluid-filled mass that is typically found near the midpoint of the vocal fold, which suggests it is the result of phonotrauma. A polyp may also be the result of localized bleeding. The location may disrupt the vibratory pattern of the vocal folds and lead to dysphonia.

posterior. In back

posterior chink. See *chink*.

posterior cricoarytenoid. A paired intrinsic laryngeal muscle that originates on the posterior surface of the cricoid cartilage and inserts into the posterior muscular process of the arytenoid cartilages. Contraction of these muscles results in abduction of the vocal folds.

posterior glottic gap. Lack of complete closure of the arytenoids by the interarytenoid muscles.

postural equilibrium. Facilitated by the vestibular apparatus, or sensory organ of the inner ear. Equilibrium plays a crucial role in monitoring head position relative to gravity, rotation, and acceleration for the purpose of equalizing us to the force of gravity and maintaining our sense of balance. See also proprioception.

power law of learning. Involves the ability to process an ever-increasing volume of variable (complex) information in evermore inclusive routines.

power spectrum. An analysis of a sound that displays power or amplitude on the vertical axis and frequency components on the horizontal axis. Display updates vary with the analysis settings. Can be used as a continuous display or frozen for examination of specific details.

practice. Repetition of an action, or set of actions, in skill acquisition and refinement. Considered the most important variable in motor learning, *conditions of practice* are therefore a prime topic in motor research.

practice, conditions of. The various ways to practice skill acquisition, retention and refinement.

- ***distributed*** practice is spaced out over time and allows for rest (versus *massed*, which does not) and is thought to be more beneficial for motor learning and performance.
- ***varied*** practice, in which many variations of a skill are included (versus *constant*, in which they are not) is thought to be more beneficial for motor learning and performance.
- ***random*** practice (also called *interleaved* practice) in which several different motor tasks are mixed or interleaved (versus *blocked* practice conditions, in which only one skill is practiced consecutively) is thought to be more beneficial for motor learning and performance;

practice, deliberate. According to K. Anders Ericsson who coined the term in research on expertise, “an effortful activity designed to optimize improvement.”

presbylaryngis. Refers to the aging larynx. Possible characteristics of presbylaryngis (physical/acoustic) include: ossification of the laryngeal cartilages, muscle wasting, vocal fold bowing; changes may also be due to age-related hormonal transitions, such as menopause.

prephonatory tuning. Posturing of the vocal folds and shaping of the vocal tract prior to phonation, usually during inhalation; the “tuning” of the resonances of the vocal tract prior to phonation.

pressed. A term to describe phonation with insufficient air flow and excessive glottal resistance.

pressure waveform. The pattern of air pressure variations that form a sound. If there is a regular pattern that repeats periodically, the sound will have a clear pitch. If there is no regularly repeating pattern, rather a random pressure variation, the sound will be perceived as noise.

primary register transition. The transition from laryngeal register mode one (chest) to mode two (head).

primo passaggio. The lower entry into the transition zone or *zona di passaggio*.

proprioception. Somatosense referring to awareness of body position in space.

proximal musculoskeletal structures. The proximal structures function as both gross motor positioning and stabilizing forces in support of distal action. Together, the proximal and distal structures form our appendages.

psychoacoustics. How the ear and brain experience and process sound.

PTP. Phonation threshold pressure.

pyriform sinuses. The small side branches of the lower pharynx which are located to either side of the laryngopharynx above the entrance to the esophagus; these create an antiresonance in the 4000–6000Hz region, highlighting the singer’s formant cluster just below. Closing the pyriform sinuses reintroduces high spectral content above 4000 Hz.

Q

quarter-wave resonator. A tube that is open at one end and closed at the other. Such a resonator can establish standing waves (resonances) at the quarter-wave length, and odd numbered multiples of that length: $3/4$ wavelength, $5/4$ wavelength, $7/4$ wavelength, etc. The vocal tract is a form of quarter wave resonator, but with more variable, tunable wavelengths.

quadrangular membrane. The superior portion of the elastic membrane that extends from the laryngeal additus to the ventricle.

