From ***Your Brain Sings Before You Do:***

*How to Use Neuroscience to Improve Your Singing*

by Meredith Colby



---

# For Voice Professionals

# Appendix II

## *Neurodidactics*

Though the subtitle includes the word *neuroscience*, this book is actually about neurodidactics (or neural didactics) in singing. Neurodidactics is the intersection of neuroscience and learning, the goal of which is to apply what we know about how brains work to create learning that is effective and positive.

Other than this book, you will find little or no published information on neurodidactics for singing. It may be that this field is simply too new, or that the established work has been in service to classroom education. It may be that the inclusion of motor memory and predictive processing in the overall educational or pedagogical framework makes studying it too complicated. Or, perhaps the educational system has not yet caught up to what neurologist and

author Oliver Sacks knew: “There is little doubt that regular exposure to music, and especially active participation in music, may stimulate development of many different areas of the brain. In terms of brain development, musical performance is every bit as important educationally as reading or writing.”[1]

This book attempts to pave the way for the work of neurodidactics in singing pedagogy and vocal coaching. This book is in service to a conversation that deserves to be started and ideas that demand to be made accessible. Singers of all ages and ambitions who turn to voice professionals for help in their journey of musical self-expression deserve the tools offered in this book.

## The Neurodidactics Used in NeuroVocal Method Training

There are many things we know about how human brains work. You don’t have to know the anatomy of the brain, how neurotransmitters work, or a lot of medical lingo to understand functionally and educationally useful principles about brains and brain function. This book offers a number of reliable neurological principles that can make voice lessons and vocal coaching easier, more effective, and more fun for both coach and client. I hope that these were offered in ways that were easy to understand and apply.

NeuroVocal Method is an active, growing approach. It continues to become both broader and more nuanced as more smart and generous voice educators engage with its training and tools. The next sections outline the neurodidactic tools that are currently used to guide NeuroVocal coaching.

This appendix draws on both established findings and practice-based observations. Where claims are grounded primarily in research, this is noted. Where correlations arise from studio

experience, they're offered as practice-informed interpretations that align with existing scientific frameworks.

## Individual Differences

More often than not, training for singing happens in private coaching or teaching environments, with one client and one coach. This can be a luxurious situation for the coach, who can adapt to the changing needs of individual clients. It can also be challenging, since it requires coaches to release attachments they may have to rote learning or rigid structures.

In group settings, some singers may be broadly described as neurodivergent, since their behaviors diverge from what is typically expected in that environment. In a private coaching session with a coach who is familiar with common behaviors of neurodivergent singers, however, those same behaviors can be considered the norm. There is no need for comparison to others; these behaviors can be understood simply as part of how that singer learns and engages.

For example, Robin might be seen in a classroom as inattentive because they look away when the instructor speaks. Robin's vocal coach, however, can recognize that this is how Robin maintains focus. This behavior then becomes a neutral observation about an individual client and something that can be easily accommodated, rather than being construed as something negative or difficult.

When working with creative, expressive, and neurodiverse people, it helps to appreciate the variety of ways brains function. While a full exploration is beyond the scope of this book, voice educators benefit from becoming familiar with one or more personality models, the educational signs of autism spectrum disorder and attention deficit disorders, and even the basics of mental health challenges. Building this knowledge doesn't simply broaden an instructor's

perspective—it provides practical tools to adjust instructional style, creating a more supportive and successful experience for both teacher and student, or coach and client.

## Neuroplasticity

The word *neuroplasticity* describes the ability of neurons to change function, chemical profile, or structure. In a larger sense, these changes will affect neural networks, which will change thoughts, habits, propensities, and abilities. An oft-used expression that sums up the process of neuroplasticity is “Nerves that fire together wire together.”

Neuroplasticity refers to the ability of the central nervous system to adapt structurally and functionally in response to experience throughout life.[2] Functional and structural plasticity has been shown to underlie motor skill learning, with measurable changes in neural networks associated with skill acquisition.[3]

Neuroplasticity is the underlying mechanism for creating or breaking habits, growing or decreasing sensitization, adapting to new things, learning and memory, and motor learning. Its role in learning and motor behavior is well established in neuroscience and psychology literature. While neuroplasticity is a constant across all brains, different things affect how easily or quickly a brain can change. Age, health, genetics, hormones, and lifestyle can all affect the rate of change in neurons.

NeuroVocal Method employs strategies that stimulate somatosensory neural networks to promote neuronal development, synaptogenesis, and long-term motor learning. Specifically, NeuroVocal coaches have observed that when singers can focus selective attention on specific sensory input, those singers can quickly access new and unfamiliar motor behaviors. Using these tools, the timeline between the introduction of a new behavior or technique and the familiar

acquisition of that skill tends to be surprisingly short when compared to traditional voice training approaches.

