Breathing imagery moderates vibrato rate

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This study investigated acoustic change in singers’ vibrato following imagery and non-imagery tasks. One task, involving breathing imagery, produced significantly more moderate and regular vibrato rates. Another task, involving imagery unrelated to breath function, produced erratic but significantly slower vibrato rates. A non-imagery task related to breath function produced no significant changes. Sound pressure level results indicated that dynamic changes were not responsible for the changes observed in vibrato. The findings of this study indicate that breathing imagery regulates singers’ vibrato in a manner consistent with that of a more proficient, warmed-up voice.

Keywords: breathing; imagery; vibrato; warm-up; tone quality

Imagery in which the breath or an abstract concept of energy is directed high into the head or deep into the body has played an important role in voice teaching since at least the sixteenth century (Stark 1999). Similar imagery is used by instrumentalists and dancers, and is also found in Middendorf technique, Qigong, meditation, and traditional Chinese healing (Moorcroft 2007). It is claimed to assist with spinal alignment (Brünner 1993, Sweigard 1975), diaphragmatic breathing (Baeumer 2004, Brünner 1993), stress and relaxation (Baeumer 2004), mental focus, performance anxiety (Langeheine 2004, Nordin and Cumming 2005, Stoyva 2000), and panic attacks (Bartley and Clifton-Smith 2006). Vocalists suggest that such imagery also balances the upward and downward forces in the stylo-pharyngeal muscle complex, raises the soft palate and lowers the larynx, and maintains larynx stability while freeing laryngeal constriction to create an “open throat” (Patenaude-Yarnell 2003, Vennard 1968, Yurisich 2000). Thus, tone quality improves (Dunbar-
Wells 1999, Miller 1977, Vennard 1968) and, if used pre-performance, it serves as a silent warm-up (Linklater 1976, Rodenburg 1992).

The recent discovery of the mirror neuron system supports claims that imagery activates neural responses triggering physical adjustments that are often beyond conscious control (Aziz-Zadeh and Ivry 2009, Filamon et al. 2007). Furthermore, mirror neurons show greater activation the more the individual has a strong sense of the goal to be achieved (Gazzola et al. 2007, Johnson-Frey et al. 2003), and pedagogical wisdom suggests imagery of sensations directed both upwards and downwards, far from the larynx, presents the singer with a proprioceptive goal. Only the singer with an inefficient, poor quality voice senses the voice solely at vocal fold level (Titze 2001). The accomplished singer’s perception of a resonant voice involves sensations throughout the entire body (Brünner 1993, Robison 2001). As reported by baritone Thomas Quasthoff: “it is very important to feel the breathing inside your entire body, and not only in a separated part of your body. The whole human being is the instrument, not only the larynx” (Holmes 2003, p. 264).

If imagery influences stress and relaxation, has a warm-up effect, and enhances tone color, it follows that imagery may affect singers’ vibrato. Stress and relaxation levels influence vibrato (Miller 1977, Titze 1994, Vennard 1968, Westerman 1938), and vocal color is determined above all by vibrato (Bartholomew 1937). A stable (Bartholomew 1934), moderate (Miller 1977) vibrato rate is essential for vocal beauty. Mürbe et al. (2007) classify vibrato below 5.20 cycles/second as slow, and vibrato above 5.80 cycles/second as fast. Titze (1994) notes that 5.5 cycles/second is the average frequency of Pavarotti and is perceived as particularly desirable by today’s audiences. Vocal warm-up exercises facilitate more moderate, stable vibrato rates (Moorcroft and Kenny 2012). This study, therefore, investigated the acoustic effect of imagery and non-imagery tasks on singers’ vibrato, and whether any changes observed resembled those generally associated with vocal warm-up.

**METHOD**

**Participants**

Six classically trained female singers, each from a different studio, participated. Three were studying tertiary level singing, and three had completed tertiary studies and sang professionally (mean age=29 years, SD=7 years; mean years of vocal study=13, SD=5).
Materials

Singers were asked to learn a set eight bars from Villa-Lobos’ *Bachianas Brasileiras* No. 5 Aria (range=D₄ to F♯₅), given the print music and a recording of the accompaniment, and requested not to warm-up on the recording day. To ensure singers perceived all interventions as equally valid, the project was described as investigating the vocal effect of varying levels of relaxation.

