

# On Singing Straws and Water Bottles: The Physics of Pressure

Studio note by Pat Wilson

A while ago I discovered two articles in the *Journal of Singing* (Finnegan et. al., 2002; Titze, 2002) which related to the use of straws of varying diameters as a means of enhancing a singer's awareness of the need for increased pressure in the vocal tract, especially when approaching higher pitches. Dr Titze and his associates asked singers to phonate into straws of many kinds, varying from small-diameter stirring straws and thick-shake drinking straws, up to wider-bore clear plastic 'resonance' tubes (not commercially available). The investigation considered the amount of flow-resistance offered by straws of different diameters, addressed the question of whether subjects raised their subglottal pressure when using these straws, especially in higher-pitched singing, and asked in what ways the amplitude of vibration and the vocal fold contact may change, as inferred by electroglottography (EGG).

Their idea was to use the straw to extend and narrow the length of the vocal tract, with a view to heightening supraglottal pressure and using it as a way of strengthening higher-pitched sound with lessened localised stress on the vocal folds.

Among their results was the fascinating discovery that higher lip resistance (i.e., the occlusion of the vocal tract by means of a narrowing straw) produced higher flows for a subject at high pitches. They hypothesised, 'Apparently the back-pressure produced on the vocal folds from the oral pressure helped spread the vocal folds apart to lower the glottal resistance, a therapeutic target of the exercise. We surmise that the subject had stiff vocal folds (high glottal impedance) that were benefitted by a resistive vocal tract load that matched this high glottal resistance' (Finnegan, 2002, p. 333). As part of their conclusions, they stated that '... the larger collision forces and pressed voice are not likely to occur with this exercise. On the contrary, the exercise seems to spread the vocal folds and promote small-amplitude vibration of the vocal folds. At the same time, the respiratory muscles seem to be exercised maximally and the vocal folds can be stretched maximally for high pitches during vocal warm-up' (Finnegan et al., 2002).

As I thought about the papers that Titze and his colleagues had put together with such meticulousness, I wondered about the degree of resistance offered by those narrowing straws. I made a small intuitive leap from phonating into my very ordinary plastic drinking straw to placing the straw in my (also very ordinary) 600ml sized plastic water bottle, which was less than half full of water. I sang on the

vowel /u/ into the straw, ensuring that there was a steady stream of bubbles through the water. My idea was that when we phonate, it is into a fluid (air). If we phonate into water, a fluid which, although denser than air, has similar properties of compressibility and resistance, then the benefits of the exercise could be amplified. The higher degree of resistance which water offers the phonatory airstream could be of service to the singer.

Having tried this myself, I then experimented with many of my students. Here are some of my anecdotal findings. As soon as a student approached the upper *passagio* and began to evidence residual constriction in their sound, I asked them to sing the exercise pattern they had been doing into the straw and water bottle, using the vowel /u/, and then immediately after that to breathe and repeat the exercise, this time singing it as usual. The invariable response from students has been a vivid recognition of their abdominal support musculature, an immediate freeing of their previously constricted pitches, and a comment along the lines of how much easier it had made their task. I have noticed a consistent freeing of the tone, together with a greater ease and confidence in managing higher supraglottal pressures. As a result of these responses, I have suggested to students that, when exercising into their upper *passagio* and beyond, they use the straw and water bottle to assist them extending their upper range safely and gently.

I wondered whether this idea would work as well if the straw is placed in a tall glass with a little water in it. My students and I tried it, and we decided that it was not nearly as effective as the plastic drink bottle. This may be because of the inherent pressure maintenance offered by the narrowing of the neck of the bottle.

In summary, this small extension of the research begun by Dr Titze and his colleagues seems to assist singers in reducing the body's natural tendency to use the vocal folds as a sort of valve to control breath flow. This allows the vocal folds to assume the thinner configuration which is more appropriate to higher pitches, thereby allowing the singer to locate that lighter registration necessary for higher and/or softer tones. My experiments with the singing straw and water bottle suggest that this method offers students both a physics advantage and useful sensory feedback, while automatically removing much of the pharyngeal restriction which so frequently dogs student singers at upper *passagio* level and beyond.

## References

- Finnegan, E.M., Jaiswal, S., Laukkanen, A.-M., & Titze, I.R. (2002). Raising lung pressure and pitch in vocal warm-ups: The use of flow-resistant straws. *Journal of Singing*, 58(4), 329–338.
- Titze, I.R. (2002). How to use the flow-resistant straws. *Journal of Singing*, 58(5), 429–430.

## Endnote

Colleague Beverley Peart, a widely respected Adelaide singing teacher, kindly sent this note to me shortly after we had discussed the ‘singing-straw-and-water-bottle’ idea last September.

There is a difference in pressure in sounding through straws and blowing bubbles into water. The water adds another dimension, which I think gives a closer feel to what we are looking for in

‘supporting’ the sound. I have found an interesting intermediate step if one loses touch between blowing into the water and singing. Try rapid right/left oscillation of the tongue tip between the lips while maintaining constant breath pressure and phonation [i.e., bubbles : tongue oscillation : sing] without drawing new breath. I’ve had great success with this in the last few days with those who push through the throat and/or lead with the chin. It has also helped those who are still trying to connect with the balance between power in body involvement and perceived effortless involvement in phonation. Often it seems students start pushing through the throat when they try to get more power in the body and conversely lose the ‘support’ when they back off the constriction in the throat.