

Anxiety and Effects on Singers' Pitch-Matching Ability

Module 6 BMPF7010

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February 9, 2026

Word Count: 15,791

Project Proposal

Context / Position of Project

As a voice pedagogy specialist working with neurodivergent and anxious students, specifically adolescents, my professional practice consistently reveals that difficulties with pitch-matching are rarely isolated technical deficits. Instead, these difficulties often emerge alongside high performance anxiety, vocal withdrawal, and reduced willingness to participate in singing tasks. Students who are described as “pitch-weak” often demonstrate hesitation before vocalization, guarded posture, shallow breathing, and negative self-talk, suggesting that emotional state plays a significant role in vocal response. These are consistent observations I have made throughout my five years of teaching in private practice, but much more consistent among my students who have a form of neurodivergence (ADHD, autism, etc., but most often, anxiety).

These observations align with existing research in music education and cognitive psychology, which suggests that affective states influence auditory perception, motor control, working memory, and musical self-efficacy (Juslin and Laukka, 2004; McPherson and Welch, 2018). In adolescence, a developmental period characterized by identity formation, vocal change, and heightened self-consciousness, anxiety related to singing may be particularly prevalent. For some learners, repeated experiences of pitch difficulty may become internalized as personal failure or insecurity, leading to avoidant behaviors and disengagement from musical learning.

This proposed project is situated at the intersection of applied voice pedagogy, developmental psychology, and music cognition. It adopts a practitioner-research approach to investigate how anxiety influences pitch-matching ability in adolescent singers and to explore instructional strategies that may reduce anxiety while supporting vocal accuracy. The project is grounded in real-world teaching practice and seeks to contribute to inclusive, emotionally responsive models of vocal instruction. As an owner of a studio with 9 teachers and over 300 students, individuals with pitch-matching difficulty come through our doors often. This study will aim to help our student population as a whole. By examining pitch-matching within authentic pedagogical contexts, the study responds directly to the gap between technical voice training and learners’ emotional readiness.

Justification

Pitch accuracy is widely regarded as a foundational component of vocal pedagogy and is often used as an early indicator of musical ability. However, pitch-matching is frequently taught

through corrective feedback and repetition, with limited attention given to learners' affective states. For example, the teacher may continuously pound on the piano keys or sing the note to have them match it. However, depending on how this is done, these approaches may cause more anxiety in the student. Research reveals that anxiety can significantly alter respiratory coordination, neuromuscular control, auditory perception, and working memory. These are all systems essential for accurate pitch production (Kenny, 2011; Jellison, Draper and Brown, 2021).

For adolescents, performance anxiety may be intensified by peer comparison, fear of judgment, and increased self-awareness. Students who experience repeated difficulty with pitch-matching may begin to associate singing with threat rather than exploration, resulting in reduced musical self-concept and participation (Welch et al., 2010). When we know we are not good at something, or when we are unsure, we do not fully participate in a task due to our insecurities. The same thing happens here with children, who are in a formative time in their lives as they develop opinions of themselves such as who they are, their interests and talents, etc. Therefore, if a student associates singing or music with anxiety, they may be more likely to quit. Despite growing recognition of the importance of emotional safety in music education, there remains limited empirical investigation into how specific instructional modifications affect pitch accuracy via anxiety modulation. I believe if we can bridge this gap, more students (and teachers) would find singing more accessible to everyone, not just to students who have more “natural talent.”

This study is justified by the need to better understand pitch-matching as a state-dependent, developmentally responsive skill rather than a fixed technical ability. By integrating voice science, embodiment theory, and trauma-informed pedagogical principles, the research aims to extend current understanding of how emotional and instructional factors play a role in adolescents' vocal learning.

Research Gap and Practitioner Positioning

Although music performance anxiety has been widely studied, much of the literature focuses on anxiety within high-stakes performance contexts rather than in every day moments and foundational learning tasks. Additionally, anxiety is often conceptualized as a trait characteristic, rather than a state-dependent response shaped by pedagogical environment (Kenny, 2011). As a result, the connections between instructional approach, emotional state, and pitch-matching response remain underexplored.

Practitioner research offers a valuable methodological lens through which to address this gap. I often observe subtle behavioral and affective changes that may not be readily captured in laboratory-based research. Students' awareness of being "pitch-weak" often exacerbates anxiety, making traditional instructional approaches less effective. I have been forced to think "outside the box" when teaching pitch-weak students. This insider perspective allows investigation of vocal learning as it unfolds in authentic teaching contexts, while also necessitating careful self-reflection regarding personal bias and power dynamics (Dwyer and Buckle, 2009). This tension between the benefits of non-laboratory based research (in this case) and biases of having my own students as participants will be difficult to navigate, but the benefits far outweigh due to the students may not participate otherwise. This will give us a better look into the general population of adolescents with anxiety, as opposed to the few children who opt-in to vocal research participation.

By adopting a practitioner-research approach, this study seeks to bridge theory and practice, contributing empirically grounded insights that are directly applicable to vocal pedagogy. The research responds to calls within music education for studies that both inform scholarly understanding and support reflective professional practice (McPherson and Welch, 2018).

Intended Impact

This project aims to do the following:

- Provide empirical insight into the relationship between anxiety and pitch-matching accuracy in adolescent singers.
- Identify instructional strategies that reduce anxiety while supporting accurate pitch production.
- Inform inclusive and affirming vocal pedagogy practices for anxious and neurodivergent learners.
- Enhance practitioner capacity to design psychologically informed vocal instruction.
- Contribute practitioner-focused knowledge to music education and performance psychology literature.

By reframing pitch-matching as a developmental skill that is dependent upon affective context rather than a fixed ability, this study has the potential to influence teachers' approaches (and their training), curriculum design, and classroom culture in music education.

Outlined Intention

The guiding research question for this study is:

How does anxiety affect pitch-matching in adolescents, and which instructional strategies reduce anxiety while supporting vocal accuracy?

To address this question, a small-scale mixed-methods practitioner study will be conducted with adolescent participants aged 11–17 who experience singing-related anxiety. Participants will engage in one-to-one pitch-matching tasks delivered under varied instructional conditions, including neutral instruction, embodied movement through solfège hand signs, and co-regulated movement combined with supportive verbal framing.

Pitch accuracy will be measured acoustically, while self-reported state anxiety will be recorded before and after each instructional condition. Observational field notes and brief post-task interviews will provide qualitative data, enabling triangulation across acoustic, behavioral, and affective domains.

Instructional conditions will be informed by embodiment theory (Sheets-Johnstone, 2015), polyvagal theory and co-regulation (Porges, 2011), and non-linear learning approaches relevant to voice pedagogy (Kenny, 2011). These frameworks will guide analysis of which pedagogical strategies most effectively support anxiety reduction and pitch perception.

Expected Learning Outcomes

Through conducting this study, I expect to develop the following:

- A deeper theoretical understanding of the interaction between emotion, perception, and motor control in adolescent vocal performance.
- Practical understanding of mixed-methods research design.

- Enhanced capacity to design trauma-informed, anxiety-sensitive vocal instruction supported by empirical evidence.
- Increased reflexive awareness of ethical complexities and power dynamics in insider research with minors.
- Broadened understanding of inclusivity in voice pedagogy, particularly for learners marginalized by conventional assessment models.

These outcomes will strengthen my development and enrich the quality of my professional teaching practice. As a teacher who is often unsure of how to best help my pitch-weak students, I am sure I am not the only one who feels this way, so I am sure these outcomes will serve the voice teacher community at large.

Ethics / Insider Research Considerations

This study involves minors who experience performance anxiety and therefore requires careful ethical consideration. Participants will be recruited from my current student base, making insider research considerations particularly important. Informed parental consent and participant assent will be obtained prior to participation, and involvement will be entirely voluntary.

Sessions will take place in private, low-stimulus environments. Language used during tasks will emphasize exploration and play rather than evaluation to minimize potential feelings of judgment or failure. Participants will be reminded that they may withdraw or decline tasks at any time without consequence.

As an insider practitioner, I will use reflexive strategies to mitigate bias and power imbalance, including structured field notes, audit trails, and ongoing self-reflection. Following Dwyer and Buckle's (2009) insider–outsider framework, particular attention will be paid to preserving participant autonomy and separating pedagogical support from research evaluation.

The study will adhere to UWTSD's Research Ethics and Integrity Code, the Belmont Report (1979), and the ethical guidelines of the American Psychological Association for research involving minors. Safeguarding procedures will be in place should distress arise, and all data will be anonymized.

Project Report

Introduction

Pitch-matching is widely regarded as a foundational skill within vocal pedagogy and music education. The ability to reproduce pitch accurately is often treated as a prerequisite for successful participation in singing, ensemble work, and broader musical development. Within educational and studio contexts, early pitch accuracy is frequently used as an informal diagnostic indicator of musical aptitude, auditory discrimination, and vocal potential. Students who struggle to match pitch are often described as “pitch-weak” or “inaccurate,” and pedagogical responses commonly emphasize repetition, aural training, and corrective feedback aimed at improving technical precision.

However, in my experience working with neurodivergent and anxious adolescents, pitch-matching difficulties rarely present as isolated technical deficits. Instead, they are consistently accompanied by heightened performance anxiety, vocal withdrawal, hesitation before phonation, and reduced willingness to participate in singing tasks. Adolescence represents a particularly complex developmental period for vocal learning. Physiological changes associated with puberty (such as vocal fold growth and shifts in vocal range) intersect with cognitive, emotional, and social development. Adolescents often experience heightened self-consciousness, increased sensitivity to peer evaluation, and evolving identity formation, all of which can intensify performance-related anxiety. In singing contexts, where the voice is both a musical instrument and an extension of the self, these factors may be especially prevalent. As a result, pitch-matching tasks, particularly when framed evaluatively, can become sites of perceived threat or vulnerability rather than opportunities for skill development. Rather than thinking “This is a skill I don’t have yet,” students more often think, “I am not good enough.” or “I am being criticized.”

Research in music psychology and voice science suggests that anxiety can significantly disrupt the physiological and cognitive systems required for accurate pitch production. Anxiety has been shown to alter respiratory coordination, increase muscular tension, narrow attentional focus, and reduce working memory capacity (Kenny, 2011). These effects directly interfere with the fine motor control, breath stability, and auditory monitoring necessary for successful pitch matching. Juslin and Laukka (2004) further highlight the close relationship between emotional

state and vocal expression, indicating that affective regulation plays a central role in vocal behavior.

Despite this, much of the pedagogical discourse surrounding pitch-matching continues to frame inaccuracy as a technical or perceptual problem to be corrected, rather than as a state-dependent response shaped by emotional and contextual factors. This deficit-oriented framing risks reinforcing fixed-mindset beliefs in learners, particularly adolescents, who may internalize pitch difficulties as evidence of personal inadequacy. Over time, such experiences can contribute to avoidance behaviors, diminished musical self-efficacy, and disengagement from singing altogether (Welch et al., 2010).

While inclusive pedagogy acknowledges the role of affect in learning, there remains limited empirical investigation into how specific instructional strategies might reduce anxiety and thereby influence measurable pitch-matching outcomes in adolescent singers. This study aims to address that gap. Situated at the intersection of applied voice pedagogy, developmental psychology, and music cognition, this project investigates how anxiety affects pitch-matching ability in adolescents and examines whether embodied and co-regulated teaching strategies can reduce anxiety while supporting vocal accuracy. Rather than treating anxiety as a peripheral concern, the study positions affective state as central to vocal learning and seeks to explore how pedagogical framing shapes moment-to-moment vocal response.

The research was conducted as a small-scale practitioner inquiry with five adolescent participants aged 11–17 who experience singing-related anxiety. I was positioned to investigate pitch-matching within an authentic teaching context, allowing close observation of behavioral, physiological, and affective responses that may be difficult to capture in laboratory-based research. Participants engaged in single-tone pitch-matching tasks delivered under three instructional conditions: neutral instruction, embodied solfège movement, and co-regulated movement with supportive verbal framing. Pitch-matching success was recorded alongside self-reported state anxiety and detailed observational field notes, enabling triangulation across acoustic, affective, and behavioral domains.