R

RA. Rheumatoid arthritis.

range. The highest to lowest pitch (entire compass) of a voice or piece of music.

rarefaction. Description of the density of air molecules in a pressure waveform; rarefaction is greater separation of molecules, and alternates with compression in a pressure waveform.

raspberries. Voiced or unvoiced vibration of the tongue extended between the lips. Can be done vibrating either the upper or lower lip by varying the airstream to above or below the tongue; a rather airflow generous SOVT exercise.

reactance. Resistance to the flow motion, referred to as an inertance. Reactance is a matching of resistance between the glottis and the vocal tract or epilarynx that increases the interactivity of the system (i.e., feedback on the vibrator).

realtime spectrography. An ever-changing, immediately current analysis and visual representation of sound that displays frequency on the vertical axis, time on the horizontal axis, and intensity on the grey or color scale. This form of sound display is perhaps the most intuitive and informative as a visual learning aide currently available for students.

rectus abdominus. The long, multi-bellied muscle of the anterior abdominal wall. This muscle extends from the pubic bone to the xiphoid process and costal cartilages of the fifth through the seventh rib. In some individuals, the rectus abdominus is visually present as the colloquial “six pack.”

recurrent laryngeal nerve (RLN). A nerve that controls all intrinsic muscles of the larynx except for the cricothyroid muscle. These muscles act to open, close, and adjust the tension of the vocal folds, and include the posterior cricoarytenoid muscles, the only muscles that open the vocal cords.

reflection. A change in direction of waves when they bounce against a barrier.

reflex. A local motor response to a local sensation; an unlearned automatic behavior that may be influenced by higher control centers, e.g., grasping a pen or a glass of water. Most reflexes are involuntary in the sense that they occur without the person willing them to do so, but all of them can be brought under voluntary control, such as when grasping an object.

reflux. The upward flow of gastric juices through the lower and upper esophageal sphincters. Reflux may occur as either laryngopharyngeal reflux disease (LPR) or gastroesophageal reflux disease (GERD). Irritation from the acid and enzymes of the stomach can damage the tissues of the larynx and pharynx causing dysphonia and/or changes in sensation such as feeling a lump in the throat, tickling, or the production of excessive mucus.

refraction. Involves a shift in the direction and speed of waves as they pass from one medium to another, such as from air to bone, or air to water.

register. A particular series of tones that possess a similar quality and that are produced by the same physiologic or acoustic mechanism within a consecutive series of pitches, which are distinct from other series of tones possessing a different quality and produced by a different mechanism.

register change. A perceivable change, both in the timbre and causal mechanism, whether acoustic or physiologic, of a series of pitches. See also *passaggio*.

reserve breath. The part of the unforced lung capacity which is not used in tidal breathing.

residual volume. The volume of air that cannot be exhaled below vital capacity; ca. 2 liters.

respiration. The movement of air or dissolved gasses into and out of the lungs. Breathing.

resonance. The tendency of an object or system to respond (oscillate) more strongly to particular frequencies introduced into it. In reference to voice, the amplification and modification of the voice source waveform by the vocal tract (throat, mouth, and nasal cavity). (See forced/conductive resonance, and free/sympathetic resonance)

resonator. Secondary vibrator; specifically, that part of an instrument which reinforces the primary vibration. In singing the resonator is the vocal tract, whose sound transfer function can be adjusted via articulation (reshaping).

reversibility. An exercise physiology principle that refers to the detraining effect of skill loss and of adaptations that can occur with decreased use or training over time. Also known as deconditioning.

rheumatoid arthritis (RA). About 25 percent of people with RA have laryngeal involvement in which the joints are restricted in mobility. This may lead to decreased range/vocal flexibility and hoarseness. Individuals may have a clear voice, but may complain of pain with voicing or swallowing.

rib breathing. A breathing method where the expanding ribcage is the sole object of the act of expansion. This method restricts the contraction of the diaphragm because the singer must pull in the upper abdomen in order to isolate the rib expansion. Also known as thoracic or costal breathing.