For the recording, singers were fitted with a head-mounted AKG C-477 microphone connected to a DAT Marantz CD recorder model 640 via a Behringer Ultragain Pro MIC-2200 preamplifier. A pre-recorded accompaniment heard through Beyerdynamic DT331 free-field earphones enabled the voice to be recorded without accompaniment. Singer sound pressure level (SPL) was calibrated using two different dB readings of a 1000 Hz pure sine wave tone and a Rion Integrating Sound Level Meter model NL-06. Recordings were converted to graphic form using Phog Interactive Phonetography System Version 2.0 and assessed using Soundswell Core Analysis Version 4.0.

Procedure

Singers recorded the excerpt before and after three non-vocal, 25 minute tasks. Each singer performed the tasks in a different, randomized order in a single sitting. One task involved imagery of the breath directed up and down as far from the larynx as possible. Another task used Braille music code, enabling the singer to engage in imagery related to music. A third task was a non-imagery activity requiring the completion of a cloze passage about breath function. For a full account of each intervention see Moorcroft (2011).

Spectrograms of the partials were produced from the 11 longest notes in each solo. A cursor was manually placed on the peaks and troughs of the vibrato undulations, and the time and frequency automatically recorded. Vibrato rate and extent were compared with SPL, which was established from the graphic representation of upper and lower calibration tones.

RESULTS

Only the more experienced singers produced mean vibrato rates for the solo between 5.35 and 5.75 cycles/second for all three pre-intervention conditions. The less experienced singers produced mean vibrato rates that were either faster or slower. However, after the breathing imagery, faster mean vibrato rates became slower, slower mean vibrato rates became faster, and even the more experienced singers’ mean vibrato rates compacted to between 5.4 and 5.6 cycles/second. Although no significant change occurred in the group
mean (mean change=0.13, p=0.15) or median (mean change=0.06, p=0.47) vibrato rates, there was a significant reduction in the range of mean vibrato rates for the group (mean change=0.52, p=0.02). Also, within individual solos, the mean vibrato rate SD from the 11 longest notes showed a significant decrease (mean change=0.17, p=0.02). Thus vibrato rates became more moderate and even, resembling the acoustic changes that follow a vocal warm-up. In contrast, after the Braille music imagery, there was a significant reduction in the group mean (mean change=0.17, p=0.01) and median (mean change=0.18, p=0.01) vibrato rates, and no significant reduction in the range of mean vibrato rates for the group (mean change=0.19, p=0.10). Within individual solos, the mean vibrato rate SD from the 11 longest notes increased for all but the most experienced singer in the group (mean change=0.07, p=0.07). After the cloze passage on breathing, no significant changes were found in either the group mean (mean change=0.0, p=0.87) or median (mean change=0.03, p=0.38) vibrato rates, nor in the range of mean vibrato rates for the group (mean change=0.05, p=0.64) or the SD of vibrato rates within individual solos (mean change=0.01, p=0.71).

Paired t-test results showed that after the breathing imagery, notes with vibrato rates slower than 5.00 cycles/second became significantly faster (t=-5.31, p=0.001), while notes with pre-test vibrato rates 6.00 cycles/second or faster became significantly slower (t=3.63, p=0.002). After the Braille music imagery, notes with vibrato rates slower than 5.00 cycles/second became slower still (t=-2.34, p=0.044), but not notes with vibrato rates 6.00 cycles/second or faster (t=1.41, p=0.180). For the cloze passage on breathing, no significant pre to post-test findings resulted from either sub-group.

In addition, within individual notes the cyclic undulations comprising the vibrato became more regular after the breathing imagery. A significant reduction in notes with vibrato rate SDs greater than 0.50 cycles/second was found after the breathing imagery (t=-3.90, p=0.002) but not after the Braille imagery (t=-0.13, p=0.902) or cloze passage (t=1.10, p=0.288).

Overall, although the breathing imagery consistently impacted the less experienced singers the most, the vibrato rate of all singers improved after the breathing imagery in a manner normally observed in voices following vocal warm-up (Moorcroft 2011, Moorcroft and Kenny 2012) and extensive training (Mürbe et al. 2007). Vibrato extent was not significantly affected by any intervention. SPL results showed no consistent association with either vibrato rate or vibrato extent, indicating that pre- to post-test changes in dynamics were not responsible for the changes observed in vibrato rate.
DISCUSSION

Traditional vocal imagery in which the breath is directed both as far above and below the larynx as possible appears to moderate singers’ vibrato rates in such a way as to reflect a more warmed-up, proficient voice. Although an image may serve many purposes, because vibrato rate is closely linked to singers’ stress and relaxation levels, it is hypothesized that one purpose of breathing imagery is to prepare mind and body by balancing the performer’s levels of mental and physical activation according to the demands of the task ahead. Future research will need to test this hypothesis.

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References