Practitioner research was selected as the methodological approach for this study due to its capacity to bridge both theory and practice. In vocal pedagogy, learning is inherently relational and embodied, shaped by teacher presence, language, pacing, and interaction. Practitioner inquiry allows these dimensions to remain visible rather than abstracted, while also requiring

reflexive awareness of insider positioning and potential bias. By engaging systematically with my own teaching practice, this research seeks to move beyond anecdotal observation, and toward empirically grounded insight that can inform both professional practice and scholarly discourse.

By reframing pitch-matching, this project aims to contribute to more inclusive and humane models of vocal instruction by challenging pedagogical assumptions that prioritize correction over regulation and invites reconsideration of how early pitch accuracy is assessed, taught, and interpreted. In doing so, the study aligns with broader educational calls to foreground emotional safety, embodiment, and relational awareness as foundations for meaningful learning.

Literature Review

Pitch-Matching in Adolescent Voice Pedagogy

Pitch-matching has long been regarded as a core skill in vocal pedagogy and music education, often used as an early indicator of musical aptitude and auditory discrimination (Welch et al., 2010). Traditional pedagogical approaches typically conceptualize pitch accuracy as an auditory-motor task that can be improved through repetition, modeling, and corrective feedback. Within this framework, pitch inaccuracy is frequently interpreted as evidence of perceptual or technical deficit.

However, research in music education increasingly challenges this narrow framing. Welch (2006) argues that pitch-matching ability develops along a continuum and is highly responsive to experience, confidence, and pedagogical environment. Similarly, McPherson and Welch (2018) emphasize that musical development is shaped by social context, emotional climate, and learners' beliefs about their own ability. These perspectives suggest that pitch-matching should be understood as a developmental and relational skill rather than a fixed technical capacity.

Studies of classroom singing further demonstrate that children who initially struggle with pitch accuracy can improve significantly when teaching methods prioritize exploration, movement, and supportive engagement rather than evaluative correction (Welch et al., 2010). This body of literature repositions pitch-matching from a measure of innate musicality to a skill that is highly sensitive to pedagogical context.

Deficit-Based and Developmental Models of Pitch-Matching

Early research into pitch-matching frequently adopted deficit-based or aptitude-oriented models, in which inaccurate pitch production was interpreted as evidence of limited musical ability (Welch, 1979). Labels such as “pitch weak” or “tone deaf” reinforced the perception that pitch accuracy reflected an inherent trait, often functioning as a gatekeeping mechanism for musical participation.

More recent developmental models challenge this view, proposing that pitch-matching ability is shaped by instruction, experience, and emotional context (Welch, 2006; Welch et al., 2010). McPherson and Welch (2018) further highlight that learners’ self-concept and beliefs about musical ability significantly influence engagement and outcomes. Deficit-based language may therefore undermine confidence and exacerbate anxiety, particularly in adolescent learners whose identities and opinions about the self are still forming.

From a voice science perspective, Thurman and Welch (2000) describe pitch production as part of the “functional unity” of body and voice, in which respiration, phonation, perception, and affect operate as an integrated system. Within this framework, pitch inaccuracy cannot be attributed to a single deficit but must be understood as a disruption within a complex, interdependent system. Emotional states such as anxiety may therefore interfere with pitch accuracy by altering breath regulation, muscular coordination, and perceptual focus.

Anxiety, Performance, and Vocal Control

Music performance anxiety literature provides substantial evidence that anxiety directly affects vocal production and motor coordination. Kenny (2011) describes anxiety as a psychophysiological state that increases muscular tension, disrupts breathing patterns, narrows attentional focus, and reduces working memory capacity. These effects compromise the systems required for accurate pitch production, including respiratory stability, laryngeal coordination, and auditory monitoring.

Juslin and Laukka (2004) further note that emotional states influence vocal expression and sound production, suggesting that affective regulation plays a central role in vocal behavior. From a motor learning perspective, anxiety interferes with skill acquisition by increasing conscious control over movements that are ideally automatic, reducing efficiency and increasing variability (Schmidt and Lee, 2011).

For adolescents, these effects may be amplified by developmental factors such as heightened self-consciousness, peer comparison, and identity formation (McPherson and Welch, 2018). Repeated experiences of anxiety during singing tasks may lead learners to associate vocalization with threat or embarrassment, reinforcing avoidance behaviors and reducing musical self-efficacy (Welch et al., 2010).

Despite this, much performance anxiety research focuses on high-stakes performance contexts rather than routine instructional tasks. While performance anxiety has been extensively examined in high-stakes musical settings such as recitals, auditions, and examinations (Kenny, 2011), fewer studies have investigated anxiety within routine instructional contexts. However, research in educational psychology has demonstrated that even low-stakes classroom tasks can elicit state anxiety that impairs cognitive performance. For example, studies of anxiety around math have shown that anticipatory worry during everyday classroom problem-solving tasks reduces working memory capacity and disrupts task execution, even when no formal evaluation is present (Ashcraft and Krause, 2007). Similarly, anxiety around foreign language research has documented that learners may experience performance-related apprehension during routine speaking activities, leading to avoidance behaviors and reduced fluency despite low external stakes (Horwitz, Horwitz and Cope, 1986).

These findings suggest that anxiety-related cognitive interference is not confined to formal performance settings but can arise during ordinary learning activities when tasks are perceived as evaluative or socially exposing. However, within vocal pedagogy, empirical research has largely concentrated on public performance anxiety rather than the micro-level affective fluctuations that occur during studio instruction or skill acquisition tasks. Where classroom-based music anxiety has been explored, methodological designs often rely on trait measures or retrospective self-report rather than capturing moment-to-moment changes during specific vocal tasks.

Consequently, while broader educational literature supports the plausibility that anxiety can disrupt low-stakes learning contexts, there remains limited research directly examining how state anxiety operates within foundational vocal training activities such as pitch-matching. This gap highlights the need for practitioner-led inquiry that attends to real-time affective shifts within instructional environments. As a result, the influence of moment-to-moment anxiety on foundational vocal learning activities such as pitch-matching remains underexplored.

Trait and State Anxiety in Vocal Learning Contexts

An important conceptual distinction within anxiety research lies between trait anxiety and state anxiety. Trait anxiety refers to a relatively stable predisposition toward experiencing anxiety across situations, whereas state anxiety describes a temporary, context-specific experience of nervousness or apprehension (Kenny, 2011). Within clinical and performance psychology, trait anxiety is often examined as a dispositional vulnerability factor. However, in pedagogical contexts, state anxiety is of particular relevance because it arises in response to specific instructional conditions; therefore, it may be modifiable.

Kenny (2011), writing specifically in relation to music performance anxiety, emphasizes that trait and state anxiety are not independent constructs but go hand in hand. Individuals high in trait anxiety are more likely to experience elevated state anxiety in performance situations; however, even individuals with low trait anxiety may experience significant state anxiety when contextual factors signal evaluation, social threat, or potential failure. Kenny further argues that performance anxiety is best understood as a situationally activated response shaped by cognitive appraisal, environmental cues, and prior learning history rather than solely as a personality characteristic. In this situation, state anxiety emerges when the performer perceives threat (reputational, social, or self-imposed/self-evaluative) and this response may vary quite a bit across different contexts.

This interactional view is particularly relevant to adolescent vocal learning. Even students without a generalized anxious personality may experience heightened state anxiety during pitch-matching tasks if these are framed evaluatively or associated with past experiences of failure. Conversely, pedagogical environments that signal safety and exploratory learning may reduce state anxiety even in students with elevated trait vulnerability. Educational research similarly indicates that anxiety experienced during specific learning activities can precede and inhibit cognitive engagement, narrowing their working memory resources and impairing task performance (Jellison, Draper and Brown, 2021).

Therefore, it is important to highlight state anxiety in vocal pedagogy. While trait anxiety may lie beyond the immediate scope of instructional control, state anxiety is directly influenced by instructional design, teacher language, relational cues, and environmental framing. By examining how pitch-matching outcomes vary across pedagogical conditions, this study adopts Kenny's interactional perspective, treating anxiety not as an immutable individual deficit but as a

contextually activated response that may be mitigated through co-regulation and embodied instructional strategies.

Embodiment, Movement, and Audiomotor Coupling

Embodiment theory proposes that cognition is grounded in bodily movement and sensory experience (Sheets-Johnstone, 2015). In the context of singing, this suggests that pitch perception and production are not purely auditory processes but are linked to physical gesture and movement.

Research into audiomotor coupling indicates that coordinated movement can support pitch accuracy by providing an externalized physical representation of sound (McPherson and Welch, 2018). Pedagogical tools such as Curwen hand signs allow singers to map pitch height onto spatial movement, supporting perception–action coupling and reducing cognitive load.

Music education studies demonstrate that incorporating movement into singing tasks can improve engagement and pitch outcomes, particularly for learners who struggle with abstract auditory instruction (Welch et al., 2010). However, embodiment is rarely discussed explicitly in relation to anxiety regulation within vocal pedagogy.

Co-Regulation, Polyvagal Theory, and Emotionally Safe Learning Environments

Polyvagal theory offers a neurophysiological framework for understanding how perceived safety influences vocalization and learning (Porges, 2011). When individuals perceive safety, the ventral vagal system supports social engagement, breath regulation, and vocal expression. Conversely, perceived threat activates defensive states that restrict breath and increase muscular tension, inhibiting vocal flexibility.

In educational contexts, co-regulation refers to the process by which a teacher's calm presence, supportive language, and paced movement help regulate learners' nervous system states. Trauma-informed educational practices emphasise that emotional safety is a prerequisite for meaningful learning, particularly for anxious or neurodivergent students (Jellison, Draper and Brown, 2021).

Despite growing interest in emotionally safe learning environments, empirical research linking co-regulation strategies directly to measurable vocal outcomes remains limited.

Debates and Tensions in Pitch-Matching, Anxiety, and Vocal Pedagogy

While the literature reviewed above establishes clear links between pitch-matching, emotional state, embodiment, and pedagogical environment, it also reveals a number of unresolved debates and conceptual tensions. These tensions are particularly evident in how pitch-matching ability is defined, how anxiety is conceptualized within learning contexts, and how responsibility for vocal difficulty is distributed between learner and pedagogy. Examining these debates is essential for situating the present study within ongoing scholarly discourse and for clarifying its contribution.

Cognitive-Perceptual Models Versus Embodied Models of Pitch-Matching

One major tension in the literature concerns whether pitch-matching should be understood primarily as a cognitive–perceptual skill or an embodied, sensorimotor behavior. Traditional models within music psychology often conceptualize pitch-matching as a function of auditory perception, working memory, and motor planning (Welch, 1979; McPherson and Welch, 2018). Within this framework, inaccurate pitch production is typically attributed to deficits in auditory discrimination or motor execution.

In contrast, embodiment theorists argue that perception and action are inseparable and that musical cognition is grounded in bodily experience (Sheets-Johnstone, 2015). From this perspective, pitch is not merely “heard” and reproduced but is enacted through coordinated bodily movement, breath, and vocal gesture. Pedagogical practices such as solfège hand signs and movement-based learning implicitly reflect this embodied understanding, yet the theoretical implications are not always made explicit within vocal pedagogy literature.

The tension between these models has practical consequences. Cognitive–perceptual approaches tend to prioritize ear training, repetition, and corrective feedback, whereas embodied approaches emphasize gesture, movement, and kinesthetic awareness. The present study sits within this tension, suggesting that embodied strategies may not only support perception-action coupling but also reduce anxiety by shifting attention away from internal monitoring and evaluation.

Skill Deficit Versus Access-Based Interpretations of Pitch Difficulty

A second tension concerns whether pitch-matching difficulties should be interpreted as evidence of skill deficit or a problem of access. Deficit-based interpretations remain common in pedagogical discourse, where learners are often labelled as “pitch weak” or “tone deaf” (Welch, 1979). Such labels imply stable limitation and may inadvertently reinforce fixed-mindset beliefs.