RLN. Recurrent laryngeal nerve.

roll off. Another designation for the rate at which harmonics weaken in intensity per octave above the fundamental frequency. Also called tilt or spectral slope.

rounded. Used to describe vowels for which the lips are rounded, pursed, or protruded.

rhythmic entrainment. The formation of regular, predictable patterns in time and/or space through interactions within or between systems that manifest potential symmetries. It is associated with the rhythmic regularity and predictability of simple, highly redundant behaviors such as running, phonatory oscillations, or the autonomically regulated rhythms of our heart and breathing rates that maintain homeostasis.

S

schwa. a mid-central vowel, in which the tongue is placed neither high nor low and the lips are relaxed; also called the neutral vowel. Schwa is common to many Western languages, such as in the English word “the,” the second syllable in the German word “liebe” and the second syllable in the French word “entre.” In linguistics, noted by the IPA symbol | ə |.

scapula. A flat bone in the back of the shoulder, also called the shoulder blade.

secondo passaggio. The transition at the top of the *zona di passaggio* into the upper register of the voice.

self-to-other ratio. A singer’s perception of personal sound level relative to nearby colleagues. A choral singer simultaneously hears airborne and conducted feedback from his/her own voice (self) and the sound of the rest of the choir (other). A positive SOR means that the sound of self is a few decibels higher than the sound of the other.

semiocluded vocal tract (SOVT). A vocal tract with a supraglottal narrowing sufficient to generate flow resistance or acoustic impedance. A short thin straw is one mechanical example, and the nasal consonant /m/ and the /w/ glide are articulatory examples of SOVT.

semiocluded vocal tract exercises (SOVTE). Vocalises that are performed with the vocal tract partially closed, either by the lips or by the tongue. When the lips are partially closed, increased back pressure reflects from the point of narrowing at the lips back to the vocal folds, reducing the transglottal pressure difference, and helping the folds vibrate with more ease. A similar effect is obtained with the tongue in /ŋ/. Other examples include straw exercises, humming, sustained voiced consonants (e.g., /v/ and /z/), lip trills, tongue trills (also known as rolled r), and “raspberries,” in which the tongue protrudes through the lips and both vibrate.

sensorimotor feedforward. The product of interacting feedforward and sensory feedback processes. Feedforward control is guided by internal action representations (mental images) that plan initial motor output before the time when sensory feedback can be translated into corrective adjustments.

sensorimotor processing. The processing of neural information involving both sensory and motor systems, functions, and pathways for the purpose of executing the task at hand in accordance with behavior outcome goals.

sensory information processing (input). The processes by which information from a stimulus event in our environment or ourselves is received, transmitted, interpreted, and perceived as a mental representation or image with the potential to be stored as knowledge.

sensory receptors. A cell or group of cells that receives stimuli, classified by the type of stimulus that generates a response in the receptor. Broadly, sensory receptors respond to one of four primary stimuli: chemicals, temperature, pressure, and light.

shimmer. A measure of cycle-to-cycle variation (perturbation) in an acoustic signal. Shimmer specifically refers to variation in amplitude. Compare with jitter, which is variation in the period of the vibration.

skull. A large structure located near the top of the spine consisting of multiple bones including the frontal bone, ethmoid bone, sphenoid bone, temporal bone, parietal bone and occipital bone.

sibilant. A linguistics term describing fricative and affricate consonants in which a stream of air is directed while the tongue rests against the teeth. When singers and choral directors refer to sibilants, they are primarily addressing the two alveolar hissing sibilants—[s] and [z]—which can be intrusive in singing. Amplified singers and recording artists often rely on electronic processing to keep sibilants under control.

singer's formant cluster. A formant grouping created by clustering the third, fourth and fifth vocal tract resonances together within a narrower frequency range, approximately around 2300–3500Hz. This clustering provides amplification of the harmonics within this range. It is thought that this is a result of narrowing the epilaryngeal tube exit relative to laryngo-pharyngeal openness. This allows the voice to project through the masking effect of an orchestra (or other accompaniment) on spectral content below ca. 500Hz.

sinus. A cavity within a bone or tissue.

