Shaken, Not Stirred: Practical Ideas for Addressing Vibrato and Nonvibrato Singing in the Studio and the Choral Rehearsal

John Nix

FEW TOPICS IN VOICE PEDAGOGY provoke stronger debates between singing voice teachers and choral ensemble directors than the health and aesthetics of singing with and without vibrato. In order to foster a better understanding of voice production in both modes of performance, a short summary of scientific research regarding vibrato and nonvibrato singing is provided below, followed by a review of recent articles on vibrato in the Journal of Singing. Then, drawing upon this knowledge base, the author has developed several types of technical exercises and corrective techniques that may be helpful to singing teachers and choral directors.

INFORMATION ON VIBRATO

What Is Vibrato?
Vibrato is a periodic oscillation of the fundamental frequency (perceived as pitch) and all its harmonics, amplitude (perceived as apparent intensity or volume), timbre (a result of harmonics sweeping through vowel formants), subglottic pressure, closed quotient (the percentage of each vibration cycle the vocal folds are in contact), and formant frequencies.

Vibrato Rate Versus Vibrato Extent
When describing how vibrato may be adjusted for performing different musical styles, the terms vibrato rate and vibrato extent are often used. Vibrato rate typically refers to the number of pitch oscillations that occur each second, and the unit of measurement is Hertz. Typical values for vibrato rate are from 4.5–6.5 Hertz. Vibrato extent refers to how far above and below the central pitch the voice’s frequency is displaced in each cycle. Extent is measured either as a percentage figure or in cents, with 3% or 100 cents making up a half step. Typical values of vibrato extent are around 100 cents (50 cents, or a quarter tone, above and below the mean frequency).

Understanding Wobble and Flutter
Three terms that are often used to discuss less than desirable vibrati are wobble, bleat, and flutter. Wobble is usually a vibrato with a wider extent and...
a slower than desirable vibrato rate (2–4 Hz), while bleat or flutter is a vibrato that has a narrower extent and a faster than desired rate (up to 8 Hz). At times, the frequency oscillations (i.e., the pitch vibrato rate) and the intensity oscillations (the intensity vibrato rate) may not be in synchrony with each other—that is to say, the pitch and loudness do not increase and decrease at the same time. In fact, when attempting to modify vowels so that a vowel formant exactly coincides with the sung pitch, intensity may increase and decrease at up to double the rate of the pitch swings as the fundamental and its harmonics sweep toward and away from the formant frequency (where vocal intensity would be at its highest) twice in each pitch vibrato cycle. This type of out of phase variation might also be perceived as a flutter.

How Vibrato Is Produced

Sundberg identifies two kinds of vibrato production, one associated with the action of the cricothyroid muscle, and the other caused by undulations of subglottic pressure. Shipp, Doherty, and Haglund concur with Sundberg, and provide more details.

Vibrato can be separated into two principal classes of production. The first relies upon rhythmic pulsations in subglottal air pressure produced by contractions of the abdominal muscles to modulate the fundamental frequency . . . For this type of vibrato, it appears that intrinsic laryngeal muscles maintain a steady contraction against which abdominally induced subglottal air pressure pulses act. The second vibrato type, and probably more common, is laryngeally mediated vibrato in which F0 [fundamental frequency] modulation results principally by modulation of CT activity. The muscle oscillations manifest themselves when structural aspects of the vocal folds, in concert with the breath mechanism, are appropriately balanced and the neuromuscular system is mature enough to produce regular contractions of select muscles . . . Abdominally mediated vibrato is under voluntary control, whereas, according to the second assumption, laryngeally mediated vibrato emerges at its own rate when conditions permit.

Titze, Story, Smith, and Long introduce other aspects to consider, including reflexes and physiologic tremors.

A reflex mechanism with a long latency (greater than 40 milliseconds) is implicated as a plausible cause of vocal vibrato. At least one pair of agonist-antagonist muscles that can change vocal-fold length is needed, such as the cricothyroid muscle paired with the thyroarytenoid muscle, or the cricothyroid muscle paired with the lateral cricoarytenoid muscle or a strap muscle . . . It is shown that singers appear to increase the gain in the reflex loop to cultivate the vibrato, which grows out of a spectrum of 0–15 Hz physiologic tremors in raw form.

The Vocal Tract and Vibrato

According to videendoscopy, other parts of the vocal mechanism often show oscillations in sync with the vibrato, including: (1) laryngeal depressor muscles, such as the sternothyroid and sternohyoid muscles; (2) the lateral pharyngeal wall; (3) the velum or soft palate; (4) the base of the tongue; (5) and the epiglottis. These oscillations may be useful for some singers in avoiding tightness or rigidity of the vocal tract adjustment.