Developmental models challenge this interpretation, emphasizing that pitch accuracy develops along a continuum influenced by experience, confidence, and instructional environment (Welch, 2006; Welch et al., 2010). From this perspective, difficulty with pitch-matching does not necessarily indicate inability but may reflect insufficient scaffolding or adverse learning conditions.

This debate parallels broader discussions in education regarding deficit versus strengths-based models of learning. Inclusive education literature cautions that deficit framing can marginalize learners and obscure the role of pedagogy in shaping outcomes (Jellison, Draper and Brown, 2021). The present study contributes to this debate by providing applied evidence that pitch-matching success varies significantly depending on instructional context, supporting an access-based interpretation rather than a deficit-based one.

Trait Anxiety Versus State Anxiety in Vocal Learning

Another key tension lies in how anxiety is conceptualized within vocal learning. Much of the music performance anxiety literature focuses on trait anxiety or clinically significant anxiety disorders, often in relation to high-stakes performance contexts such as auditions or concerts (Kenny, 2011). While this work has been invaluable in understanding performer experiences, it may obscure the role of state anxiety experienced during everyday learning tasks.

State anxiety refers to transient, situation-specific nervousness triggered by contextual factors such as evaluation, social exposure, or perceived failure. Educational research increasingly recognizes that state anxiety can significantly inhibit learning even in individuals without chronic anxiety (Jellison, Draper and Brown, 2021). However, this distinction is not consistently applied within vocal pedagogy literature.

The present study aligns with perspectives that foreground state anxiety as a pedagogically mediated phenomenon. By examining anxiety fluctuations across instructional conditions within a single session, the research challenges interpretations that locate anxiety solely within the

learner. Instead, it supports the view that anxiety is co-constructed through pedagogical framing, relational dynamics, and task design.

Performance-Oriented Versus Learning-Oriented Pedagogies

A further tension emerges between performance-oriented and learning-oriented approaches to vocal instruction. Performance-oriented pedagogies prioritize accuracy, evaluation, and outcome, often mirroring assessment practices. While such approaches may be appropriate in advanced or professional contexts, they can be problematic for learners still developing foundational skills.

Learning-oriented pedagogies emphasize exploration, process, and developmental readiness. Research in music education suggests that learning environments characterized by psychological safety and low evaluative pressure support greater engagement and long-term participation (McPherson and Welch, 2018). However, vocal pedagogy literature does not always clearly differentiate between pedagogies suited to performance preparation and those appropriate for early skill acquisition.

This tension is particularly relevant for adolescents, whose voices and identities are undergoing rapid change. The present study suggests that performance-oriented framing may inadvertently increase anxiety during pitch-matching tasks, whereas learning-oriented, co-regulated approaches may facilitate access to vocal skill.

Individual Responsibility Versus Pedagogical Responsibility

A central ethical and pedagogical tension concerns where responsibility for pitch-matching difficulty is located. Traditional approaches often implicitly place responsibility on the learner, framing difficulty as a personal limitation requiring remediation. In contrast, inclusive and relational pedagogies argue that teachers share responsibility for creating conditions in which learning can occur.

Polyvagal theory offers a framework for understanding this tension by highlighting how environmental cues of safety or threat influence physiological readiness for vocalization (Porges, 2011). From this perspective, pedagogical responsibility includes attending to nervous system regulation, not merely delivering technical instruction.

The present study supports a shift toward shared responsibility, suggesting that teachers play an active role in shaping learners' emotional readiness and vocal access. This reframing has ethical implications, challenging pedagogical practices that inadvertently induce anxiety through evaluative language or pacing.

Tensions in Practitioner Research

Finally, the literature reveals ongoing debate regarding the legitimacy and rigor of practitioner research. Critics argue that insider research risks bias, lacks objectivity, and produces findings that are overly context-specific. Proponents counter that practitioner research offers unique access to lived pedagogical processes and generates knowledge that is directly applicable to practice (Dwyer and Buckle, 2009).

This study is situated within this debate, embracing practitioner research as a means of investigating affect-sensitive phenomena that may be inaccessible to external researchers. At the same time, it acknowledges the need for reflexivity, transparency, and methodological rigor to mitigate insider bias.

Defining the Research Gap

Across these bodies of literature, several themes emerge:

1. pitch-matching is developmentally responsive
2. anxiety directly affects the physiological systems required for vocal production
3. emotional safety supports learning; and movement and co-regulation facilitate engagement.

However, there is a significant absence of empirical research examining how specific anxiety-reducing instructional strategies influence pitch-matching accuracy in adolescent singers within authentic teaching contexts.

This study addressed this gap by examining pitch-matching outcomes under varying instructional conditions designed to modulate anxiety.

Methodology & Reflexivity

Research Paradigm and Epistemological Positioning

This study was situated within an interpretivist research paradigm, which recognizes that learning, behavior, and meaning are constructed through lived experience and social context rather than existing as objective, value-neutral phenomena. From this perspective, pitch-matching is not understood as a purely measurable technical skill, but a behavior shaped by emotional state, relational dynamics, pedagogical framing, and embodied experience.

Interpretivism is particularly well suited to educational and practitioner research, where the aim is not to establish universal causal laws but to generate situated understanding of complex human processes. In the context of vocal pedagogy, this paradigm acknowledges that vocal responses are inseparable from learners' perceptions of safety, evaluation, and interpersonal interaction. As such, a positivist or purely experimental approach would risk stripping pitch-matching of the very affective and relational dimensions this study seeks to examine.

Positioning the research within an interpretivist framework also legitimizes the use of qualitative data, such as observation and participant reflection, as meaningful sources of knowledge rather than ancillary supplements to quantitative measurement. This stance aligns with contemporary scholarship in music education, which increasingly recognizes musical learning as an experiential, embodied, and socially mediated process (McPherson and Welch, 2018).

Practitioner Research Framework

This project was designed as a practitioner-research study, with the researcher operating simultaneously as voice teacher and investigator. Practitioner research offers a powerful framework for examining pedagogical phenomena as they occur within authentic teaching contexts, preserving the relational and embodied realities of learning that may be lost in laboratory-based studies.

My professional role provided sustained access to the population under investigation and enabled close observation of subtle behavioral and affective changes during pitch-matching tasks. This insider positioning allowed the research questions to emerge directly from practice-based concerns, enhancing the ecological validity and practical relevance of the study.

However, practitioner research also raises significant methodological and ethical challenges, particularly in relation to bias, power dynamics, and role duality. Following Dwyer and Buckle's (2009) insider–outsider framework, this study explicitly acknowledges insider status as both a strength and a risk. Rather than attempting to eliminate subjectivity, reflexive strategies were

employed to make assumptions visible, to interrogate interpretive decisions, and to mitigate undue influence over participants.

Justification for a Mixed-Methods Design

A mixed-methods approach was adopted to reflect the multi-dimensional nature of pitch-matching as both an observable vocal outcome and an affectively mediated experience. Pitch accuracy alone cannot account for learners' hesitation, bodily tension, or self-reported anxiety, while qualitative observation alone cannot demonstrate patterns of change across instructional conditions.

Quantitative data were therefore collected through binary pitch-match outcomes and Visual Analogue Scale (VAS) measures of state anxiety. See Appendix D for what the students were given. These data allowed comparison of pitch accuracy and anxiety levels across instructional conditions. Qualitative data were gathered through structured observational field notes and brief participant reflections, capturing behavioral indicators such as posture, breath initiation, vocal onset, and expressed ease or discomfort.

The integration of these data sources enabled triangulation, strengthening the credibility of findings by allowing patterns to be examined across multiple forms of evidence. This methodological choice aligns with mixed-methods standards in educational research, where complex learning processes benefit from both numerical trend analysis and contextual interpretation.

Research Design and Structure

The study employed a repeated-measures within-subjects design, in which each participant experienced all instructional conditions. This design was selected for several reasons. First, it allowed each participant to act as their own point of comparison, reducing the influence of inter-individual variability in vocal development, confidence, and prior experience. Second, it was well suited to the small sample size typical of practitioner research, maximizing analytic depth rather than breadth.

Each participant completed a single one-to-one session lasting approximately 20 minutes. Within this session, participants attempted five single-tone pitch-matching tasks under each of three instructional conditions: neutral instruction, embodied solfège, and co-regulated

movement with supportive framing. This structure produced fifteen pitch attempts per participant and allowed observation of immediate changes in anxiety and vocal response across pedagogical contexts.

The decision to conduct the study in a single session reflected ethical and practical considerations. Prolonged or repeated exposure to anxiety-inducing tasks could increase participant distress, particularly given the age and vulnerability of the population. A single-session design minimized burden while still allowing meaningful within-session comparison through repeated measures.

Participants and Recruitment

Five adolescent singers aged 11–17 participated in the study. All participants were current students of the researcher and had been identified through ongoing teaching practice as experiencing anxiety related to singing and pitch-matching tasks. This recruitment approach reflects the realities of practitioner research, where access to participants often occurs through existing professional relationships.

The involvement of current students introduced potential power dynamics and ethical risk, which were carefully addressed through procedural safeguards. Participation was explicitly framed as voluntary, with reassurance that choosing not to participate would have no impact on lessons, assessment, or teacher–student relationship. Parental consent and participant assent were obtained prior to participation, and language throughout the study emphasized exploration rather than evaluation.

Although recruiting current students may raise concerns regarding coercion, this approach also ensured continuity of pedagogical context and emotional familiarity, which was particularly important given the study’s focus on anxiety. Conducting the research within an established teaching relationship reduced the likelihood that participants’ anxiety would be heightened by unfamiliar settings or researchers.

Research Setting

All sessions took place in a private teaching studio familiar to participants. The environment was intentionally low-stimulus, quiet, and free from peer observation. This setting supported

emotional safety and reduced extraneous sources of performance pressure, aligning with trauma-informed pedagogical principles (Jellison, Draper and Brown, 2021).

The use of a familiar space also enhanced ecological validity by reflecting typical one-to-one teaching conditions rather than artificially constructed research environments. This was particularly important given the study's aim to investigate pitch-matching as it occurs within real instructional contexts.

Instructional Conditions

Three instructional conditions were designed to reflect increasing levels of embodied and affective support:

- **Condition A: Neutral Instruction (Control)**

Participants were asked to match the pitch following a neutral verbal prompt, with no additional gesture, movement, or affective scaffolding. This condition reflected conventional pitch-matching instruction and served as a baseline for comparison.

- **Condition B: Embodied Solfège**

Participants used solfège hand signs corresponding to perceived pitch height while matching each tone. This condition was informed by embodiment theory, which posits that cognition and perception are grounded in bodily movement (Sheets-Johnstone, 2015). The hand signs provided a spatial and kinaesthetic reference for pitch, supporting audiomotor coupling.

- **Condition C: Co-Regulated Movement and Supportive Framing**

Participants engaged in gentle swaying or stepping movements before and during phonation. Supportive, non-evaluative language was used, alongside slow breathing cues and encouragement of audiation prior to vocalization. This condition drew on polyvagal theory and co-regulation principles, aiming to promote perceived safety and nervous system regulation (Porges, 2011).

The order of conditions was kept consistent across participants to reduce cognitive load and procedural confusion. While this introduces the potential of order effects, it is important to

consider the likely direction of such influence. If familiarization or simple task repetition contributed to improved performance, one would expect incremental improvements across successive conditions regardless of pedagogical framing. In such a case, later conditions might appear more effective merely due to increased comfort with the task itself.

However, several observations suggest that the magnitude and quality of change observed cannot be fully explained by familiarization alone. First, improvements were accompanied by marked reductions in anxiety ratings and observable shifts in posture, breath regulation, and vocal initiation patterns, rather than merely increased speed of response. Second, within-participant variability in earlier conditions did not uniformly stabilize over time; rather, changes were most pronounced when specific embodied and co-regulated supports were introduced. While order effects cannot be ruled out, the implementation of combining acoustic, affective, and behavioural data suggests that instructional framing played a substantive role beyond simple repetition. This trade-off reflects a pragmatic methodological decision, which prioritizes participant clarity and emotional safety within a small-scale practitioner context.