SLN. Superior laryngeal nerve.

soft palate. The muscular fold at the back of the hard palate that partially separates the mouth from the pharynx and/or nasal cavity. Composed of five muscles: tensor veli palatini, levator veli palatini, uvular muscle, palatoglossus, and palatopharyngeus.

somatic. Relating to the body.

somatosense. Sensations of the body. Primary somatosenses include heat (thermoception), pain (boiception), position (proprioception), and touch (mechanoreception).

sound. Variations in pressure propagated through a medium (like air) which is perceivable by the sense of hearing.

sound intensity. Raw power of a sound.

sound level. The (logarithmic) decibel measure of the intensity relative to a given 0 decibel marker.

source–filter model. The theory of voice that postulates voice as the result of a source waveform that is filtered by the sound transfer characteristics of the vocal tract.

SOVT. Semioccluded vocal tract.

spectral centroid. An amplitude weighted average of the spectral components of a formant. For example, a vocal tract resonance may be amplifying several harmonics. The cumulative effect of those harmonics on the perceived tone color (vowel-like quality) can be determined by calculating their spectral centroid.

spectral envelope. An outline of the power dimension of a power spectrum. It is useful for revealing the resonance characteristics (formants) of a particular vocal tract shape.

spectral slope. The rate at which harmonics above the fundamental frequency weaken in intensity, stated in negative dBs/octave. Also called spectral tilt or roll-off.

spectrogram. A graphing of a sound with frequency on the y axis, time on the x axis, and intensity on a grey or color scale.

spectrography. A graphic display of a sound signal wherein frequency and intensity are plotted over time. Both glottal and supraglottal influences on the sound signal can be evaluated, including vowel type, voiced and voiceless transitions, vibrato rate and extent, aspiration, coarticulation, and influence of the epilarynx. In a periodic signal, the fundamental frequency is displayed as the lowest energy horizontal line in the spectrogram. Formants are displayed as bands or concentrations of frequencies above the fundamental. Turbulent or transient noise can be seen as fill-in between the horizontal harmonic lines.

sphincter. Muscle or group of muscles that serve to close an orifice upon contraction.

squamous epithelium. The stratified, outermost layer of the vocal folds.

standing wave. A phenomenon that occurs when the positive and negative interference of two waves of identical frequency traveling in opposite directions align, causing pressure peaks and valleys to seem to stand still.

steady airflow. An airflow characteristic needed to sustain efficient phonation.

sternocleidomastoid. Muscles of the neck that connect the sternum and clavicle to the mastoid process, which arises from the temporal bone of the skull.

sternohyoid. Connects the sternum and the hyoid bone; laryngeal depressor.

sternothyroid. One of the infrahyoid muscles. Originates at the sternum and costal cartilage of rib one and attaches to the thyroid cartilage. Depresses the larynx.

stop. See plosive.

styloglossus. Muscle connecting the styloid process of the temporal bone and the tongue. The styloglossus lifts and curls the tongue and—by proxy—the larynx.

stylohyoid. Muscle that connects the hyoid bone to the skull, elevates the larynx and tongue base, and elongates the floor of the mouth.

styloid process. A sharp spine that projects downward and forward from the inferior surface of the temporal bone just in front of the stylomastoid foramen and that is derived from cartilage of the second visceral arch.

stiffness. In physics, the measure of a material's resistance to deformation.

strain. In physics, the response of a material to applied force.

stress. (1) In physics, the force per area applied to a material. (2) In linguistics, the accented syllable in a word or phrase.

stroboscopy. An evaluative tool in which a strobe light illuminates similar or successive views across many cycles in nearly periodic vocal fold vibration during sustained phonation. The illuminated points coupled with the persistence of vision of the human eye results in a perception of a full vibratory movement, when in actuality, the examiner is seeing small segments of several consecutive cycles. Stroboscopy is the standard for clinical assessment of vocal fold structure and function. See also videolaryngostroboscopy.

subglottal. Below the glottis.

subglottal pressure. A measure of the lung pressure below the glottis during a phonation.

superior laryngeal nerve (SLN). A branch of the vagus nerve. The superior laryngeal nerve has two branches, external and internal; the external branch innervates the cricothyroid muscle, while the internal branch provides sensation of the laryngeal mucosa.

supplemental breath. Air which may be exhaled in addition to tidal expiration, by effort. See inspiratory reserve volume.

supraglottal pressure. A measure of the pressure in the vocal tract above the glottis during phonation.

