Supplemental Material S3. Sensorimotor mechanisms: empirical studies.

Author(s), Year	Label	Criteria for MTD-1 diagnosis	Study groups	Assessment measures relevant to the sensorimotor category	Main results for the sensorimotor category
Kryshtopava et al., 2017	Muscle tension dysphonia	History of psychological/personality factors, stress, technical misuse/abuse, high vocal demands Extrinsic laryngeal muscle tension detected on palpation Results from voice assessment including dysphonia severity index Laryngeal features of MTD (posterior gap with decreased amplitude and symmetry of the mucosal waves, false vocal fold adduction, partial or complete AP contraction) Absence of organic laryngeal pathology	G1: 10 patients with MTD-1 G2: 15 healthy controls	Areas of activation (fMRI)	When compared to the control group, the MTD-1 group had higher brain activity in *motor control-related areas* (precentral gyrus, SFG, MFG, IFG, lingual gyrus, insula, cerebellum, midbrain, and brainstem) for comfortable and high-pitched phonation. In the MTD-1 group, lower activation was found in the *sensory control-related areas* (cingulate gyrus, MTG, STG, and inferior parietal lobe) for comfortable and high-pitched phonation. When compared to a prolonged exhalation, patients with MTD-1 showed greater activation in MFG, SFG, and midbrain (for comfortable and high-pitched phonation) and lower activation in left MTG and right inferior parietal lobe (for high-pitched phonation).
McKenna et al., 2020	Vocal hyperfunction (Nonphonotrau-matic - NPVH; phonotraumatic - PVH)	No structural changes to the vocal folds (for the NPVH subgroup)	G1: 32 patients with vocal hyperfunction (21 with NPVH; 11 with PVH) G2: 32 healthy controls	-Voice onset time (VOT) -Coefficient of variation of voice onset time (CoV)	VOT were not different between healthy speakers and patients with vocal hyperfunction (p = .703), but a significant effect was found in a subset of participants with more severe voice quality ratings, who had shorter mean VOTs than their matched controls (p = .025). There was a significant main effect of group for CoV, which was larger in patients with hyperfunction (p = .006).

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					There was no significant effect of hyperfunction subtype.
Schultz-Coulon, 1978 (reports findings from an original study in German)	Hyperfunctional dysphonia	"Faulty habits of voice production"	G1: 24 trained singers G2: 34 vocally untrained G3: 30 patients with hyperfunctional dysphonia	-Change in SPL -Change in F0 -F0 variation -Tone reproduction accuracy -Tone stability	Under masking conditions: change in intensity was not different between groups but change (increase) in F0 was significantly greater in the dysphonic group. The dysphonic group also reduced their pitch modulation (F0 variation) significantly ($p < .05$). With and without masking, participants with hyperfunction had the largest deviations from reference tone during pitch matching tasks. Regarding tone stability, pitch fluctuations were more pronounced in dysphonic patients when compared to healthy controls ($p < .01$).
Stepp et al., 2017	Hyperfunctional voice disorder (NPVH or PVH)	Not specified	G1: 9 patients with hyperfunctional voice disorder (4 with PVH; 5 with NPVH) G2: 9 healthy controls	-Pitch-shift reflex as measured with F0	5/9 of the participants in the patient group did not show the expected adaptive response to the pitch shift and instead of opposing the perturbation, followed it by increasing their pitch in the same direction. The interaction between group and phase of the pitch shift was significant ($p < .001$). The presence of lesion was not a factor in the type of response in the patient group.
Vertigan et al., 2006	Muscle tension dysphonia	Perceptual deviation in voice quality Glottic or supraglottic constriction Posterior glottal gap Vocal fold bowing while phonating	G1: 15 patients with MTD G2: 15 healthy controls	-Pulmonary function measures -Reduction (%) in FEV_1 and FIF_{50} following hypertonic saline challenge (HSC) -Dose of hypertonic saline leading to 20% reduction in FIF_{50}	Pulmonary function measures at baseline were normal in patients with MTD and healthy controls. 67% of patients with MTD had a reduction in $FIF_{50} > 20\%$ (suggestive of vocal cord dysfunction). This proportion was higher than in the control group ($p = .001$). 13% of