Vibrato, Nonvibrato, Air Flow, and Adduction

In an aerodynamic study of vibrato and nonvibrato pairs of tones, Iwata and Large find that air flow fluctuations occur in sync with the amplitude (i.e., intensity) vibrato, and that air flow rates are approximately 10% higher for vibrato tones than for nonvibrato tones. Iwata and Large explain the reduction in air flow in nonvibrato singing as a result of increased glottal resistance from the muscle activity needed to withhold the vibrato. Gauffin and Sundberg, reviewing Iwata and Large’s work, feel this suggests that vibrato singing involves less glottal adduction than nonvibrato singing. In addition, when sopranos are singing with vibrato in “head” register (approx. E5–B5), there seem to be strong interactions between the pitch being sung, the first formant of the vowel, and air flow rates. As the fundamental (F0) swings closer to the first formant (F1), air flow rates go down; as F0 swings away from the F1, higher air flow occurs.

The Effect of Training on Vibrato

Empirical evidence from the studio indicates that training can have a substantial impact on vibrato. As breath management, postural balance, vowel consistency, and laryngeal coordination improve, vibrato tends to become more regular. Some studies have confirmed this. Murbe et al. found three years of training increased rates of those with slower vibrato (<5.2 Hz), decreased rates of those with faster vibrato (>5.8 Hz), and reduced the standard deviation of those with irregular vibrato rates. Mitchell and Kenny confirmed the reduction in vibrato
rate standard deviation over several semesters of study, and found an increase in vibrato extent through training. However, Mendes et al. did not see any changes in vibrato over four semesters of training.

Who Provides Instruction in Vibrato and Nonvibrato

Nix surveyed 350 singers who participate in college, community, and professional choirs, and/or are active as voice teachers, speech pathologists, and choir directors. Responses were received from 8 countries—Australia, Canada, Germany, Mexico, Norway, Sweden, UK, and US; 90.5% of responses were from the US. The results showed that if a singer had received explicit instruction in vibrato (23.1% said yes, 59.4% said no, their teachers only indirectly mentioned it; 17.4% said no, vibrato never was mentioned), it was primarily from a voice teacher (70.4% from a voice teacher, 2.5% from a choral director, 27.2% both). On the contrary, if a singer received explicit instruction in nonvibrato singing (22.3% said yes; 62% said no, only indirectly; 15.7% said no, never mentioned), it was primarily from a choral director (19.5% from a voice teacher, 53.2% from a choral director, and 27.3% from both).

Aging and Vibrato

According to three different studies cited by Titze, age has a definite effect upon vibrato. Hirano measured 21 singers from ages 20–65, and vibrato rates dropped from 5.4 Hz in the youngest to 4.7 Hz in the oldest. Titze cites similar findings of an approximately 1 Hz reduction in the vibrato rate over half a lifetime in the research of Damsté and Sundberg, who examined recordings of professional singers singing the same pieces multiple times over their careers. Among the reasons mentioned are reduced nerve conduction velocities with age, increased muscle activation and contraction times, and possible poor muscle tone/conditioning, which can be addressed through training.

Matching Vibratos

Not many studies have been done on the topic of singers matching the vibrato of another singer. King and Horii (testing nine singers) found that vibrato rate was easier to match than faster ones, while Dromney, Carter, and Hopkin found that SPL decreased when eight female subjects matched a slower rate and increased in head register when matching a faster rate. The study’s authors suggest that subjects may have adjusted breath pressure in order to adjust rate.

The “Straight” Tone

Slight fluctuations in pitch, intensity, or other vocal characteristics occur in all singing. Even one’s heart rate can leave a small trace on a vocal signal. Titze and colleagues state that when a singer sings “nonvibrato,” he or she does so not by reducing the vibrato rate but by reducing the extent. Titze also notes that at the extremes of the singing voice, vibrato tends to diminish. At very low pitches thyroarytenoid muscle activity is high, and at very high pitches cricothyroid muscle activity is very high; simultaneously, the action of the respective antagonist muscle at each extreme point is very low. Titze feels this dominance of one vocal fold length changing muscle over another damps out the extent of the frequency swings, resulting in what is perceived as a more “straight” tone.