supraglottic. Above the glottis.

suprahyoid muscles. Muscles attached to and above the hyoid bone. All suprahyoid muscles play a significant role in mastication. (See mylohyoid, geniohyoid, digastric, stylohyoid)

synapse. The point at which a nervous impulse passes from one neuron to another.

synovial joint. The most common type of joint in the body. Synovial joints contain an articular capsule that unites the articulating bones. Synovial joints also contain a synovial cavity—a space between the articulating bones—containing synovial fluid. There are six types of synovial joints: ball and socket, plane joints, pivot joints, hinge joint, saddle joints, and condylar joints.

T

TA. Thyroarytenoid.

TTB (tenor/baritone/bass). A voice classification such as tenor, baritone, or bass whose primary range lies within the bass clef. This term has been suggested to as the best one to avoid gendered terminology in voice classification, and as superior to the term *nontreble*, seen by some as pejorative.

temporomandibular joint (TMJ). The joint between the skull and the mandible; the only moveable joint of the skull; a synovial, condylar, and hinge joint. Movements include depression and elevation, as well as protraction and retraction. The articular disc (made of fibrocartilage) divides the joint into superior and inferior compartments.

tendon. A tough cord or band of dense white fibrous connective tissue that unites a muscle with some other part (such as a bone) and transmits the force which the muscle exerts.

tensor. A muscle that stretches or tightens a part of the body.

tessitura. The term for the range segment within which most pitches of a piece lie; tessitura affects vocal dosage.

thorax. The upper torso or ribcage, which holds the heart, trachea, and lungs and provides structure for the intercostal muscles.

thoracic breathing. See *rib breathing, costal breathing.*

thyroarytenoid (TA) muscles. The muscles that comprise 90 percent of the vocal folds. In the three-layer body/cover scheme (along with the ligament and mucosa), the TA muscle constitutes the largest segment or the “body” of the vocal fold. Also considered one of the three vocal fold adductor muscles (the other two being the *lateral cricoarytenoids* and the *interarytenoids*).

thyrohyoid. One of the infrahyoid muscles, the thyrohyoid originates at the thyroid cartilage and inserts at the hyoid bone. It is involved in depression of the hyoid bone and elevation of the larynx.

thyroid cartilage. The chief cartilage of the larynx; consists of two broad lamellae joined at an angle which varies according to biologic sex.

tidal volume. The amount of air moved in one cycle of respiration. It ranges from .5 liters at resting level respiration potentially to the entire vital capacity (4–5 liters) during maximal exertion. Resting tidal breathing is characterized by a relatively regular inhalation-exhalation (inspiration–expiration) pattern. Inhalation is active, though automatic, and exhalation during tidal breathing is predominantly passive: as the inhalatory muscles relax, the lungs and chest wall recoil, returning the lungs to resting volume.

timbre. Aspects of sound other than pitch and loudness; primarily composed of the relative intensities of the frequencies in the sound spectrum.

tone. Refers to musical sound, or to the pitch, quality, and strength of a musical or vocal sound.

tone quality. A description of the timbre (spectral content) of a sung sound, from which function can be approximately deduced. Tone quality descriptors include breathy, clear, noisy, nasal, and others.

tongue. A fleshy movable muscular process of the floor of the mouths of most vertebrates that bears sensory end organs and small glands and functions especially in taking and swallowing food and in humans as a speech organ. Divided into five parts: the tip (portion of the tongue that is closest to the front teeth at rest), blade (region posterior to the tip and inferior to the alveolar ridge), *maxilla dorsum* (region posterior to the blade and below the back part of the hard palate, below the velum), root (portion that faces the back of the pharynx and front of the epiglottis), and body (represents the central mass of the tongue that underlies the surface features).

total lung capacity. The entire volume of air the lungs can contain; it includes inhalatory capacity as well as functional residual capacity; or, alternatively, all four lung volumes: residual, expiratory reserve, tidal, and inspiratory reserve.

trachea. A long tube made of rings of cartilage and membranes that connects the larynx to the bronchi. The trachea is the passageway for air.

transgender. A gender identity that describes individuals whose gender identity does not necessarily match the gender with which they were assigned at birth.