Measures

Pitch-Matching Measure

Pitch accuracy was recorded as a binary outcome (match / no match), reflecting whether the participant's vocal response corresponded perceptually and acoustically to the presented pitch. This pedagogical measure prioritized functional accuracy within a teaching context rather than fine-grained deviation in cents. Recordings were later reviewed using Praat software to confirm pitch correspondence, increasing reliability beyond live judgement.

Anxiety Measure

State anxiety was measured using a Visual Analogue Scale (VAS) adapted for singing tasks. Participants marked how nervous they felt before and after each instructional condition on a scale from 0-100 line ranging from "Not anxious at all" to "Very anxious." This method was selected due to its simplicity, minimal intrusion, and suitability for use with adolescents.

The VAS allowed capture of moment-to-moment affective changes without invoking clinical diagnostic language. Anxiety was framed as a normal and expected response rather than a deficit, supporting ethical integrity and emotional safety.

Data Analysis

Quantitative data were analysed by comparing pitch-match outcomes and anxiety scores across instructional conditions within each participant. Patterns were then examined across participants to identify consistent trends.

Qualitative data from observational field notes and participant reflections were thematically coded, focusing on indicators of emotional regulation, engagement, and vocal ease. Themes were compared with quantitative findings to support triangulation and deepen interpretation.

Reflexivity and Insider Research Considerations

Reflexivity was central to this study due to the researcher's insider position as participants' voice teacher. My professional beliefs/assumptions that anxiety frequently mediates pitch-matching difficulties informed the research questions and design, creating potential confirmation bias.

To address this, reflexive strategies included:

- Explicit documentation of assumptions prior to data collection
- Use of structured observation templates
- Delayed acoustic analysis to separate teaching impressions from analytic judgement
- Triangulation across data sources

Power dynamics were mitigated through transparent communication, voluntary participation, and emphasis on participant agency. The study was framed as exploratory rather than instructional, and care was taken to distinguish research participation from regular lessons.

Ethical Considerations

The study adhered to institutional ethical guidelines, the Belmont Report (1979), and APA standards for research with minors. This study was also approved by UWTSD. Safeguarding procedures were in place should distress arise, and all data were anonymized. Participants were reminded that they could pause or withdraw at any time without consequence.

Ethics, Power, and Safeguarding in Insider Research with Current Students

Conducting practitioner research with current students presents distinct ethical and methodological challenges, particularly when participants are minors and the research topic involves emotional vulnerability. This study required careful consideration of power dynamics, consent, emotional safety, and the dual-role tensions inherent in insider research. Rather than viewing these challenges as limitations to be minimized, the study treated them as central methodological concerns requiring explicit, reflexive engagement.

Insider Research and Dual-Role Complexity

As both teacher and researcher, I occupied a dual role that carried inherent authority and relational influence. Dwyer and Buckle (2009) describe insider research as existing within a “space between,” where proximity to participants offers deep contextual understanding while simultaneously increasing the risk of bias and coercion. In this study, my existing pedagogical relationship with participants necessitated heightened ethical vigilance.

The teacher–student relationship is characterized by asymmetrical power: teachers evaluate, guide, and hold responsibility for student progress. When research is embedded within this relationship, participants may feel implicit pressure to comply, perform, or provide socially desirable responses. Acknowledging this imbalance was foundational to the ethical design of the study.

To mitigate these risks, participation was framed explicitly as voluntary and separate from ongoing instruction. Students were informed that their choice to participate, decline, or withdraw would have no impact on their lessons, assessment, or relationship with the researcher. This message was reinforced verbally and in writing, recognizing that minors may require repeated reassurance to feel genuine agency.

Informed Consent and Assent with Minors

Ethical research with minors requires both parental consent and participant assent. In this study, parents or guardians received detailed information outlining the purpose of the research, procedures, potential risks, and safeguarding measures. Consent materials were written in accessible language and emphasized that the research focused on learning processes rather than performance evaluation.

Equally important was the process of assent with participants themselves. Adolescents were provided with age-appropriate explanations of the study and were encouraged to ask questions. Assent was treated as an ongoing process rather than a single event; participants were reminded throughout the session that they could pause, skip tasks, or withdraw at any point.

This approach aligns with ethical frameworks that prioritize autonomy and respect for persons, particularly when working with young participants (Belmont Report, 1979). By foregrounding participant agency, the study sought to counterbalance the inherent authority of the teacher role.

Emotional Risk and Safeguarding Considerations

The research topic, pitch-matching in anxious adolescent singers, carried potential emotional risk. Singing-related anxiety can evoke feelings of shame, embarrassment, or failure, particularly for students who have previously internalized negative labels regarding their vocal ability. Recognizing this, the study was designed to minimize psychological risk and prioritize emotional safety.

Sessions were conducted in familiar, low-stimulus environments to reduce performance pressure. Tasks were framed as exploratory experiments rather than assessments, and evaluative language was intentionally avoided. Participants were not given feedback indicating success or failure during tasks, reducing the likelihood of reinforcing anxiety or self-judgement.

Safeguarding protocols were established in advance should distress arise. These included pausing the session, redirecting to grounding activities, and, if necessary, terminating participation. No participant exhibited distress requiring escalation; however, the presence of clear procedures supported ethical preparedness.

Measuring Anxiety Without Pathologizing

Measuring anxiety in minors presents ethical challenges, particularly the risk of pathologizing normal emotional responses. The use of a Visual Analogue Scale (VAS) was a deliberate choice to balance data collection with emotional sensitivity. Rather than invoking clinical terminology or diagnostic framing, the VAS allowed participants to express momentary feelings of nervousness in a neutral, non-judgemental manner.

Participants were informed that feeling nervous was normal and expected, and that their responses were not indicators of success or failure. This framing aligns with trauma-informed

educational practices, which emphasize normalization of emotional responses and avoidance of deficit narratives (Jellison, Draper and Brown, 2021). Students seemed to accept this as truth, especially when I too did not make it a “big deal.”

By situating anxiety measurement as a reflective check-in rather than an evaluative tool, the study sought to honour participants’ emotional experience while still capturing meaningful data.

Power Dynamics During Data Collection

Despite ethical safeguards, the influence of power dynamics during data collection cannot be entirely eliminated. Participants may have modified their behavior to please the researcher, suppress discomfort, or demonstrate perceived competence. This possibility was acknowledged throughout the research process and addressed through methodological design.

Data triangulation served as a key mitigating strategy. By combining pitch-match outcomes, self-reported anxiety, observational notes, and participant reflections, the study reduced reliance on any single data source. This allowed discrepancies between perceived comfort, observable behavior, and vocal outcomes to be examined rather than obscured.

Additionally, observational notes were recorded using structured templates to reduce interpretive bias. Acoustic verification of pitch outcomes using Praat software further supported objectivity beyond in-the-moment pedagogical judgement.

Reflexivity as Ethical Practice

Reflexivity was not treated as a supplementary activity but as an ethical practice embedded throughout the study. I maintained awareness of my own assumptions, particularly the belief (formed through experience) that anxiety often mediates pitch-matching difficulty. Rather than attempting to suppress this assumption, it was made explicit and examined through systematic inquiry.

Reflexive journaling and audit trails documented decision-making processes, moments of uncertainty, and interpretive choices. This transparency supports research integrity by allowing readers to understand how conclusions were reached and where subjective judgement may have influenced interpretation.

Importantly, reflexivity also involved recognizing moments where pedagogical instincts conflicted with research neutrality. For example, resisting the urge to offer corrective feedback during tasks required conscious effort. These moments highlighted the tension inherent in insider research and reinforced the importance of clearly delineating teaching and research roles.

Ethical Trade-Offs and Methodological Justification

Several ethical trade-offs were inherent in the study design. Conducting research with current students enhanced ecological validity and emotional safety but increased the risk of coercion and bias. Conversely, recruiting unfamiliar participants might have reduced power imbalance but introduced heightened anxiety and reduced authenticity.

The decision to work with current students was therefore ethically justified not despite these risks, but because of them. For anxious adolescents, relational safety was a prerequisite for participation. The study prioritized minimizing harm and supporting wellbeing over maximal experimental control, consistent with interpretivist and practitioner research paradigms.

This approach aligns with ethical guidance emphasizing proportionality of risk and benefit, particularly in educational research with minors. By foregrounding safeguarding and reflexivity, the study maintained ethical integrity while preserving the authenticity necessary to investigate affect-sensitive learning processes.

Ethical Positioning of the Researcher

Ultimately, this study positions the researcher not as a neutral observer but an ethically accountable participant within the learning environment. Accepting this responsibility required ongoing attention to power, care, and consent. Rather than attempting to eliminate relational influence, the research acknowledged and worked within it transparently.

This ethical positioning reinforces the legitimacy of practitioner research as a method capable of generating meaningful, contextually grounded knowledge when conducted with reflexivity, care, and respect for participant autonomy.

Findings

Overview

This study examined pitch-matching accuracy and state anxiety in adolescent singers across three instructional conditions: neutral instruction, embodied solfège movement, and co-regulated movement with supportive verbal framing. Data were collected through pitch-match outcomes (match/no match), Visual Analogue Scale (VAS) anxiety ratings, structured observational field notes, and brief participant reflections.

Across all five participants, a consistent pattern emerged: as instructional support increased and self-reported anxiety decreased, pitch-matching accuracy improved. This pattern was evident across quantitative and qualitative data sources, supporting triangulation of findings within the practitioner-research framework.

Pitch-Matching Accuracy Across Instructional Conditions

Pitch-matching accuracy varied notably across the three instructional conditions.

Neutral Instruction

Under the neutral instruction condition, participants demonstrated the lowest rate of successful pitch matches. Vocal responses were often delayed, with visible hesitation prior to phonation. Several participants requested repeated pitch presentations, and false starts were common. Pitch attempts in this condition were frequently brief and interrupted, suggesting uncertainty and reduced confidence in vocal response.

Embodied Solfège

In the embodied solfège condition, pitch-matching accuracy improved for all participants. The use of solfège hand signs appeared to support quicker initiation of sound and more consistent attempts. Although incorrect matches still occurred, fewer false starts were observed, and participants demonstrated increased willingness to attempt the task without hesitation. Overall, pitch responses in this condition were more stable than in the neutral instruction condition.

Co-Regulated Movement and Supportive Framing

The co-regulated movement and supportive framing condition produced the highest rate of successful pitch matches across participants. Most correct pitch matches occurred in this condition. Participants initiated phonation more quickly, sustained tones more consistently, and

demonstrated fewer interruptions or restarts. Vocal responses appeared more confident and continuous, with reduced visible effort compared to earlier conditions.

These results indicate that pedagogical conditions incorporating movement and affective scaffolding were associated with higher pitch-matching success than neutral instruction alone.

Self-Reported Anxiety (VAS Scores)

Self-reported anxiety ratings showed a clear downward trend across the three instructional conditions.

Neutral Instruction

Participants reported the highest levels of anxiety during the neutral instruction condition. VAS ratings frequently fell in the moderate to high range both before and after the task. Visible signs of tension, such as shallow breathing and guarded posture, were commonly observed alongside elevated anxiety ratings.

Embodied Solfège

Anxiety ratings decreased during the embodied solfège condition. Most participants reported lower post-task anxiety scores compared to pre-task ratings, suggesting that engagement with gesture and movement reduced task-related nervousness. Participants appeared more relaxed and focused, and verbal expressions of uncertainty were less frequent.

Co-Regulated Movement and Supportive Framing

The lowest anxiety ratings were consistently recorded during the co-regulated movement condition. Several participants marked near the “not nervous at all” end of the scale following this task. This condition produced the largest reduction in anxiety relative to the neutral instruction condition and was associated with visible indicators of ease and regulation.

Observational Findings

Observational field notes revealed distinct behavioral patterns associated with each instructional condition.

Neutral Instruction

During the neutral instruction condition, participants commonly exhibited:

- Shallow or interrupted breathing
- Guarded posture and reduced physical movement
- Delayed vocal onset
- Avoidance of eye contact
- Verbal expressions of doubt (example: "I'm not sure.")

