Vocal fry, also known as pulse register phonation or Strohbass, has been recognized as having a very low fundamental frequency, where each flow pulse damps out nearly completely before the next one commences. As such, vocal fry can be distinguished from so-called "creaky voice," which is found at higher frequencies and is characterized by a perception of roughness and the presence of subharmonics in the glottal waveform. The vocal folds are shorter in length in fry than in modal production and have little significant change in length as frequency increases. Subglottal air pressure and transglottal air flow are lower in fry than in modal production. Lower activity levels in the interarytenoid, posterior cricoarytenoid, and cricothyroid muscles, and greater activity levels in the thyroarytenoid muscle have been observed in fry as compared to modal (chest) voice. Extrinsic to the larynx, greater velar closure and reduced nasality has been observed in vocal fry as compared to modal voice, and constriction of the laryngeal vestibule has been observed in vocal fry.

Pedagogical opinions on vocal fry vary widely. Some authors, such as Ralph Appleman and Meribeth Bunch, make no mention of vocal fry, pulse register, or creaky voice in their books; other authors have commented on fry's existence as a register without making any statements about its utility; still others have advised positively or negatively on its use in singing. William Leyerle wrote in *Vocal Development Through Organic Imagery*: "This register is tight and crackly. It is not generally a usable part of the baritone's range, but is useful for low basses..." He does not go on to state how it might be used or trained. In *Bel Canto: A History of Vocal Pedagogy*, James Stark cites the writings of Johann Agricola and Marin Mersenne on the practice of using vocal fry to extend the low range of baritones and basses. Later, Stark notes that vocal fry is often heard in Russian choral music. His discussion concludes with a brief description of some of the physiologic, aerodynamic, and acoustic properties of fry. Barbara Doscher also takes a descriptive approach in her book, detailing the characteristics of fry without making any recommendations for its use. Doscher was the teacher of one of the authors (Nix), and in his observations of hundreds of lessons she neither used it in the studio nor advised for or against its use.

Cornelius Reid is very outspoken in his rejection of not only vocal fry as a phonatory mode but also the terms used to describe this kind of vocalization.

Pulse register: a term introduced by scientific investigators to refer to vocalized
sounds with extremely low frequencies and pulse-like oscillations; a “vocal fry,” “glottal fry,” “creak,” or Strohbass.

The concept of a “pulse register” is without value to voice culture for the following reasons: 1. It is a designation based upon acoustic rather than physiological data, and there is no distinct mechanical or muscular system responsible for its articulation; 2. The vibratory impulses it describes have no relevance to the “pulse” or vibrato of a legitimate vocal tone; 3. The vibratory impulses it describes are “musical” only in that they possess measureable pitch; they contain no recognizable vowel phoneme and cannot be swelled or diminished; 4. The sounds to which it refers are “freak” tones with no aesthetic value; like squeaks, groans, screams, and squeals, they should be considered forms of affective expression, and not confused with legitimate vocalization, and 5. The sounds to which it refers have no pedagogic value since they could never be incorporated into, or used to influence or improve, the quality of those tones universally accepted as being legitimate.

The term “pulse register” should be abandoned, since a further proliferation of terminology, even when justified on acoustic terms, simply adds confusion to an already confused area of thinking with respect to the number and origin of vocal registers.13

William Vennard, on the other hand, advocated the use of fry as a corrective technique for an overly breathy voice.

This exercise is especially good for breathy pupils. A breathy tone can hardly be initiated by the tension required for the rattle. However, it is an ideal tension which adjusts the glottis without tightening the throat, and as such benefits students who are too tense. The voiceless [sic] rattle may rumble into a tone by adding phonation. This approach is the opposite of that described in Par. 182. The “imaginary h” is more suitable for attacking high notes, where tension is a danger, and the “rattle” is better for low notes, indeed it builds the low part of the range. It is especially beneficial for low voices.14

Vennard went on to say that “The glottal rattle, or fry requires a loose glottis, and is much more difficult to perform on either Ee or Oo than it is while the resonators are forming an Ah.”15

Oren Brown also advocated an exploration of vocal fry, especially for the development of the low range. In Discover Your Voice, the chapter “Range and Registers” includes the following passage:

To find the lowest notes in Register 1, the larynx must rest in a very relaxed, low position and then apply an almost breathy flow of air. It takes more air flow and less pressure to produce low notes than high notes because the vocal folds are looser (that is, they do not come together so often) and the amount of air that escapes at each opening pulse is greater. Any attempt to produce these notes by tensing and pushing down into them prevents the muscles from performing their natural function and shuts off the resonance. For this part of the voice, let the tone slide down and let the air flow do the work.16

Brown goes on to include a 5-4-3-2-1 descending vocalise (Exercise XV in his book) for the exploration of fry,17 and includes audio examples of this type of phonation on the CD that accompanies his book.18 Additionally, Brown employed a fry onset exercise in a lesson with one of the authors (Emerich) in July 2000. Seth Riggs advocates the use of creaky voice exercises in his book Singing for the Stars as a means to finding what he calls Speech-Level Singing. He begins with a single upward-inflected glide in a creaky voice hum (Exercise 14 in the book), then moves on to arpeggiated patterns on a hum with creaky type onsets (Exercises 15–19).19 The number of creaky onsets is gradually reduced as the singer progresses through the course of exercises. Riggs’s book also contains a CD that demonstrates these exercises.20 Riggs’s concepts were successfully employed by Randy Buescher in a single-subject case study recently reported in the Journal of Singing.21

Finally, Richard Miller takes a more cautious view of Strohbass (which he distinguishes from vocal fry) and fry.