transglottal pressure difference. The difference between sub- and supra-glottal breath pressures. This pressure difference determines the load that glottal resistance must bear during phonation and the resultant collision forces of the glottal tissues. Supra-glottal pressure can be raised via inertive acoustic strategies to keep the transglottal pressure difference sustainably low.

transition zone. See *zona di passaggio*.

transmission of sensory information. (See neural transmission, afferent and efferent transmission)

transition points. A traditional voice teaching term that refers to pitches where a particular singer shifts into a different register or registration strategy. See lift notes.

transverse abdominals. A broad, paired muscle found laterally in the abdominal wall. This muscle is involved in increasing intra-abdominal pressure for phonation.

trapezius. A large, triangularly shaped muscle found in the posterior region of the neck and thorax. This paired muscle gets its name from its shape which is trapezoidal and is one of the extrinsic muscles of the back found in the superficial layer. The main function of the trapezius is stabilization of the scapula. However, it is also involved in movements of the head and neck.

treble. A voice classification such as soprano, mezzo-soprano, contralto, and countertenor whose primary range lies above the bass clef—i.e., in and through the treble clef.

tremolo. A vibrato with a rapid rate and an extent/excursion large enough to detract from the intended pitch, causing a rapid pulsing or beating effect.

trill. Rapid alternation between a written tone and a tone one or two semitones above.

trillo. Rapid sequence/repetition of voice onset/offset of the same pitch.

turning over. A term used by some pedagogues to describe the passing of the second harmonic ($2f_0$) above the first resonance (f_{R1}) of a voice, and its accompanying sound and sensation. Also called covering or closing.

U

unilateral. On one side.

unrounded vowels. Vowels in which the lips are *not* rounded, pursed, or protruded, and may even be slightly retracted. Can also refer to ‘spread’ or ‘wide’ vowels, in which the mouth opening is more lateralized.

upper chest breathing. See *clavicular* breathing.

uvula. Fleishy, protruding pendant lobe that hangs from the middle of the posterior part of the soft palate.

V

Valsalva maneuver. Valsalva maneuver. A breathing technique used for varied purposes, but not for singing: for adjusting pressure in the middle ear (such as during scuba diving), to slow a rapid heart rate (*ventricular tachycardia*), or to increase thoracic fixation (*torque*) for heavy lifting. For the first two purposes, the maneuver is often done by pinching the nostrils shut, then attempting to force exhaled air through closed lips. In extreme versions of the Valsalva maneuver (such as heavy lifting and childbirth), the glottis is closed and the ventricular folds may constrict. Singers who take in too much air (called “over-breathing” by many pedagogues) should beware of possibly tapping into the *valsalva maneuver* as a reflexive response in preparation for heavy lifting or defecation.

velar. Refers to the velum or soft palate.

velum. Another term for the soft palate. Located posteriorly to the hard palate.

ventricle. A small space located immediately above the true vocal folds and below the ventricular (false) folds.

ventricular vocal folds. The ventricular folds are located superiorly to the true vocal folds. They are also known as the vestibular or false vocal folds. They play a role in vocal fold lubrication but their compression during phonation can negatively influence acoustic output by producing what some pedagogues call “pressed” or “squeezed” vocal tone..

Venturi effect. The lessening of pressure when a fluid or gas passes through a narrowing in a tube, causing its acceleration. A direct consequence of the Bernoulli principle.

verbal/cognitive stage. The earliest stage of motor learning in which skills are novel and the learner is inexperienced and movements are inefficient. There are frequent errors and increased feedback is used. Most noticeable gains happen in this stage.

vertical phase difference. The difference in the timing of opening and closing of the vocal folds’ vertical contact. It is caused by a thicker vocal fold whose contact area opens and closes at its lower margins ahead of the opening and closing of its upper margins.

vestibular system. The sensorimotor system responsible for maintaining balance and bodily orientation relative to gravity. With its sensory organ or apparatus of the inner ear, the vestibular system is responsible for encoding information about equilibrium, the sense of balance. It is essential to spatial cognition. Its primary role is to monitor and correct postural and autonomic equilibrium during voluntary behaviors such as singing, and to contribute to the calculation of

the spatial coordinates that position our effectors to make the right action (e.g., sounds) at the right time. See Equilibrium.