These behaviors frequently coincided with unsuccessful pitch matches and higher anxiety ratings.

Embodied Solfège

During the embodied solfège condition, participants demonstrated:

- Increased physical engagement through gesture
- Improved postural stability
- Faster initiation of vocal response
- Greater focus on the task

Behavioral signs of hesitation were reduced, and participants appeared more willing to attempt pitch matches without prompting.

Co-Regulated Movement and Supportive Framing

During the co-regulated movement condition, participants consistently displayed:

- Relaxed shoulders and jaw
- More continuous airflow prior to phonation
- Immediate and confident vocal attempts
- Increased willingness to retry without hesitation
- Greater eye contact and visible ease

These behavioral changes aligned closely with both reduced anxiety ratings and improved pitch-matching accuracy.

Participant Reflections

Post-session reflections further supported the observed patterns. All participants identified the co-regulated movement and supportive framing condition as the easiest or most comfortable. Common comments included:

- “That felt easier.”
- “I wasn’t thinking as much.”
- “The moving helped.”
- “I didn’t have to concentrate as hard.”
- “It just came out.”

In contrast, the neutral instruction condition was frequently described as the most difficult, with participants reporting increased pressure and self-consciousness.

Patterns Across Participants

Although individual differences were present, all five participants demonstrated the same overall trend:

- Highest anxiety and lowest pitch-matching accuracy during neutral instruction
- Moderate anxiety reduction and improved pitch accuracy during embodied solfège
- Lowest anxiety and highest pitch-matching accuracy during co-regulated movement

This consistency across participants strengthens the credibility of the findings within the context of a small-scale practitioner study.

Within-Participant Micro-Analysis and Threshold Moments

In addition to cross-condition trends, closer examination of within-participant responses revealed nuanced patterns in how anxiety, instructional framing, and pitch-matching interacted at the individual level. This micro-analysis provides insight into how and when changes in pitch access occurred, rather than simply whether they occurred.

Initial Hesitation and Access Delays

Across participants, the neutral instructional condition was characterized by delayed vocal onset and visible hesitation prior to singing. Even when participants ultimately produced a correct pitch match, access to the sound was often preceded by pauses, false starts, or verbal expressions of being unsure. These access delays suggest that pitch-matching difficulty was not solely related to perceptual accuracy, but to the initiation of vocal action under perceived evaluative pressure.

Within-participant comparison revealed that these delays were substantially reduced in subsequent conditions. Notably, some participants who produced incorrect matches in the neutral condition were able to produce more immediate, accurate responses under co-regulated conditions. This shift suggests that the barrier to pitch-matching was not the pitch itself, but the learner's readiness to engage vocally.

One example of this is "Participant C" (alias), a 14-year-old female student who initially demonstrated significant hesitation in the neutral condition. Upon hearing the target pitch, she

paused for several seconds, inhaled shallowly, and stated timidly, “I’m not sure.” Two attempts followed, both slightly below the target pitch, each interrupted mid-phonation. In contrast, during the co-regulated movement condition, after a brief period of swaying and guided breathing, the same participant responded immediately following pitch presentation. This time, she sustained the tone with stable airflow and matching accurately on the first attempt. Notably, no verbal hesitation occurred prior to phonation in this condition with just a little hesitation shown on her face. The shift was not gradual but abrupt, coinciding specifically with the introduction of movement and supportive framing.

I observed this pattern in various ways across all participants: the removal of visible access delays coincided with embodied or co-regulated instructional scaffolds. Such moments suggest that pitch-matching difficulty may at times reflect inhibited vocal initiation under perceived evaluation rather than an inability to perceive or reproduce pitch accurately. The difference between “I’m not sure” and immediate phonation under supportive conditions underscores the central proposition of this study: pitch access is mediated not only by auditory-motor capacity but by affective readiness.

Threshold Moments of Engagement

A particularly salient pattern emerged in what may be described as threshold moments, which are points within the session at which participants appeared to cross from guarded participation into more spontaneous vocal engagement. These moments were not evenly distributed across conditions.

For most participants, threshold moments occurred during the co-regulated movement condition. Observable indicators included:

- immediate phonation following pitch presentation
- increased volume consistency
- reduced facial tension

- spontaneous retries without prompting

In several cases, participants who had previously requested repeated pitch presentations began responding after a single stimulus. This shift often occurred after one or two successful attempts within the co-regulated condition, suggesting that early success under low-anxiety conditions may have reinforced confidence and reduced anticipatory tension.

Variability Within Conditions

Within-condition variability further supports the role of affective state in pitch-matching. In the neutral condition, participants' responses fluctuated considerably, with correct and incorrect matches interspersed unpredictably. This inconsistency aligns with anxiety literature suggesting that heightened arousal disrupts motor stability and increases performance variability (Kenny, 2011).

By contrast, responses within the co-regulated condition were more stable. Even when participants did not achieve a correct pitch match, their attempts were more consistent in tone quality, onset timing, and willingness to continue. This suggests that reduced anxiety supported not only accuracy but also *task persistence*, an important precursor to learning.

Shifts in Self-Monitoring Behavior

Observational data indicated a notable reduction in overt self-monitoring behaviors across conditions. In the neutral condition, participants frequently engaged in behaviors associated with evaluative self-monitoring, such as:

- verbalizing doubt before singing
- watching the researcher closely for feedback
- restarting phonation mid-attempt

As instructional support increased, these behaviors diminished. During embodied and co-regulated conditions, participants appeared less concerned with external validation and more absorbed in the act of singing itself. This shift aligns with motor learning research suggesting

that reduced conscious monitoring supports more efficient motor execution (Schmidt and Lee, 2011).

Anxiety Reduction as an Enabler

Within-participant data also suggest that anxiety reduction functioned as an enabler of pitch-matching rather than merely a consequence of successful attempts. In several cases, VAS anxiety scores decreased before a correct match occurred within a condition, indicating that emotional regulation preceded technical success.

This temporal relationship challenges interpretations that improved pitch accuracy simply reduces anxiety. Instead, it supports the view that pedagogical conditions which reduce perceived threat may unlock access to vocal coordination that is already developmentally available.

Individual Differences Within Shared Patterns

While overall trends were consistent across participants, individual pathways varied. Some participants demonstrated rapid improvement once anxiety decreased, while others showed gradual changes across conditions. These differences highlight the importance of recognizing individual variability within pedagogical research and caution against assuming uniform responses to instructional strategies.

However, despite these differences, all participants demonstrated their highest level of engagement and pitch-matching success within the co-regulated condition. This convergence strengthens confidence in the broader pattern while respecting individual nuance.

Summary of Micro-Analytic Findings

The within-participant micro-analysis reinforces the central finding that pitch-matching access is highly sensitive to affective and pedagogical context. Threshold moments of engagement, reduced hesitation, increased response stability, and diminished self-monitoring behaviors all coincided with conditions designed to reduce anxiety and support co-regulation.

These findings suggest that pitch-matching difficulties in adolescents may often reflect delayed access rather than lack of ability. By attending to the moments where access shifts (rather than

solely to outcomes) educators may gain deeper insight into how to support vocal development in anxious learners.

Summary of Findings

The findings demonstrated a clear relationship between instructional approach, anxiety levels, and pitch-matching success. As anxiety decreased across instructional conditions, pitch accuracy increased. The co-regulated movement and supportive framing condition produced both the lowest anxiety and the highest pitch-matching accuracy across all participants.

These results suggest that pitch-matching ability in adolescent singers may be strongly mediated by affective state and pedagogical framing, rather than representing a fixed technical limitation.

A full breakdown of pitch-match outcomes per participant and aggregated VAS scores is provided in Appendix C and Appendix E.

Limitations

Several limitations should be acknowledged. The small sample size limits the generalizability of the findings beyond this specific teaching context. Pitch accuracy was measured using a binary match/no match system, which may not capture subtle improvements in intonation or vocal stability. Additionally, the fixed order of instructional conditions may have contributed to increased comfort over time independent of pedagogical approach.

My (the researcher) presence and teaching style may also have influenced participant responses despite reflexive efforts to mitigate bias. Nevertheless, the consistency of patterns across participants and triangulation of quantitative and qualitative data support the validity of the findings within an exploratory practitioner-research framework.

Discussion

Reinterpreting Pitch-Matching Through an Affective Lens

The findings of this study suggest that pitch-matching in adolescent singers is not a fixed or purely technical ability, but a behavior that is strongly mediated by affective state and

pedagogical context. Across all participants, pitch accuracy improved as anxiety decreased, particularly under instructional conditions designed to promote embodied engagement and co-regulation. This pattern invites a reconsideration of how pitch-matching is conceptualized within vocal pedagogy.

Traditional models often frame pitch-matching as a perceptual or motor skill that can be trained through repetition and corrective feedback (Welch, 1979). Within such models, inaccurate pitch reproduction is frequently attributed to deficits in auditory discrimination or vocal control.

However, the present findings challenge this deficit-oriented interpretation. Participants demonstrated markedly different levels of pitch accuracy across instructional conditions within a single session, suggesting that pitch-matching capacity was present but inconsistently accessible depending on emotional and relational context.

This aligns with developmental perspectives that view pitch accuracy as context-sensitive and experience-dependent rather than innate or static (Welch, 2006; McPherson and Welch, 2018). By demonstrating that pitch accuracy improved when anxiety was reduced, the study supports the interpretation of pitch-matching as an affectively mediated skill, contingent upon learners' perceived safety and readiness to engage.

Anxiety as a Mediating Variable in Vocal Learning

The relationship between anxiety and pitch-matching observed in this study is consistent with existing research on music performance anxiety and motor control. Anxiety is known to alter breathing patterns, increase muscular tension, narrow attentional focus, and disrupt working memory (Kenny, 2011). Each of these factors directly affects the physiological and cognitive systems required for accurate pitch production.

In the neutral instructional condition, participants exhibited behaviors commonly associated with heightened anxiety, including shallow breathing, delayed vocal onset, and hesitation. These behaviors likely interfered with respiratory–phonatory coordination and auditory monitoring, resulting in reduced pitch accuracy. From a motor learning perspective, increased self-monitoring under anxiety may have disrupted automatic motor execution, leading to greater variability and inconsistency (Schmidt and Lee, 2011).

Importantly, the anxiety measured in this study was state anxiety rather than trait anxiety. Participants were not identified as clinically anxious, yet still demonstrated significant

fluctuations in anxiety depending on instructional framing. This distinction is critical for pedagogical practice. It suggests that vocal difficulties attributed to learner disposition may, in fact, be situationally induced by instructional design, evaluative pressure, or relational dynamics.

Educational literature increasingly emphasizes that state anxiety during learning tasks can precede and inhibit cognitive and motor engagement (Jellison, Draper and Brown, 2021). The present findings reinforce this perspective, indicating that anxiety reduction may be a prerequisite for effective vocal learning rather than an ancillary concern.

Embodiment and Audiomotor Integration

The embodied solfège condition produced moderate improvements in pitch accuracy and anxiety reduction, supporting theoretical claims that movement facilitates perception–action coupling. Embodiment theory proposes that cognition is grounded in bodily experience and that movement can scaffold abstract processes such as pitch perception (Sheets-Johnstone, 2015).

In this study, solfège hand signs appeared to provide participants with an externalized spatial representation of pitch height, reducing reliance on internal auditory monitoring. This external focus may have alleviated cognitive load and reduced self-consciousness, allowing participants to access pitch more directly. These findings are consistent with music education research demonstrating that gesture and movement enhance pitch perception and engagement, particularly for learners who struggle with purely auditory instruction (Welch et al., 2010).

However, while embodiment supported improved pitch outcomes, it did not fully account for the lowest anxiety levels or highest accuracy observed in the co-regulated condition. This suggests that embodiment alone may be insufficient if not accompanied by affective support and relational safety.

Co-Regulation, Polyvagal Theory, and Vocal Access

The most significant improvements in both pitch accuracy and anxiety reduction occurred under the co-regulated movement and supportive framing condition. This finding strongly supports polyvagal theory, which posits that vocalization and social communication are dependent on perceived safety and autonomic nervous system regulation (Porges, 2011).