Just as an occasional falsetto note is intruded in legitimate upper range for some specific coloration, so an occasional Strohbass tone may be introduced in the lowest range of the voice. . . Strohbass, if used at all, should be used judiciously. Exercises for the development of this register phenomenon should be undertaken only with a teacher, and never for more than a few brief moments . . At times, a moderate use of vocal fry may help a young, low-voiced male develop a “feel” for additional pitches at the lower extension of his range. Vocal fry encourages an imprecise onset and should not be relied on as a standard vocalizing technique.22

Miller includes a 5-3-1-3-5 exercise (Exercise 9.3 in his text)23 for developing the Strohbass quality, with only the lowest note in the pattern being sung in Strohbass.

Vocal fry has been used by one of the authors (Emerich) therapeutically to address the efficiency and function of the glottal sound source and to restore symmetry to the laryngeal mechanism. The therapy employs vocal fry to optimize the glottal closure pattern and to decrease the need for lateral or anterior-posterior compression as a compensatory reaction to incomplete glottal closure or laryngeal asymmetry. Motor learning principles are an essential element of this program. The therapy works first at the syllable level, then progresses to word, functional phrase, and conversational voice levels. It also incorporates pitch glides as stretching exercises to reinforce the concept of
efficient glottal closure and to address cricothyroid muscle weakness and vocal fold stiffness and/or scarring. The efficacy of therapy with vocal fry is currently being clinically tested on a population of school teachers as a part of NIH grant RO1 DC04224, "Research Towards Occupational Safety in Vocalization."

The authors have found that the prudent use of a relaxed vocal fry onset gliding into selected singing exercises is useful in both the therapeutic setting and the voice teaching studio. The benefits may include: 1) optimizing posturing of the vocal folds for increased efficiency of voicing; 2) improving ease/spontaneity of onset of voicing; 3) decreasing compensatory muscle behaviors associated with laryngeal weakness; and 4) shaping the glottal configuration and the epilarynx to optimize voice output. One possible explanation for why fry works in improving spontaneity and decreasing compensatory behaviors that it is an "unused register," to borrow Vennard's term, and as such, the singer does not have any habits (good or bad) associated with it. The freedom found through using fry can be transferred to other more familiar modes of phonation. As Donald Miller of the Groningen (Netherlands) Voice Laboratory recently said in an e-mail:

I have given your ideas on fry some thought. Aside from the idiiosyncratic use that I sometimes employ for guiding formant tuning, I think the clearest benefits have to do with intervening in glottal behavior—as you say, improving glottal efficiency. My guess is that fry helps to isolate glottal adduction from the more general tensions in the whole laryngeal area that get lumped together in phonation. What further helps is that producing "good" fry requires a delicate and healthy balance of intrinsic laryngeal muscles with low subglottal pressure. Thus the idea of using fry in training or rehabilitating singers seems to me a promising one.

The low activity levels observed in fry in the interarytenoid, posterior criocarytenoid, and cricothyroid muscles, and greater activity level observed in the thyroarytenoid muscle may result in a vocal fold configuration that is thicker, with a bulge at the lower surface of the fold, and a more "square" contact, yet lacking in undue longitudinal tension. Titze has shown that such a vocal fold vibration pattern causes the flow of air through the glottis to shut off more quickly in each vibratory cycle, which in turn increases sound intensity. Again, the benefits of this vocal fold configuration are practiced in fry and transferred gradually to other types of phonation. Finally, some of the constriction of the laryngeal vestibule or epilarynx that has been observed in fry phonation may be transferable in a constructive way to sung production. As Titze has also noted, a narrowed epilarynx tube can enhance the efficiency of vocal fold output by also causing the glottal flow to rapidly decrease. This last point needs further exploration and verification, however; as Donald Miller noted in the e-mail cited above:

I would guess, however, that fry is not related to the sort of aryepiglottic constriction to which we attribute the singer's formant. If there is a voluntary and specific way to produce that constriction directly, I don't know about it. We learn certain general behaviors that reliably (and seemingly involuntarily) produce it as a byproduct, but these are not directed principally at glottal behavior, as fry is. The aryepiglottic constriction is a feature of the general vocal tract configuration, and fry (or intrusive phonation, which has quite different pressure and adduction requirements) is largely independent of the vocal tract.