RECENT ARTICLES ON VIBRATO IN JOURNAL OF SINGING

Strempel’s “The Shifting Aesthetics of Vibrato” provides good advice for performers who wish to give successful and authentic renderings of works with respect to vibrato. She urges singers to consider the time period of the work’s composition and to research whether the work was composed for the operatic stage, the church, or a chamber room. Another very important consideration she mentions is the reverberation time of the current performance space. As a note, the reverberation time is defined as the time it takes for a terminated sound to diminish 60 dB in amplitude.

Kirkpatrick’s article, “Teaching Methods for Correcting Problematic Vibratos: Using Sustained Dynamic Exercises to Discover and Foster Healthy Vibratos,” presents a number of ideas that need further clarification. Early in the article, he mentions Mason and Zemlin’s finding that vibrato is “caused by the cricothyroid muscle.” Research already mentioned in this article that has been undertaken since the time of Mason and
Zemlin (and Vennard, the source cited by Kirkpatrick) demonstrates that while the cricothyroid muscle plays a prominent role in vibrato, other factors, including subglottic air pressure, reflexes, auditory feedback, and physiologic tremors, are also involved. Kirkpatrick includes two figures (p. 553) that are purported to show the relationship between transglottal airflow, subglottic pressure, and vibrato. While this author agrees that an appropriate flow-to-pressure ratio does seem to provide the ideal conditions for a regular vibrato to emerge, he is not aware of any scientific data (other than the previously cited Iwata and Large study) linking airflow, subglottic pressure, and vibrato rate or extent. No citation is provided for either figure, nor is a citation present in the accompanying text. Lacking evidence from a controlled study, the conclusions drawn are speculative at best. More concerning still is the suggestion to lift something heavy during Kirkpatrick’s Exercise 1 (p. 554). This author hopes that the teaching of singing has progressed beyond lifting something heavy (or pushing on the piano) to encourage adduction and greater muscle activation in the torso. Finally, the role of appropriate vowel modification for the required pitch and dynamic level is never mentioned in the discussion of causes and corrections for “the wobble” and “the bleat” (p. 555).

In the same issue, Olson’s “Vibrato vs. Nonvibrato: The Solo Singer in the Collegiate Choral Ensemble” offers a wide variety of opinions on vibrato and nonvibrato singing in ensembles. She balances her choice of experts whom she quotes on the subject among choral conductors, voice pedagogues, and voice scientists. Most importantly, she offers some practical advice for younger singers and choral directors who wish to give healthy and stylistic choral performances.

Isherwood’s “Vocal Vibrato: New Directions” presents a lengthy description of the many kinds of vibrato required by modern composers. The author’s personal experience working as a performer with (among others) Carter, Crumb, Henze, Messiaen, Xenakis, and Stockhausen gives him a great deal of authority on the practical mechanics of producing extended vocal techniques. However, his article has a number of shortcomings. First, he uses the term amplitude to describe the pitch excursion found in vibrato. This pitch excursion is called vibrato extent in the research literature, and it is measured not in Hertz, but rather in cents (100 cents per semitone) or as a percentage. He also uses the term vibrato rhythm in place of the widely used descriptor vibrato rate. These two terminology issues make his discussion somewhat confusing to the reader. The article also contains fourteen figures that are neither labeled clearly nor described thoroughly in the text. This author, who is well versed in voice analysis, had a difficult time understanding a number of the displays in the figures. Additionally, four kinds of vibrato (gentle glottal vibrato, hard glottal vibrato, goat vibrato, horse vibrato) are said to be produced primarily by the epiglottis. There is not a citation of any study supporting this unusual movement of the epiglottis. Confirmation of this claim with videendoscopy would be a welcome addition to the article.

The most recent vibrato article in this periodical, Carter, Hopkin, and Dromney’s “Volitional Control of Vibrato in Trained Singers,” builds upon the work reported by the same authors in 2003 in the Journal of Voice (and previously cited in this article in notes 19–20). A particularly significant outcome of this study is the finding that singers do have some quantifiable volitional control over their vibrato production. These objective findings were also paired with subjective observations of the study’s participants.