According to polyvagal theory, activation of the ventral vagal system supports breath regulation, vocal flexibility, and auditory receptivity. In contrast, perceived threat activates defensive states

that restrict vocal and respiratory freedom. The behaviors observed in the neutral condition (guarded posture, shallow breath, delayed onset) are consistent with defensive autonomic states, while the relaxed posture and immediate vocal responses observed in the co-regulated condition align with ventral vagal engagement.

The combination of gentle movement, slow breathing, and non-evaluative language likely functioned as cues of safety, enabling participants to regulate their nervous systems sufficiently to attempt pitch-matching without fear of failure. Importantly, this condition did not eliminate challenge; rather, it reframed challenge within a context of support, allowing vocal access without triggering threat responses.

These findings extend polyvagal-informed pedagogy into the domain of pitch-matching, an area where emotional regulation has received limited empirical attention. They suggest that co-regulation is not merely a classroom management strategy, but a foundational pedagogical mechanism influencing vocal function itself.

Pitch-Matching as a Relational Skill

A central contribution of this study is the repositioning of pitch-matching as a relational and affective skill rather than an isolated technical ability. The consistent improvement observed across participants under supportive conditions indicates that pitch accuracy is shaped by how learners perceive the teaching interaction, not solely by their auditory capacity.

This perspective aligns with relational models of learning, which emphasize that knowledge and skill emerge through interaction rather than individual capacity alone. In voice pedagogy, where the instrument is inseparable from the body and self, relational safety may be particularly critical.

Deficit-based labels such as “pitch weak” risk obscuring this relational dimension by framing difficulty as inherent limitation. The present findings challenge such labels by demonstrating that the same learners who struggled to match pitch under evaluative conditions could do so more successfully when anxiety was reduced. This has significant implications for how teachers assess, describe, and respond to pitch-matching difficulties in adolescents.

Contextual-Affective Model of Pitch-Matching

The findings of this study support a reconceptualization of pitch-matching as a contextual–affective skill rather than a purely auditory or technical capacity. While traditional

pedagogical models often frame pitch-matching as an isolated auditory-motor task, the results of this practitioner inquiry suggest that access to pitch is contingent upon a complex interaction between affective state, pedagogical framing, bodily engagement, and perceived safety within the learning environment.

Moving Beyond Deficit-Based Models

Conventional approaches to pitch-matching frequently interpret inaccuracy as evidence of limited auditory perception or innate musical aptitude (Welch, 1979). Within such deficit-based frameworks, instructional responses tend to prioritize repetition, correction, and increased auditory focus. However, the present findings challenge the assumption that pitch-matching difficulty necessarily reflects a deficit in perceptual ability.

Across participants, pitch accuracy fluctuated significantly depending on instructional context. When anxiety was elevated, pitch access was delayed or inhibited, even when perceptual understanding appeared intact. When anxiety was reduced through embodied movement and co-regulation, pitch-matching improved rapidly and consistently. This pattern suggests that pitch-matching difficulty may often represent a *state-dependent access issue* rather than a stable technical limitation.

This aligns with developmental perspectives that position pitch-matching on a continuum influenced by experience, confidence, and learning environment (Welch, 2006; McPherson and Welch, 2018). The present study extends this view by demonstrating how affective context can mediate access to pitch in real time.

Affective State as a Mediating Variable

A central contribution of this study is the identification of affective state as a mediating variable between auditory perception and vocal output. Anxiety appeared to disrupt pitch-matching not by altering perceptual input, but by interfering with the physiological and motor processes required for vocal initiation and coordination.

From a psychophysiological perspective, anxiety alters breathing patterns, increases muscular tension, and narrows attentional focus (Kenny, 2011). These effects compromise the respiratory–phonatory coordination essential for accurate pitch production. Observational data from this study provide applied evidence of these mechanisms in adolescent learners.

It is worth noting that the temporal sequencing of anxiety ratings and pitch outcomes offers further insight into this relationship. In each instructional condition, participants recorded a VAS anxiety score prior to completing the five pitch trials and again immediately following the condition. In several cases, anxiety ratings decreased following the initial embodied or co-regulated preparatory elements (including swaying, breathing cues, or supportive reframing) before consistent pitch-matching success was observed. For example, Participant A (alias) reported a pre-condition anxiety rating of 62/100 in the neutral condition and 58/100 following that condition, alongside inconsistent pitch attempts. In the co-regulated condition, the participant's pre-trial anxiety rating was already lower (44/100) following the preparatory breathing and movement cues. The first pitch attempt in that condition was accurate and immediate. Similar patterns were observed in other participants, where anxiety ratings at the start of embodied or co-regulated conditions were lower than in the neutral condition, and accurate matches occurred within the first or second trial of the five-note sequence.

While the study design does not permit strong causal inference, this sequencing suggests that reduced anxiety was present prior to sustained pitch accuracy within those conditions rather than emerging only after repeated correct matches. In other words, improvements in pitch-matching were not consistently preceded by a string of successful attempts that might explain anxiety reduction as a consequence of technical mastery. Instead, lower anxiety states appeared to coincide with the initiation of more immediate and stable vocal responses.

This pattern supports the interpretation of anxiety reduction as an enabling condition for pitch access rather than merely an outcome of success. Rather than viewing emotional regulation as a byproduct of improved technical performance, the data suggest that affective state may function as a gatekeeper variable influencing whether existing perceptual-motor capacity can be accessed in the first place.

Embodiment and Audiomotor Access

Embodied learning strategies played a significant role in mediating pitch access. The use of solfège hand signs and movement appeared to reduce cognitive load and externalize pitch relationships, supporting audiomotor coupling. This aligns with embodiment theory, which proposes that cognition is grounded in bodily action and sensory experience (Sheets-Johnstone, 2015).

Within this study, embodied strategies shifted participants' attention away from internal self-monitoring and toward physical engagement with sound. This shift appeared to reduce evaluative pressure and support more immediate vocal responses. While embodied solfège alone did not produce the strongest outcomes, it functioned as a transitional support, reducing anxiety sufficiently to improve pitch accuracy for many participants.

This suggests that embodiment may operate as a bridge between auditory perception and vocal execution, particularly for learners whose access is disrupted by anxiety.

Co-Regulation and Perceived Safety

The most significant improvements in pitch-matching occurred under conditions of co-regulated movement and supportive framing. From a polyvagal perspective, these conditions likely supported engagement of the ventral vagal system, which facilitates breath regulation, vocalization, and social communication (Porges, 2011).

Supportive language, gentle movement, and the explicit removal of evaluative framing appeared to shift participants from defensive states into conditions more conducive to vocal engagement. Observable indicators of this shift included relaxed posture, continuous airflow, and spontaneous retries following unsuccessful attempts.

These findings reinforce the importance of perceived safety as a prerequisite for vocal learning. Within a contextual–affective model, pitch-matching is not simply a response to auditory input but a behavior that emerges when the nervous system is sufficiently regulated to permit vocal risk-taking.

Integrating the Model

Taken together, the findings support a contextual–affective model of pitch-matching in which:

- Auditory perception provides the informational basis for pitch
- Affective state mediates access to vocal coordination
- Embodiment supports audiomotor integration

- Co-regulation creates conditions of safety necessary for vocal engagement

Within this model, pitch-matching difficulty may arise when any element of the system is disrupted, even in the presence of adequate perceptual capacity. This challenges pedagogical practices that focus narrowly on auditory correction without attending to emotional readiness.

Implications of the Model

Adopting a contextual–affective model has significant implications for voice pedagogy and music education. It suggests that early pitch instruction should prioritize emotional safety and bodily engagement as foundational conditions rather than supplementary strategies. Teachers may need to reconsider assessment practices that interpret pitch accuracy as a stable indicator of ability without accounting for affective context.

For anxious and neurodivergent learners in particular, this model offers a reframing that shifts responsibility away from the learner’s perceived deficiency and toward the instructional environment. By adjusting pedagogical framing, educators may unlock access to pitch-matching abilities that were previously inhibited.

Positioning the Contribution

While previous literature has acknowledged the roles of anxiety, embodiment, and inclusive pedagogy, this study integrates these strands into a coherent applied model grounded in practitioner data. By examining pitch-matching through the combined lenses of affect, embodiment, and co-regulation, the research contributes a nuanced conceptualization of pitch-matching as an emergent, relational skill.

This contextual–affective model does not reject technical training, but situates it within a broader understanding of how emotional and physiological readiness shape vocal learning. In doing so, it offers both theoretical and practical insight into how adolescent singers can be more effectively supported in developing pitch accuracy.

Pedagogical Reframing of Pitch Assessment

The findings of this study invite us to take a careful look and critically reconsider how pitch-matching is assessed within vocal pedagogy, specifically with adolescents. Traditional

assessment practices often position pitch accuracy as an early indicator of musical competence, implicitly treating it as a stable trait rather than a context-sensitive skill. Within such frameworks, inaccurate pitch reproduction is often interpreted as evidence of limited ability, leading to corrective or remedial approaches that may inadvertently reinforce anxiety and disengagement. More often than not, a teacher may write off this student or may not even want to work with them, because it takes “more effort” or “there is no guarantee the student will become a great singer.” Arguably, those individuals should not be teaching, but perhaps given the right information, this mindset can change.

The contextual–affective model proposed in this study suggests that pitch-matching accuracy is contingent upon affective state, pedagogical framing, and perceived safety. As such, assessment practices that do not account for these variables risk misrepresenting learners’ true vocal capacity. When pitch-matching is evaluated in emotionally charged or evaluative contexts, the resulting data may reflect anxiety-mediated inhibition rather than perceptual or technical limitation.

From this perspective, pitch-matching assessment should be understood not as a diagnostic endpoint, but as a situational snapshot influenced by instructional conditions. This aligns with developmental models of musical learning that caution against early aptitude-based judgments and emphasize the development and malleability of vocal skills over one’s life (Welch, 2006; McPherson and Welch, 2018). Reframing pitch assessment in this way supports a shift from deficit-based labeling toward formative, process-oriented evaluation.

What might affective-sensitive assessment look like in practice for teachers? An affectively-sensitive approach to pitch assessment does not eliminate evaluation, but restructures the conditions under which it occurs. Procedurally, this may involve several deliberate stages:

1. Regulation Before Evaluation

Rather than beginning with immediate pitch reproduction, the teacher might first guide brief co-regulatory preparation. This can include slow breathing, gentle swaying, or a short vocal exploration task framed as non-evaluative. This establishes a baseline of perceived safety before pitch tasks are introduced.

2. Audiation and Response Latency Built In

Students could be explicitly invited to audiate silently before singing, perhaps counting to three or five prior to phonation. This has worked extremely well with my students, specifically those with ADHD. This reduces impulsive responding, actually hearing the note before trying to respond, and supports attentional focus, particularly for learners with anxiety or attentional variability. Importantly, response latency would not be interpreted as incompetence but as part of the assessment process.

3. Multiple Context Sampling

Rather than assessing pitch accuracy under a single neutral prompt, teachers might observe pitch-matching across varied conditions: neutral instruction, embodied gesture, and supportive framing. If accuracy improves under certain conditions, this indicates that affective or kinesthetic scaffolding supports access to pitch capacity.

4. Observing Process Indicators

Teachers would attend not only to match/no-match outcomes, but also to behavioural markers such as breath continuity, onset timing, posture, and willingness to retry. These indicators may reveal whether difficulty arises from tension, hesitation, or perceptual confusion.

5. Framing Results Developmentally

Feedback would emphasize variability and growth potential rather than categorical labeling. For example, rather than stating “You struggle with pitch,” a teacher might note, “Your pitch is most accurate when you use movement and take a moment to listen first. Let’s keep building from there.”

Such an approach does not dilute technical standards. Instead, it seeks to ensure that assessment reflects a learner’s accessible capacity rather than their momentary anxiety state. By structuring assessment as an exploration of conditions that support success, educators can identify both current skill level and optimal learning pathways.