Among the types of pathologies that may be addressed with this approach are: 1) mild paresis of the recurrent laryngeal nerve, which may cause difficulty with adduction; 2) mild paresis of the superior laryngeal nerve, which may cause compensatory behaviors such as tongue-base depression at the onset of phonation or at an increase in frequency, jaw tension, lateral and anterior-posterior compression of the extrinsic laryngeal musculature, and insufficient respiratory support; and 3) vocal fold injuries, such as a vocal cyst plus a reactive mass on the opposite side, vocal fold stiffness secondary to a vocal fold hemorrhage, or postoperative singers.

As a case history success story, the authors share images of a professional singer with a vocal fold injury who benefited from the use of fry-based therapies and singing exercises. The singer, a forty-one-year-old lyric coloratura soprano, had experienced a severe upper respiratory infection and had coughed heavily for some weeks. A videostrobe exam done by Emerich revealed a posthemorrhagic left vocal fold mass and reactive swelling on the opposite side, coupled with significant compensatory tension in both the anterior-posterior and lateral directions (Figure 1). Therapy was begun (with Emerich) as well as more reg...
ular singing voice lessons (with Nix). Pathologist and singing teacher communicated frequently on the implementation of intervention strategies, which included fry-based exercises as a key component. Figure 2 shows the same singer's strobe exam six weeks posttherapy, with only slight swellings at the striking zone bilaterally and greatly decreased compensation. This second strobe exam was done within forty-eight hours of the singer completing a professional engagement as soprano soloist in a performance of the complete Messiah.

Key points in the application of vocal fry to the training of singers include:

- The target behavior is a loose, relatively slow fry. Oren Brown's description of how to elicit this sound (see above) may be helpful to some vocalists.
- The fry lead-in should be performed on the same vowel with the same vocal tract posture the singer is about to use in a vocalise or a musical phrase (Figures 3 and 4).
- The singer should have the pitch of the target sung tone in mind while doing the fry lead-in.
- The fry onset should not be used for extremely high pitches. Nix's experience in the teaching studio has shown that the upper pitch limit for effective use is approximately D₄ for males and D₅ for females.
- For motor learning purposes, it is best to mix in a random fashion trials with the fry lead-in with trials of the same exercise or phrase without the fry (Figure 3). As the singer becomes more accomplished with the nonfry initiated version, the fry trials should be randomly and gradually reduced in frequency, then totally eliminated altogether. Nix has found that mixing fry onset patterns with staccato or other onset exercises (as described in detail by Miller30) can be very effective, as was previously noted by Buescher.30 Nix also advises for the sake of intrinsic muscle balance that exercises that use the fry onset, which encourages more activation of the thyroarytenoid muscle, be performed in alternation with descending patterns, which encourage the cricothyroid muscle to be more active (Figure 4).
- It is entirely normal for some young singers, especially females under the age of twenty-two, to have some breathiness in their sound; this developmental stage usually resolves itself with time and training. The authors are not recommending a heavy diet of fry onset exercises to force a young voice to be less breathy.
- Singers should pay close attention to the sensation of the fry assisted onset, then recall that sensation of relaxed yet laryngeally competent adduction in order to transfer the new habits to phonation without using the fry. The fry is a training tool, not a crutch for the singer to be dependent upon.
- When using a spectrographic display program for visual feedback in practicing/teaching, the fry onset may be useful as a nonhar-
Figure 5A. VoceVista power spectrum (right), spectrogram (lower left) and audio envelope of one of the authors (Nix) using vocal fry on the vowel /e/, then gliding into singing /e/ on D3 (147 Hz). This image shows the power spectrum during the vocal fry portion. Note the peaks for F1 at approximately 550 Hz and F2 at approximately 1450 Hz as revealed in vocal fry.

Figure 5B. This image shows the power spectrum during the sung portion. Note that in the sung segment H3 is in close proximity to F1 and H10 is in proximity to F2, as shown in image 5A.

monic sound source for determining the approximate location of vowel formants for a given vocal tract shape; as the singer transitions into singing from vocal fry, it can easily be determined whether or not a harmonic is in close proximity to the formants that were seen in the vocal fry spectrum (Figure 5).

In summary, the authors believe that fry is another means to achieve a free, healthy production that can be applied to artistic singing. A careful, judicious use of fry as a tool is not harmful, in our opinion. As with other pedagogical tools (such as movement work, humming, lip trills, chanting, using voice analysis technology, etc.), fry is not a panacea for solving every vocal problem, it should not be used in excess, and it should be explored with the guidance of a knowledgeable teacher first.

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NOTES


23. Ibid., 126.


25. Donald Miller, personal e-mail correspondence, November 15, 2004.


27. Ibid.


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**John Nix, Kate Emerich, and Ingo R. Titze**

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11. Ibid., 89.

12. Doscher.


15. Ibid., 124.


17. Ibid., 270-271.


23. Ibid., 126.


25. Donald Miller, personal e-mail correspondence, November 15, 2004.


27. Ibid.


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Richard Miller, Training Soprano Voices, 117.

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