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		No organic cause or psychogenic cause		-Inspiratory flow limitation during HSC (dose response slope) -Inspiratory flow volume loops	patients with MTD had a reduction in FEV_1 > 15% (indicative of asthma). -The average dose to induce a 20% reduction in FIF_{50} was 6.8 (±5.8) mL in the MTD-1 group and 7.5 (±7.0) mL in the control group. The dose response slope was higher in the MTD-1 group, but the difference was not significant (p = .304). In the patient group, 40% of flow volume loop shapes remained abnormal after the HSC, while 85% returned to normal in the control group (p < .001). *These results suggest upper airway hypersensitivity in patients with MTD-1.*
Vertigan et al., 2013	Muscle tension dysphonia	Perceptual deviation in voice quality Tension in the intrinsic and/or extrinsic laryngeal muscles No structural, neurological, or psychological cause	G1: 33 patients with chronic refractory cough (CRC) G2: 28 patients with paradoxical vocal fold movement (PVFM) G3: 11 patients with globus pharyngeus G4: 18 patients with MTD G5: 13 healthy controls	Assessment of sensory symptoms: *Swallowing* Timed Swallow Test results *Vocalization* VHI, auditory-perceptual ratings of voice quality, MPT, DSI, Voice Stress Test results *Vocal fold closure* HSC results *Cough* Capsaicin cough reflex testing results *Sensory symptoms and paresthesia* Symptom Frequency and Severity Scale questionnaire Laryngeal Paresthesia Questionnaire	*Swallowing*: the patient groups had worse timed swallow test results when compared to the control group (p < .0125). No difference between patient groups. *Vocalization:* all voice outcomes (VHI, auditory-perceptual ratings, MPT, and DSI) were worse in the patient groups when compared to control (p < .001, p < .0125, p < .001, p < .001, respectively). Patients with MTD-1 had worse scores than patients with CRC for VHI (p < .001) and worse than CRC and PVFM for auditory-perceptual ratings (p < .008). *Breathing:* the proportion of abnormal HSC results was higher in the patient groups when compared to controls (p = .006). No difference was found between patient groups.

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					Cough: cough reflex sensitivity was higher in patients compared to healthy controls. Cough counts was higher in the PVFM ($p < .001$) and MTD-1 ($p = .005$) groups when compared to the control group. *Sensory symptoms and paresthesia:* Laryngeal paraesthesia scores were worse in the patient groups in comparison with healthy controls ($p < .001$). No difference was noted between the patient groups. The MTD group had the highest score for voice symptoms (breathing and upper airway scores were also abnormal)
Ziethe et al., 2018	Muscle tension dysphonia	Not specified	G1: 61 healthy controls G2: 22 patients with MTD	Pitch-shift reflex as measured with: -EEG (N100, MMN) -EGG -High-speed video endoscopy (glottal area waveform) -Acoustic measures	There were no differences between groups in the perception of the pitch shift or in response latency for the phonation and speech paradigms; suggestive of a normal auditory feedback process in both groups. In terms of voice pitch response magnitude, a significant difference was found between groups for both sustained phonation and speech tasks, with MTD patients showing a larger magnitude ($p = .046$). Although not significant, a shorter kinesthetic process time was noted in the MTD group when compared to the control group.

Note. fMRI = functional magnetic resonance imaging; SFG = superior frontal gyrus; MFG = middle front gyrus; IFG = inferior frontal gyrus; MTG = middle temporal gyrus; STG = superior temporal gyrus; NPVH = nonphonotraumatic vocal hyperfunction; PVH = phonotraumatic vocal hyperfunction; VOT = voice onset time; CoV = coefficient of variation of voice onset time; F0 = fundamental frequency; FEV_1 = forced expiratory volume in one second; FIF_{50} = flow rate at 50% of total volume inhaled; HSC = hypertonic saline challenge; CRC = chronic refractory cough; PVFM = paradoxical vocal fold movement; VHI = voice handicap index; MPT = maximum phonation time; DSI = dysphonia severity index; EEG = electroencephalogram; EGG = electroglottography; MMN = mismatch negativity.