For neurodivergent and anxious adolescents, such reframing carries particular ethical significance. Assessment practices that privilege immediate accuracy may disproportionately disadvantage learners who require additional time, movement, or relational safety to engage vocally. Think of all the singers who quit too soon because of this. By acknowledging the role of affective context, educators can design assessment processes that are more inclusive and developmentally appropriate.

Ultimately, reframing pitch-matching assessment as context-sensitive rather than ability-definitive aligns assessment practices with the realities of vocal learning. It positions pitch accuracy as an emergent outcome shaped by pedagogy, rather than a fixed benchmark against which learners are judged. In doing so, it supports assessment approaches that foster confidence, engagement, and long-term participation in singing rather than premature categorization or exclusion.

Implications for Vocal Pedagogy

The pedagogical implications of this study are substantial. If pitch-matching accuracy is contingent upon affective state and instructional framing, then emotionally responsive teaching is not optional but essential. Voice teachers may need to reconsider pedagogical practices that prioritize correction, repetition, or accuracy without first addressing nervous system regulation.

Practical implications include:

- Integrating embodied movement routinely into pitch instruction rather than as a remedial strategy
- Using non-evaluative language that emphasizes exploration rather than correctness
- Allowing time for breath regulation and audiation before vocal response
- Recognizing hesitation and withdrawal as signals of anxiety rather than lack of ability

For anxious and neurodivergent learners, these strategies may be particularly important. Inclusive pedagogy literature highlights that learners with heightened sensory or emotional sensitivity are disproportionately affected by evaluative teaching models (Jellison, Draper and Brown, 2021). By foregrounding co-regulation and embodiment, voice teachers can create learning environments that accommodate diverse needs without lowering musical expectations.

Implications for Assessment and Labelling

The findings also raise important questions about assessment practices in vocal education. Pitch-matching is often used as an early diagnostic indicator of musical potential, yet this study

suggests that such assessments may conflate anxiety with ability. When pitch accuracy is assessed without regard to affective context, learners may be mischaracterized and discouraged prematurely.

Reframing pitch-matching as developmental and context-sensitive may support more equitable assessment practices. Rather than asking whether a student can match pitch, teachers might ask under what conditions pitch becomes accessible. This shift has the potential to reduce stigma, increase retention, and foster long-term musical engagement.

Practitioner Reflection and Professional Learning

This study prompted significant reflection on my own pedagogical habits. While I entered the research with a belief that anxiety played a central role in pitch-matching difficulties, systematic observation revealed the extent to which my own instructional choices shaped learners' responses.

The research process highlighted that my language, pacing, and physical presence were not neutral variables but active contributors to students' nervous system states. Subtle shifts toward non-evaluative framing and co-regulated pacing produced observable changes in vocal ease and willingness to engage.

Engaging in practitioner research also reinforced the value of empirical inquiry as a tool for professional growth. By triangulating observation with self-reported anxiety and pitch outcomes, I was able to interrogate assumptions and refine practice based on evidence rather than intuition alone.

Critical Limitations and Methodological Reflection

While this study offers valuable insight into the relationship between anxiety, instructional framing, and pitch-matching in adolescent singers, several methodological limitations must be acknowledged. Critically examining these limitations is essential not only for transparency, but for situating the findings appropriately within practitioner research and identifying directions for future inquiry.

Sample Size and Scope

The small sample size of five participants limits the generalizability of the findings beyond the immediate teaching context. The primary aim was depth of insight rather than statistical representativeness. However, the limited number of participants means that findings should be interpreted as indicative rather than definitive.

The consistency of patterns observed across participants strengthens confidence in the internal coherence of the findings, yet it remains possible that individual differences in temperament, musical background, or developmental stage influenced outcomes. Future research involving larger participant groups and varied learning contexts would be necessary to determine the extent to which these patterns generalize across adolescent populations.

Single-Session Design

The decision to conduct the study within a single session was informed by ethical considerations, including minimizing participant burden and avoiding prolonged exposure to potentially anxiety-inducing tasks. While this design enabled observation of immediate changes in anxiety and pitch response, it also limited insight into longer-term learning effects.

Pitch-matching improvements observed within a single session may reflect short-term access rather than sustained skill development. Longitudinal designs could investigate whether repeated exposure to co-regulated and embodied instructional approaches leads to enduring improvements in pitch accuracy, confidence, and self-efficacy.

Measurement of Pitch Accuracy

Pitch accuracy in this study was measured using a binary match/no match system, reflecting functional pedagogical assessment rather than fine-grained acoustic deviation. While this approach aligns with classroom practice and reduced evaluative pressure on participants, it may have obscured subtle improvements in intonation, pitch stability, or onset accuracy.

Although recordings were reviewed using Praat software to confirm pitch correspondence, future research could incorporate detailed acoustic analysis to examine whether anxiety reduction influences not only pitch accuracy but also pitch precision and vocal consistency.

Measurement of Anxiety

State anxiety was measured using a Visual Analogue Scale (VAS), chosen for its simplicity and suitability for adolescent participants. While the VAS effectively captured moment-to-moment affective shifts, it relied on self-report and did not capture physiological indicators of anxiety such as heart rate or respiration.

Additionally, the framing of anxiety measurement as a non-evaluative check-in may have influenced how participants interpreted and reported their feelings. While this framing was ethically appropriate, it may have resulted in underreporting of discomfort in some cases. Future studies could explore triangulating self-report with physiological or behavioral markers of anxiety.

Order Effects and Procedural Constraints

The fixed order of instructional conditions introduces the possibility of order effects. Participants may have become more comfortable with the task over time, independently of instructional approach. While the repeated-measures design allowed for within-participant comparison, randomizing condition order in future studies could help disentangle familiarity effects from pedagogical impact.

However, the decision to maintain a consistent order was a pragmatic choice aligned with ethical priorities. Reducing cognitive load and procedural confusion was deemed more important than strict experimental control, particularly given the participants' age and anxiety profile. This trade-off reflects a broader tension in practitioner research between methodological purity and participant wellbeing.

Insider Research and Researcher Influence

The researcher's dual role as teacher and investigator represents both a strength and a limitation of the study. Insider knowledge enabled nuanced observation of subtle behavioral shifts and informed the selection of pedagogically meaningful instructional conditions. However, this positioning also introduced the risk of confirmation bias and participant response bias.

Participants may have altered their behavior due to the existing teacher–student relationship, either attempting to please the researcher or suppressing expressions of discomfort. To mitigate this, participation was framed as voluntary, non-evaluative, and separate from regular instruction. Nonetheless, the influence of relational dynamics cannot be fully eliminated.

Reflexive strategies such as structured observation templates, delayed analysis, and triangulation across data sources, were employed to reduce bias. Acknowledging these limitations does not diminish the validity of the findings, but situates them within the ethical and relational realities of practitioner research.

Methodological Trade-Offs and Research Integrity

Several methodological decisions involved deliberate trade-offs between experimental control and ecological validity. Conducting the study within a familiar teaching environment enhanced emotional safety and authenticity, but reduced the ability to control extraneous variables. Similarly, prioritizing participant wellbeing over randomization or repeated exposure limited methodological precision.

These trade-offs were consistent with the interpretivist paradigm underpinning the study, which values situated understanding over generalizable prediction. Within this framework, research integrity is maintained not through control alone, but through transparency, reflexivity, and alignment between research questions, methods, and ethical commitments.

Reflective Evaluation of the Research Process

Engaging in this research prompted critical reflection on the complexities of investigating affect-sensitive phenomena within one's own teaching practice. The process highlighted the challenge of balancing pedagogical care with analytical distance, particularly when working with vulnerable populations.

The study also underscored the importance of humility in practitioner research. While the findings support the role of anxiety reduction in facilitating pitch-matching, they do not suggest a single solution or universal approach. Rather, they invite ongoing inquiry into how pedagogical environments shape vocal access and learning readiness.

Implications of Limitations for Interpretation

Taken together, these limitations suggest that the findings should be interpreted as contextually grounded insights rather than universal claims. They offer evidence that instructional framing can significantly influence pitch-matching access within a specific teaching context, while also highlighting the need for further research to explore scope, durability, and generalizability.

By critically engaging with methodological limitations, this study contributes not only findings but also a reflective account of how practitioner research can responsibly investigate complex, affectively mediated learning processes.

Directions for Future Research

While the findings offer valuable insight, they also point toward areas for further investigation. Longitudinal studies could examine whether sustained use of co-regulated and embodied pedagogy leads to lasting improvements in pitch accuracy and musical self-efficacy. Larger sample sizes and varied age groups could strengthen generalizability.

Future research might also incorporate fine-grained acoustic analysis to examine whether anxiety reduction affects pitch stability, timbre, or vocal onset beyond binary accuracy. Exploration of neurodivergent populations in greater depth may further inform inclusive voice pedagogy.

Contribution to Knowledge and Professional Practice

This study makes a modest but meaningful contribution to both scholarly understanding and professional practice within voice pedagogy and music education. While its scope is necessarily limited by scale and context, the research offers empirically grounded insight into how anxiety and pedagogical framing interact to shape pitch-matching behavior in adolescent singers.

Contribution to Knowledge

At a conceptual level, this study contributes to existing literature by reframing pitch-matching as an affectively mediated, context-dependent behavior rather than a fixed technical skill or indicator of musical aptitude. While previous research has acknowledged that pitch accuracy develops along a continuum and is influenced by learning environment (Welch, 2006; McPherson and Welch, 2018), few empirical studies have examined how moment-to-moment state anxiety directly influences pitch-matching access in adolescents.

By demonstrating that the same learners produced markedly different pitch-matching outcomes under different instructional conditions within a single session, this study provides applied evidence that anxiety functions as a mediating variable in early vocal skill execution. This finding

extends music performance anxiety literature, which has traditionally focused on high-stakes performance contexts (Kenny, 2011), into the domain of routine vocal learning tasks.

The study also contributes to theoretical integration across disciplines. By bringing together embodiment theory (Sheets-Johnstone, 2015), polyvagal theory (Porges, 2011), and motor learning principles (Schmidt and Lee, 2011), the research offers a more holistic explanatory framework for pitch-matching difficulties. This interdisciplinary synthesis supports the argument that vocal accuracy cannot be fully understood without considering emotional regulation, bodily engagement, and relational safety.

Importantly, this study contributes to practitioner-led scholarship by demonstrating how insider research can generate rigorous, ethically grounded insight into pedagogical phenomena that are difficult to capture through external observation alone. In doing so, it responds to calls within music education research for studies that bridge theory and practice rather than treating them as separate domains (McPherson and Welch, 2018).

Contribution to Professional Practice

From a professional practice perspective, the findings offer clear and actionable implications for voice teachers working with adolescents, particularly those who experience anxiety or neurodivergence. The study challenges deficit-based interpretations of pitch-matching difficulties and encourages educators to consider affective readiness as a prerequisite for technical instruction.

Practically, the research supports the integration of:

- embodied movement as a routine component of pitch instruction
- co-regulated pacing, breath, and movement to support nervous system regulation
- non-evaluative language that reframes pitch tasks as exploratory rather than diagnostic

These strategies are not presented as remedial tools for “weak” singers, but as inclusive pedagogical practices that may benefit all learners. By shifting emphasis from correctness to

access, teachers may reduce avoidance behaviors, increase willingness to engage, and foster more sustainable vocal development.

The study also has implications for assessment and labelling practices within vocal education. When pitch-matching is evaluated without consideration of affective context, learners may be prematurely categorized in ways that undermine confidence and long-term engagement. This research supports a more developmental, context-sensitive approach to assessing pitch accuracy, particularly in early and adolescent stages of vocal learning.