As an individual exhibits a change in consistent or normalized behavior or experience, we see that as evidence of the effects of neuroplasticity. In NeuroVocal training, we consistently observe a correlation between the new behaviors and skills introduced to the singer and a consistent or normalized experience of singing over time.

## Emotional Regulation

The efficacy of NeuroVocal training relies on the singer's sense of agency and emotional safety in the coaching process.

Because of the inside-out, sensory-based approach that NeuroVocal offers, it's crucial from the outset that the singer is steering their own ship. Singers need to understand from the first coaching session that they are engaged in an experiential process, and this is an unfamiliar approach for most singers. The singer is often experiencing a new model that is contrary to the binary or dualistic thinking typical in the normalized teacher-student relationship. Agency, nuance, and horizontal instruction become the norm when singers realize that they cannot "get it wrong."

The coach-client relationship has significantly less inherent hierarchy than the student-teacher relationship. Once a singer understands that this is the new normal, it generally supports a sense of emotional safety in the coaching space. Although making artistic choices can initially produce anxiety in certain singers who feel safer following instructions than making choices, these are often the singers who benefit most from neurodidactic coaching.

NeuroVocal encourages the singer to focus on a sensory experience of motor outcomes for phonation instead of aesthetic judgment of singing sounds. We find that it's difficult (or even impossible) for singers to focus on a specific sensory experience that meets their intention—a task that requires the "selective attention knob" to be cranked up—and simultaneously experience anxiety or self-criticism. The intention to generate a specific sensory experience, along with the selective attention required to gauge whether that intention has been met, seems to create an internal state that's more emotionally neutral. The emotionally neutral state allows the singer to experience, and then selectively modulate, new vocal behaviors.

The horizontal and experiential process with a kind vocal coach helps with emotional regulation, particularly if the coach is familiar with the "Brains Are Like Cats" phenomenon and has tools to help clients with those sticking points.

A physiological effect that contributes to emotional regulation is a result of the interplay between phonation and the autonomic nervous system (ANS).[4] Phonation has a well-documented relationship with emotional regulation. This connection is rooted in the anatomy and physiology of the larynx, along with its sole source of innervation by the vagus nerve, or CN X.

Over the years, I've found both a surprising lack of credible research regarding this relationship and a wealth of observational connections. What we do know is that the vagus nerve innervates the larynx, modulating both phonation and ANS activity. The ANS is the primary regulator of our physiological states that give rise to emotions. The vibrations created by phonation, the controlled and extended exhalations that naturally occur when people phonate, and the intentional use of interoception to guide selective attention all appear to contribute to the calming effect of NeuroVocal work.

## Selective Attention

Selective attention is a primary driver of neuroplasticity. Remember that neurons function via bioelectric impulses. Engaging selective attention to focus on something turns up the volume on that neural signal—literally. Focused attention increases the gain of that particular process and decreases "neural noise." It enhances signal-to-noise ratios, improving the ability to discriminate over time. In the case of motor learning, this process eventually makes the new behavior feel automatic.[5]

It's also true that people differ, and it can be difficult for some people to engage their selective attention. Further, singers sometimes hold onto their expectations for particular sonic outcomes. When a singer is listening and judging their sound, they cannot also engage their selective attention to assess an internal sensory experience.

Strategies for focusing attention can be borrowed from other education modalities and seamlessly applied to the NeuroVocal process. It's important to remember, however, that each brain is unique; a strategy that works well for one person might not apply to another.

## Multisensory Learning

Few singers possess an explicit cognitive framework for understanding singing as an embodied act. They typically integrate interoceptive and auditory input with executive function, aesthetic judgment, emotional interpretations, and language processing. This complex neurological interplay renders the acquisition or modification of vocal skills an unnecessarily gradual process.

NeuroVocal Method guides the singer to learn to distinguish between various elements of singing, specifically focusing on using interoceptive information to guide motor outcomes. These processes help singers to first identify singing as an embodied experience, and subsequently to separate, explore, and interpret various sources of sensory input.