**PRACTICAL EXERCISES TO ADDRESS DIFFICULTIES WITH VIBRATO**

The exercises provided below have been designed with the previously mentioned research in mind. They are this author’s response to the challenge of teaching students whose choral obligations and musical style choices require vibrato and/or nonvibrato. Please note that no vowels are indicated; the author leaves the choice of vowels and consonants up to each teacher or singer, depending upon his or her needs. These exercises are not intended to be an explicit means to teach or create vibrato or nonvibrato in a singer; rather, they should be used to build the technique of the singer so that a flexible, spontaneous, artistically appropriate vocal production emerges, where vibrato or nonvibrato singing are possible, depending on the singer’s needs or desires. It is the author’s hope that these exercises and suggestions will add to the growing body of science-based pedagogic practices.
Exercises that Work on the Interplay between the Thyroarytenoid and the Cricothyroid Muscles

1. Alternating between agility passages (i.e., rapid wide pitch changes) and sustained tones. The pedagogic goal for these exercises is to employ the same quick and easy pitch swing and air flow found in the agility portions on the sustained tones (Example 1).

2. Alternating between florid passages (rapid narrow pitch changes) and sustained tones. The goal is to allow the freedom of the fast moving notes to continue on the sustained notes (Example 2).

3. Alternating between arpeggiated passages and sustained tones. The intent is to encourage the vocal movement of the sweeping *arpeggi* to be continued throughout the sustained tones (Example 3).

Exercises that Work on the Interplay between the Thyroarytenoid and the Cricothyroid, in Combination with Adduction/Abduction

1. Alternating between bounced patterns and sustained tones. These exercises combine a quick and light pitch change, abduction, then adduction on a sustained tone. The goal is that the easy production and buoyant *appoggio* of the bounced notes transfers to the sustained tones (Example 4).

2. Alternating between agility staccato passages and sustained tones. Exercises like this combine abductor/adductor coordination and rapid, disjunct pitch changes with sustained tones. The teaching goal is that the flexible, light, intrinsic balance fostered by the rapid staccato continues during the sustained tones (Example 5).
Alternating between florid passages, staccato, and sustained notes. These exercises combine abductor/adductor coordination and rapid, conjunct pitch changes with sustained tones (Example 6).

**Exercises that Promote Freedom within the Vocal Tract, the Use of a Lighter Production, and Efficient Phonation**

1. Using semioccluded vocal tract postures as pilots into a vowel. These postures are the basis for all “resonant voice” work. For example:
   - Berton Coffin’s “standing wave” exercise, where the singer forms a vowel, covers his or her open mouth with one hand, then sings the chosen vowel into the hand. This can also be used as a pilot into (open mouthed) vocalises or phrases. According to Doscher, Coffin found evidence that the “standing wave” helped release the constrictor muscles of the lower pharynx. By releasing extraneous tension, the singer’s production (including vibrato or nonvibrato) is improved.
   - The raspberry, which can also be used as a pilot into sustained vowels, vocalises, or phrases from the repertoire. The raspberry’s tongue extension provides an easy stretch for the complex of muscles making up the tongue, while it simultaneously encourages an appropriately energized air stream. Tongue tension issues may be associated with vibrato and nonvibrato difficulties.
   - The lip buzz. The lip buzz is an excellent tool for promoting palate elevation, jaw/lip freedom, and achieving a good balance between air flow and breath pressure. As with the standing wave and the raspberry, it is beneficial as a pilot into other singing, and as was previously mentioned, by improving the vocal production in the general sense, the lip buzz can be beneficial to specific aspects of production, such vibrato and nonvibrato.
   - Singing a vowel into a straw. The rapid shutoff of air flow in each vocal fold vibratory cycle provided by this and all the other semioccluded postures can give a singer more acoustic output with less respiratory effort, thus increasing vocal efficiency and, one hopes, providing optimal conditions for vibrato and nonvibrato singing.

**Facilitation Suggestions**

Several common facilitation techniques can be employed to quicken student progress with these exercises. For example, all of these types of exercises can be combined with flowing movements; coupling continuous body motion with singing may help establish the concept of continuous vocal movement during sustained notes. Exercises can also be combined with tactile stimuli, such as sweeping a hand smoothly and steadily along the top of the piano or along a wall. Engaging the tactile sense along with singing can assist a singer in making the physical connection between moving patterns and sustained tones. Exercises can also be combined with real-time visual feedback. Visual feedback enables a singer to tap into still another sense during practice; he or she can see the results as well as hear and feel them. Software such as VoceVista can also be used to track progress, as the program allows the singer or teacher to easily measure vibrato rate and extent.

**Singing Styles Without Vibrato**

For early music, jazz, some music theater, rock, and barbershop, where singing without vibrato may be required, the following exercises may be helpful:

1. Easy slides up and down intervals of a 4th or 5th.
2. Slides into a sustained nonvibrato note.
3. Alternating vibrato and nonvibrato singing on a single tone. The pedagogic key is to ensure that the air stream is steady throughout, and that the sensations of freedom in the vibrato singing continue in the nonvibrato segments.
4. In belt, where long notes may be begun without vibrato, then the vibrato is allowed to start toward the end of the notes, it is beneficial to encourage students to think of the long note as a “sustained” note, not a “held” note. The language a singer uses to think is directly related to how he or she will try to do things!