Contribution to Practitioner Development

Creating and engaging in this research study greatly contributed to my growth and development as a teacher. I learned so much about conducting a study, and the process of observing, measuring, reflecting, and analyzing pedagogical interactions deepened my awareness of how instructional framing shapes learners' emotional and vocal responses. Rather than relying on intuitive impressions of what "seemed to work," I was required to truly examine my assumptions and biases, notice patterns across conditions, and consider alternative explanations. This shifted my orientation from reactive teaching toward more deliberate, evidence-informed practice. One of the most significant changes in my understanding concerned the interpretation of hesitation. Prior to undertaking this study, I often interpreted delayed vocal onset as uncertainty about pitch perception or lack of confidence in auditory discrimination. While I attempted to respond supportively, I still tended to address the issue through repetition or increased modelling. Through systematic observation, however, I began to recognize that hesitation frequently coincided with visible tension (specifically in the throat), shallow breathing, and evaluative self-talk. All of these things suggest that the barrier was not perceptual confusion but inhibited initiation. This realization altered my immediate pedagogical response. Rather than repeating the pitch or narrowing my instructions, I now pause, shift to co-regulatory strategies (gentle movement, guided breathing, etc.), and reframe the task as exploratory. The emphasis has moved from "correcting the pitch" to "creating conditions for access." Depending on the age of the student, I may also call out the "elephant in the room" and say, "This is not anything you're doing 'wrong.' We're just going to try to let our bodies take in the information in a more efficient way." This takes pressure off of the student and eliminates feelings of shame and embarrassment.

A second shift has taken place in how I structure early lessons with adolescents who present as “pitch-weak.” Previously, I might have included pitch-matching tasks relatively early in a session to assess ability. Following this research, I intentionally delay direct pitch evaluation until after embodied vocal exploration and relational safety are established. I am a stranger to them for the first lesson, and I cannot expect them to perform at their best or make judgments about their ability in one session. I now view affective regulation as preparatory pedagogy rather than an optional supplement. This adjustment reflects a conceptual reordering of priorities for me, because emotional safety precedes technical assessment. When we have emotional safety, the technique will come.

The research process also sharpened my reflexive awareness. Being both teacher and researcher required careful monitoring of my tone, pacing, and subtle evaluative cues. I became increasingly conscious of how even neutral phrasing can carry perceived judgment for adolescents. As a result, I have adopted more explicit meta-communication in my teaching (such as naming that hesitation is normal, normalising variability, and emphasizing process over outcome). These changes are not performative; rather, they represent a deeper alignment between my theoretical commitments to inclusive pedagogy and my embodied teaching presence.

Finally, conducting this study strengthened my confidence in integrating interdisciplinary theory into practice. Concepts such as polyvagal-informed co-regulation and embodiment are no longer abstract frameworks but lived pedagogical tools. Rather than treating research as external validation, I now experience it as a lens through which teaching becomes more intentional, ethically grounded, and responsive to learner variability.

Through this process, my professional identity has shifted from that of a teacher who draws on research to that of a practitioner who generates and interrogates knowledge within her own pedagogical context. This has made me not only more confident, but a more critical and reflexive teacher in my approaches and pedagogy.

Summary of Contribution

Taken together, this study contributes to knowledge by:

- empirically linking state anxiety to pitch-matching access in adolescents
- integrating embodiment, polyvagal theory, and motor learning within vocal pedagogy
- demonstrating the value of practitioner research in affect-sensitive learning contexts

It contributes to practice by:

- offering concrete strategies for anxiety-sensitive pitch instruction
- challenging deficit-based narratives around pitch accuracy
- supporting inclusive, relational approaches to adolescent voice teaching

While the study does not claim generalizability, it offers transferable insight that may inform both future research and reflective pedagogical practice within voice education.

Concluding Synthesis

Taken together, the findings of this study suggest that pitch-matching difficulties in adolescent singers may reflect not an inability to hear or produce pitch, but a temporary inaccessibility mediated by anxiety and pedagogical context. By integrating embodiment, co-regulation, and supportive framing, voice teachers may unlock pitch accuracy that is otherwise inhibited.

Ultimately, this research reframes voice pedagogy as a relational, embodied, and affect-sensitive practice. In doing so, it challenges deficit-based narratives and invites educators to reconsider what it truly means to support vocal development in adolescents.

Reflective Conclusion

Summary of the Study

This practitioner research project investigated the relationship between anxiety and pitch-matching ability in adolescent singers and examined whether specific instructional

strategies could reduce anxiety while supporting vocal accuracy. Through a small-scale, mixed-methods study involving five current students, clear patterns emerged demonstrating that pitch-matching success increased as anxiety decreased across instructional conditions.

The study found that neutral instructional framing was associated with higher anxiety and lower pitch accuracy, while embodied solfège movement produced moderate improvements. The most significant gains occurred when instruction incorporated co-regulated movement and supportive verbal framing, resulting in both the lowest anxiety levels and the highest pitch-matching success.

Contribution to Practice and Knowledge

While limited in scale, this study contributes applied, practitioner-informed insight to the fields of voice pedagogy and music education. It provides empirical support for the proposition that pitch-matching difficulties in adolescents may be mediated by affective state rather than reflecting fixed technical deficits. By demonstrating measurable changes in pitch accuracy alongside changes in anxiety, the research bridges performance psychology, embodiment theory, and vocal pedagogy within an authentic teaching context.

The study also contributes methodologically by illustrating the value of practitioner research in examining moment-to-moment pedagogical processes that may be difficult to capture through external or laboratory-based research. In doing so, it responds to calls for research that informs both scholarly understanding and professional practice (McPherson and Welch, 2018).

Practitioner Reflexivity and Professional Learning

Conducting this research prompted significant reflexive insight into my own teaching practice. While I had long suspected that anxiety influenced pitch-matching difficulties, systematic investigation revealed the extent to which my instructional language, pacing, and physical presence shaped students' vocal responses. The research highlighted that pedagogical neutrality is not truly neutral and that instructional framing can either amplify or alleviate anxiety.

Engaging in practitioner research also strengthened my ability to critically examine assumptions embedded within my teaching. Triangulating observational impressions with participant self-report and pitch outcomes allowed me to distinguish between perceived effort and actual

vocal response. This process reinforced the value of empirical inquiry as a tool for professional growth rather than mere academic requirement.

As a result, I have begun to integrate co-regulation, embodied movement, and explicit normalization of uncertainty more intentionally into my teaching practice. These changes reflect a shift toward viewing vocal instruction as an inherently relational and embodied process.

Limitations and Future Directions

Several limitations must be acknowledged. The small sample size and single-session design limit generalizability. The binary measurement of pitch accuracy does not capture subtle changes in intonation or vocal stability. Additionally, the fixed order of instructional conditions may have influenced participant comfort independently of pedagogical approach.

Future research could address these limitations by incorporating larger participant groups, longitudinal designs, and fine-grained acoustic analysis of pitch deviation. Further investigation into neurodivergent populations and varied age groups may also yield important insights. Long-term studies could explore whether sustained use of co-regulated and embodied pedagogy leads to enduring improvements in pitch accuracy and musical self-efficacy.

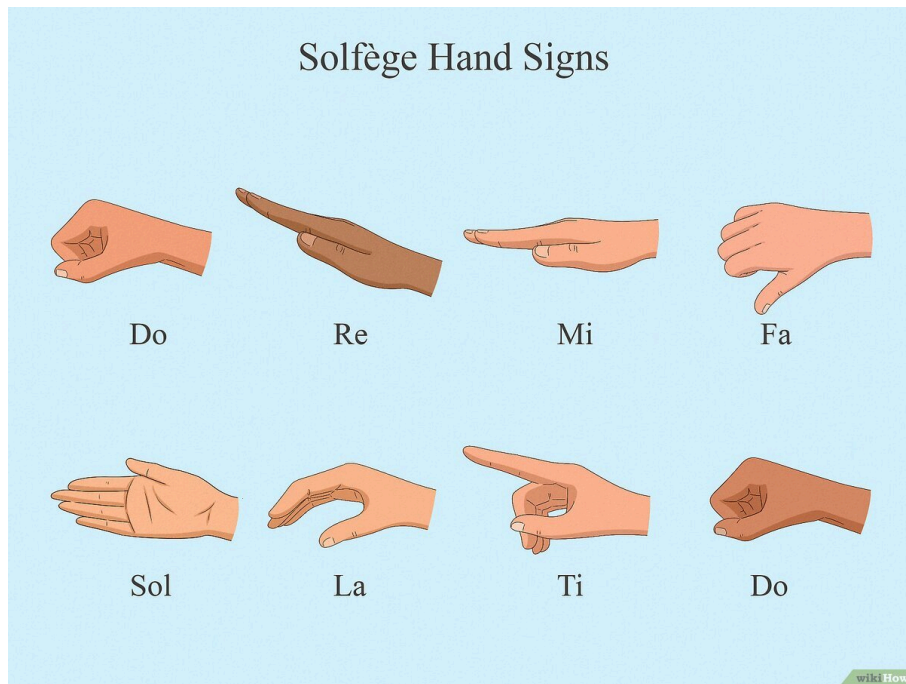
Final Reflection

This study suggests that pitch-matching accuracy in adolescent singers may be less about hearing correctly and more about feeling safe enough to attempt the sound. In this way, voice pedagogy becomes not only a technical discipline but a relational and embodied practice. By aligning instruction with emotional readiness, voice teachers may unlock vocal potential that would otherwise remain inhibited by anxiety.

Appendix A

Instructional Condition	Pitch-Match Success (overall trend)	Average Anxiety (VAS trend)	Common Observations
Neutral Instruction	Lowest success rate	Highest anxiety	Hesitation, shallow breath, guarded posture, delayed onset
Embodied Solfège	Moderate improvement	Moderate anxiety reduction	Increased focus, quicker attempts, improved posture
Co-regulated Movement & Supportive Framing	Highest success rate	Lowest anxiety	Relaxed jaw/shoulders, immediate attempts, visible ease, sustained phonation

Appendix B



Appendix C

Pitch-Match Outcomes by Participant

PARTICIPANT	NEUTRAL	EMBODIED	CO-REGULATED	TOTAL CORRECT
A	2/5	3/5	5/5	10/15
B	2/5	4/5	4/5	10/15
C	1/5	3/5	4/5	8/15
D	1/5	2/5	4/5	7/15
E	2/5	3/5	3/5	8/15

Aggregated Condition Totals

Neutral Condition

- Total correct: 8/25
- Mean per participant: 1.6/5
- Success rate: 32%

Embodied Solfège

- Total correct: 15/25

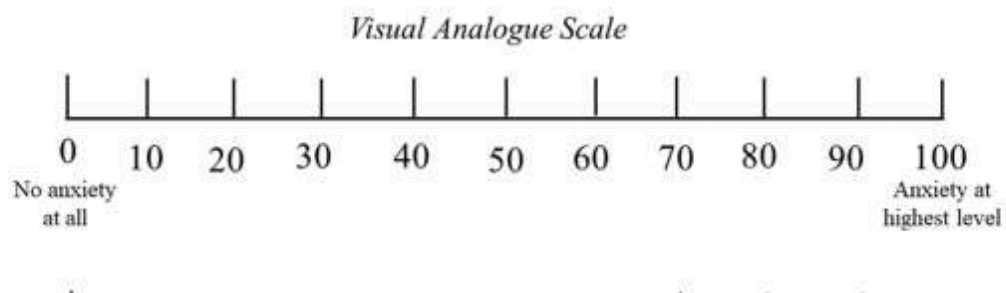
- Mean per participant: 3/5
- Success rate: 60%

Co-Regulated Movement

- Total correct: 20/25
- Mean per participant: 4/5
- Success rate: 80%

Appendix D

Participant VAS Anxiety Form (Wu et al., 2021)



Appendix E

Participant VAS Anxiety Scores (Pre and Post per Condition)

Scores recorded on a scale of 0-100.

Participant	Pre-Neutral	Post-Neutral	Pre-Solfège	Post-Solfège	Pre-Co Regulated	Post-Co Regulated
A	62	58	48	42	44	35
B	70	65	55	48	40	30
C	60	55	50	45	38	28
D	68	63	52	46	42	32
E	65	60	47	41	36	25

Aggregated Anxiety Means

Neutral

- Mean Pre: 65
- Mean Post: 60.2

- Mean Reduction: 4.8

Embodied Solfege

- Mean Pre: 50.4
- Mean Post: 44.4
- Mean Reduction: 6

Co-Regulated

- Mean Pre: 40
- Mean Post: 30
- Mean Reduction: 10

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