vibrato. Periodic oscillations of one or more voice characteristics during phonation. Frequency, intensity, timbre, airflow, and vocal tract resonances can all vary in a regular fashion, and many of these factors can vary in or out of phase with each other. The most obvious oscillation in singing is the frequency vibrato, which is a periodic oscillation above and below the mean frequency. The three main acoustic metrics of vibrato are rate (how many oscillations per second, measured in Hertz), extent (how far from the mean value does the frequency change, measured in cents or %), and jitter percentage (how regular are the periods of the vibrato cycle). Typical norms are a rate of 5-7 Hertz and an extent of plus or minus 50 cents.

vibrator. That part of an instrument which turns the energy input into oscillation. In singing, the vocal folds serve as the vibrator. See also actuator and resonator.

vibrotactile sensation. Subjective response to bodily vibrations. See pallesthesia.

viscera. Internal organs in the main cavity of the body, specifically the abdomen. The abdominal viscera are displaced downward by the contraction of the diaphragm.

viscosity. The measure of fluid resistance to flow.

vital capacity. The total amount of the air that can be moved in and out of the lungs during maximal respiration; distinguished from the residual volume, which cannot be exhaled.

vocal distortion. A voice source signal containing significant aperiodicity (noise), such as grit, growl, scream, and fry; used in some CCM styles.

vocal efficiency. A measure of the ability of the larynx to convert aerodynamic power to acoustic power.

vocal folds. A multilayered structure consisting of an epithelium, connective tissue known as the lamina propria, and thyroarytenoid muscle that projects medially from the interior of the thyroid cartilage. The edges of these structures vibrate in the airstream to produce voice and provide a valve to protect the larynx and increase interthoracic pressure.

vocal fry. See fry.

vocalis. A small muscle that is the medial part of the thyroarytenoid that originates in the lamina of the thyroid cartilage, inserts in the vocal process of the arytenoid cartilage, and modulates the tension of the vocal folds.

vocal tract filter. The tube resonator comprised of the vocal tract from the glottis to the lips. This resonator “filters” the harmonics passing through it, strengthening some and weakening others to create the vowels and timbre of the sound radiated from the lips.

vocal tract resonances. Peak frequency responses of the vocal tract to sound input.

voce aperta. Italian term for open timbre. *Voce aperta* refers to any sung sounds in which two or more harmonics are at or below the first resonance—in other words, the timbre of any pitches sung an octave or more below the first resonance. This term has also been used historically to describe an overall divergent resonator shape characterized by open timbre, in which vowels may migrate towards a yell-like quality, which are more typical of belting and various world music singing styles.

voce chiusa. Italian term for close timbre. *Voce chiusa* refers to any sung sounds in which the second harmonic is above the first resonance—in other words, the timbre of any pitches within an octave below the first resonance. This term has also been used historically to describe an overall convergent resonator shape that results in the *chiaroscuro* timbre of Western classical singing, in which vowels close an octave below an *unraised* first formant, in contrast to a predominantly divergent, open timbre resonator adjustment.

voce finta. Italian for feigned voice, a sound in the nontreble voice that is less robust, often thought to be insufficiently energized.

voce mista. Italian for mixed voice.

voce di petto. Italian for chest voice; a thicker vocal fold vibrational mode involving both the cover and the body of the folds, including the underlying thyroarytenoid muscles in the oscillation, and in which the spectral slope is shallow with more high, strong spectral content and a buzzy timbral percept (more auditory roughness).

voce piena. Italian for full voice, or a voice with a complete, robust timbre (spectral content).

voce di testa. Italian for head voice; a thinner vocal fold vibrational mode in which the spectral slope is steep and the timbre is dominated by the fundamental frequency and a smoother timbral percept (little to no auditory roughness/buzz).

voiced. Sounds involving phonation.

voice range profile (VRP). A measure of the absolute range of phonatory capacity for sound pressure level and frequency. Capacity range is expressed in a graphic display wherein frequency is represented on the x-axis and sound pressure level is represented on the y-axis. For the normal human voice, the plot typically takes the form of a football as dynamic range tends to become narrower at the extremes of frequency range. Also known as the phonetogram.