**VIBRATO PROBLEM-SOLVING SUGGESTIONS**

Most teachers have a general pedagogic checklist to consult when working with a student with vocal problems. Vibrato issues should be no exception. With that in mind, check the singer’s body alignment. Is
the vibrato only a symptom of a larger postural issue? Second, assess the student’s breathing. Is the vibrato issue a symptom of an uneven air stream? Is the breath pressure too high or unsteady? Third, observe the singer’s extrinsic musculature. Is the vibrato issue a symptom of an overly elevated or depressed larynx? Is there tongue or jaw tension that is manifesting itself through irregularities in the vibrato?

If a student sings without vibrato on the note immediately prior to an upward leap, try reversing the pattern of the exercise or phrase. Often altering the pattern can make the student aware of the issue. Tactile work or visual feedback can be very effective in cases like this as well. Another strategy is to have the student sing a cappella, rather than with the piano.

Sometimes students have good and bad vowels as far as vibrato is concerned. Perhaps the rate is too fast and the extent is too narrow on front vowels, or the rate is too slow and the extent too wide on back vowels. One first step is to ensure appropriate vowel modification and air flow are being used. Often when the rate goes up and the extent narrows on front vowels, the vowel is slightly too closed for the pitch being sung and the breath pressure is too high; when the rate slows and the extent widens for back vowels, often the vowel is slightly too open for the pitch. Adjusting the vowel and encouraging appropriate air flow can help correct matters. Another intervention is to pair a “good” vowel (where the vibrato is regular and does not draw attention to itself) with a “bad” vowel, where the vibrato is irregular or too slow or too fast or too narrow or too wide. The goal is to transfer the good production from the “good” vowel to the one needing help.

**CONCLUSIONS**

Many unanswered research questions remain regarding vibrato and nonvibrato singing. The author believes that singing teachers and choral directors need to accept mutual responsibility for providing the students in their care with accurate, science-based, user friendly information about vibrato and nonvibrato voice production. As colleagues, both groups should communicate with each other about how best to prepare the singers in their teaching studios and ensembles for the technical, aesthetic, and expressive demands of all genres of music.

**NOTES**

2. Ibid.
3. Ibid.
8. Ibid.
10. Ibid.


20. Ibid.


22. Ibid; Ingo Titze, personal e-mail to the author (January 28, 2008).


26. Ibid., 551.


---

John Nix, tenor, is Associate Professor of Voice and Vocal Pedagogy at the University of Texas at San Antonio, coordinator of the Vocal Area for the 2011–2014 academic years, and founding director of the UTSA Vocal Arts Laboratory. Previously he was on the staff of the National Center for Voice and Speech in Denver, where he worked with Ingo Titze. Mr. Nix has also served on the music faculties of The University of Colorado at Denver and Eastern New Mexico University. He holds degrees in Arts Administration from Florida State University, in Vocal Performance from the University of Georgia and the University of Colorado at Boulder, and Certification in Vocology from the University of Iowa. At Colorado, he studied voice and pedagogy with the late Barbara Doscher and the Alexander Technique with James Brody. His current and former students include a member of the Mormon Tabernacle Choir, two Santa Fe Opera apprentices, members of the Army Soldiers’ Chorus, a second place winner in the National Federation of Music Clubs competition, a two-time finalist in the American Traditions competition, and faculty members at universities in Montana, Texas, Wyoming, and New York. UTSA students of his have gone on to win graduate fellowships to major universities. His work has been funded by The San Antonio Area Foundation, The Grammy Foundation, UT-San Antonio, and two R-13 grants from NIH. Mr. Nix was the 2006 winner of the NATS/Voice Foundation Van Lawrence Award. His published articles have appeared in The NATS Journal, The New York Opera Newsletter, Otolaryngology-Head and Neck Surgery, Journal of Voice, Journal of Singing, International Journal of Research in Choral Singing, VocalEase, Australian Voice, and Opera Journal. Mr. Nix is editor and annotator of From Studio to Stage: Repertoire for the Voice, compiled by Barbara Doscher (Scarecrow, 2002), is Vocal Music section editor for the Oxford Handbook of Music Education (2012), and a general editor and author for The Oxford Handbook of Singing (to be published in 2014).