## Predictive Processing

Predictive processing is the currently accepted unifying theory of cognitive neuroscience, and the approach used in NeuroVocal Method is based on it. The theory states that the brain functions as a prediction machine that constantly generates and updates internal models of the world to predict incoming sensory information. When actual sensory input differs from these predictions, the brain adjusts its models to minimize the discrepancy, or prediction error. This process of integrating past experiences with current sensory data is the most efficient way for a brain—not just our brains, but *all* brains—to interpret and respond to its environment.[6]

Unlike any other applied instrument, everyone who seeks training for singing has already invested thousands of hours in creating and cementing their motor memory for singing. Each time they have the intention to sing, their predictive processing attends to singing in the way it already knows. Their brain sings before they do. Because of this reality, NeuroVocal focuses on phonation outside the context of singing. **The absence of an internal model for *efficient phonation* in most individuals means that efficient phonation can be developed with an intention for a specific outcome.**

The sensory stimuli of performance situations are overwhelming (exteroceptive, interpersonal, interoceptive, and affective), and the singer's brain must make ever-changing decisions about a hierarchy of importance. The cognitive expense of applying executive function

to the motor action of singing—as is seen in most teaching methods—is simply not available to the performing singer. However, if the *motor skills* that underlie the singing element of a performance are automatic and based on an assumption of an interoceptive sensory experience (predictive processing), the singer has freed up "cognitive real estate" to focus on managing more of the sensory input involved in performance situations.

## Agency and Self-Assessment

Singing is an expressive skill that depends on the brain's ability to interpret outcomes and adjust behavior. A growing body of research in cognitive neuroscience suggests that learning from errors — and the awareness of those errors — is central to how the brain updates its internal models. When an outcome differs from a singer's intention or expectation, prediction error signals draw attention to the discrepancy. This feedback loop will trigger adjustments in future performance.[7]

The processes that lead to skilled singing are tied to the brain's ability to detect mismatches between intention and result, and to use that information to refine future attempts. Research shows that when learners detect their own errors, the brain's error processing networks are engaged and can support learning and skill acquisition.[8]

Within traditional teacher-centered paradigms, feedback is typically delivered from an external authority. While external feedback can be helpful, it places the neural locus of evaluation outside the learner's own predictive and error-correction systems. In contrast, when singers are supported in self-assessment — noticing sensations, comparing intentions to outcomes, and adapting accordingly — they engage their own internal error-processing mechanisms. This engagement aligns with predictive brain frameworks and is closely tied to mechanisms of neuroplasticity and motor learning.

When a singer learns to attend to interoceptive sensory cues and compare them to their intended outcomes, they generate prediction error signals that are essential for refining internal models. This process of self-generated error correction supports durable changes in performance because it engages the learner's predictive systems directly, rather than simply reinforcing externally labeled "correct" or "incorrect" actions. Over time, this leads to consistent, self-guided improvement.

In the NeuroVocal coaching environment, the coach's role is not to dictate outcomes but to facilitate the learner's attention to sensory signals and support their capacity for self-assessment. Coaches help singers clarify their intentions, notice relevant sensations, and interpret discrepancies between intention and experience. This approach encourages the singer to become the active agent of their own learning, engaging neural systems involved in prediction, error detection, and adaptive adjustment.

As singers repeatedly engage in self-assessment and intentional refinement, they not only build singing skills but also develop confidence in their abilities to make creative and expressive choices. This confidence emerges not from being "told what is right," but from understanding that their sensory perceptions and adjustments matter in shaping skill and artistry.

---

[1] Scott Horton, "*Musicophilia:* Six Questions for Oliver Sacks," *Harper's Magazine*, July 28, 2009 https://harpers.org/2009/07/musicophilia-six-questions-for-oliver-sacks/https://harpers.org/2009/07/musicophilia-six-questions-for-oliver-sacks/.

[2] Puderbaugh and Emmady. “Neuroplasticity.” *Nih.gov*, StatPearls Publishing, May 2023.
[3] Dayan and Cohen. “Neuroplasticity Subserving Motor Skill Learning.” *Neuron*, vol. 72, no. 3, Nov. 2011.

[4] Morales-Luque, et al. “Mapping the Neurophysiological Link between Voice and Autonomic Function: A Scoping Review.” *Biology*, 10 October 2025.

[5] Wulf and Lewthwaite. “Optimizing Performance through Intrinsic Motivation and Attention for Learning: The OPTIMAL Theory of Motor Learning.” *Psychonomic Bulletin & Review*, January 2016.

[6] Andy Clark, *The Experience Machine: How Our Minds Predict and Shape Reality* (New York: Pantheon Books, 2023).
[7] Brenneman, Ross. “Brain Study Suggests How Students Learn from Mistakes | USC Rossier School of Education.” August 2020.

[8] Lewis, Richard. “Mindful Mistakes: How Brains Learn from Errors.” *Neuroscience News*, November 2023.