voice source. The sound signal produced at the vibrator (vocal folds), resulting from how oscillation of the vocal folds modulates the tracheal airflow into a sound pressure waveform.

voluntary behaviors. Controlled actions that are generated from within, independent of external influences and distinguishable from automatic stimulus response mechanisms. They are the

intentional expression of our thoughts and feelings. More specifically, voluntary motor plans of action are tailored to meet a specific goal at a specific moment.

vowel. A speech sound in which the oral and pharyngeal cavities are not constricted enough to cause audible friction. Tone color categories used in speech, primarily created by the tone colors of the harmonics being featured by the first two resonances of the vocal tract and radiated as the first two formants. Vowel intelligibility is reduced at high fundamental frequencies because harmonics of the source, being widely spaced, do not adequately populate and energize the first two vocal tract resonances.

vowel formants. The lowest formants of the radiated spectrum, generated by the resonances of the vocal tract that are lowest in frequency. Some authors cite only the first two formants as vowel formants, while others, such as Ladefoged, mention the first three. The lowest resonances are the most tunable, and therefore the most significant in defining the vowel quality of a sound. Their resultant formants together are called the vowel formants.

vowel modification. Changing the articulation (shape) of a vowel (often higher in the pitch range) for optimized acoustic and physiologic function. As pitch ascends, its harmonic set rises, causing its changing frequencies to migrate through their inherent spectral tone color gradients; furthermore, as source harmonics move into and through vocal tract resonance peaks, their intensity rises and falls, changing their individual contribution to the overall, composite tone color and vowel percept. This is especially evident when harmonics rise into and through the first resonance (F_1). Usually refers to intentional changes of vocal tract shape.

vowel migration. Another term for passive vowel modification; the gradual timbral change a vowel undergoes when vocal tract shape is maintained while pitch is changed; due to the changing relationships between stable resonances and changing harmonics, especially evident when harmonics pass through the first resonance.

VRP. Voice range profile.

W

whoop timbre. A term popularized by pedagogue Ken Bozeman describing the timbre of a treble voice singer using an acoustic strategy where the first resonance of the sung vowel is tracking the pitch being sung. Acoustically, its radiated spectrum has a dominant fundamental (first harmonic). It tends to be accompanied by mode two laryngeal registration (head voice). Its full, 'round' quality is characteristic of the Western classical operatic treble voice upper range, but the timbre can be also heard in mammalian howling, and as a celebratory alternative to yelling. Also called "hoot" by voice researcher Donald Miller.

wobble. Excessive vibrato, usually in reference to a slower rate and wider excursion, in which the undulation of pitch is very apparent.

working memory. Involves the temporary, ad hoc activation of an extensive network of perceptual and motor memory, the capacity to hold information in our mind for as long as we use

it. It is essential to sequencing thoughts and behaviors for speech and singing. In short, it is how we work out the telling of a story in anticipation of the execution of a behavior

Y

yell. A voice quality featuring an acoustic coupling of the first resonance with the second harmonic ($f_{R1}:2f_o$) that has been carried higher than normal through tube shortening and narrowing and mouth widening ($f_{R1}:2f_o$ tracking), chiefly on open vowels; bright in timbre and often described in the Western Classical tradition as being ‘spread’ in quality.

yoga. A modality that is focused on finding mind–body balance through exercises that include a series of poses and breath work.

Z

zona di passaggio. Italian term for the transition zone, a range segment of about a fourth or fifth in nontreble voice singers, during which it is thought that the laryngeal registration should shift from a TA-dominant mode one to a lighter mode one with greater CT participation. In treble voice registration this transition area is longer and is subdivided into a lower middle and upper middle, during which the voice transitions into ligamentous, CT-dominant vibrational mode two.

zygomatic muscles. The zygomatic major and minor muscles originate on the zygomatic bone and extend across the cheek to the mouth. Zygomatic major extends to the angle of the mouth, while the zygomatic minor extends to the upper lip. These muscles are part of the buccolabial group of muscles which are predominantly involved in facial expression.