

MODULE 4 (BMPF7073D)

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How do the cognitive and neural mechanisms of human voice stimuli, the mirror neuron system, and focus of attention underpin the effectiveness of vocal modelling in voice pedagogy?

Word Count:

Project Portfolio (1551 words)

Project Report (5732 words)

Critical Reflection (1002 words)

Total word count: 8285 words

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Project Portfolio

Part 1

Introduction and Rationale:

As a voice teacher working with both private students and tertiary education institutions, I am dedicated to equipping my students with the essential skills needed to develop a professional career in music and musical theatre (Crocco et al., 2020). This sense of responsibility drives me to excel and continually improve my coaching and teaching abilities, providing my students with the most comprehensive training possible. I have always been intrigued by vocal modelling because I have seen its effectiveness many times during my teaching career. Modelling works exceptionally well in my voice lessons, particularly when the instructions are too complex to explain verbally. Another factor contributing to this fascination is the discovery made during my Module 3 study on the perceived impact of implicit and explicit instructions in voice lessons (Tang, 2024). While two participants preferred implicit instructions, all four agreed that a mixed-methods approach is most effective, and almost all unexpectedly mentioned modelling during their interviews. They stated that they found it easiest and quickest to learn by imitating the teacher. This discovery encourages me to investigate the underlying mechanisms that make modelling effective. I intend to explore the cognitive and neural sciences behind vocal modelling by examining the roles of human voice stimuli, the mirror neuron system (HMS), and the focus of attention (FOA) in vocal modelling to gain insights into its effectiveness. By doing so, I aim to refine my pedagogical tools to offer an evidence-based strategy in my voice studio and enhance my students' learning performance.

Part 2

Planned Programme of Study

Context:

Voice teachers often utilise modelling to teach a variety of singing techniques, such as intonation, phrasing, and expression (Fonza, 2014). Singing is a complex motor task that involves an intricate network of multiple brain regions forming an auditory-motor loop, possibly involving the MNS in the frontal-parietal area, which enables effective perception, encoding, execution, and refinement of sound production (Granot et al., 2013). This

sensorimotor loop is found to be more responsive to human voice stimuli, as it yields better results in pitch and interval matching studies compared to instrumental or synthesised sounds (Granot et al., 2013). Furthermore, when the human voice stimuli align with the participant's age, gender, and/or voice type, the positive outcome is more pronounced (Lévêque, 2012), suggesting the advantage of timbre translation (Watts & Hall, 2008). In the field of motor learning, vocal modelling can be considered an external FOA due to its goal-oriented nature, as it directs attention to the targeted outcome rather than focusing internally on the bodily parts involved (Treinkman, 2022). The amount of evidence supporting the efficiency of external FOA in motor learning is substantial (Treinkman, 2022). This review aims to investigate and synthesise these underlying mechanisms: 1) the human voice stimuli, 2) the MNS, and 3) the FOA, to understand how they may have contributed to the effectiveness of vocal modelling in voice lessons.

Aims & Objectives

Aims:

- To investigate, using an inductive thematic approach to analyse and synthesise the cognitive and neural sciences underpinning the effectiveness of vocal modelling.
- To develop evidence-based strategies that will elevate my pedagogical practice with the acquired understanding from this study.

Objectives:

- Identify the cognitive and neural mechanisms that contribute to the effectiveness of vocal modelling, i.e., human voice stimuli, the MNS, and the FOA.
- Investigate how these cognitive and neural mechanisms contribute to the effectiveness of modelling.
- Explore the relationships between these mechanisms to synthesise the information.
- Examine these mechanisms to inform practical teaching strategies for voice lessons.
- Gain knowledge and experience in writing literature reviews and reflective journals.

Expected Learning Outcomes:

- Acquire a deeper understanding of the cognitive and neural mechanisms behind modelling, thus improving my ability to critically analyse pedagogical techniques.
- Aim to gain practical insights into how to optimise the use of modelling and other possible directives in my teaching.

Literature search and reading (March 3 - 30), analysis and preliminary writing (April 1 - 13), final writing and synthesising (April 28 - May 28), draft turn-in (June 15), draft amendments (June 23 - 29), and final turn-in (July 1).

Timeline 📅	MARCH 3-9	MARCH 10-16	MARCH 17-23	MARCH 24-30	APR 1-6	APR 7-13	APR 14-20	APR 21-27	APR/MAY 28-4
Vacation ✈️							18-24 Japan	Taiwan	
Tutor Meetings 👤	Meet Joseph		Meet Joseph						Meet Joseph
Tasks 📋	Research question								
Tasks 📋	Learn zotero	Search articles	Read articles	👉	Start writing pt 1	👈			Start pt 2
Sub-tasks 🖊️		Start writing on individual article 3 per week			Should have 6 written by now				Synthesise
	Article 1	✓	✓	☐			☐		
	Article 2	✓	☐	☐			☐		
	Article 3	✓	☐	☐			☐		
	Article 4	✓	☐	☐			☐		
	Article 5	✓	☐	☐			☐		
								🧠	
Other courses 🏫						Apply		Cert. Neurology 22nd, 23rd, 24th , 25th, 28th, 29th April 2025	
Time passed ⌚	✓	✓	✓	✓	✓	✓	✓	✓	✓
MAY 5-11	MAY 12-18	MAY 19-25	MAY 26-31	JUN 1-8	JUN 9-15	JUN 16-22 (15 D)	JUN 23-29	JULY 1 Deadline	
				29-12 France					
🎒				Turn in draft 🙌		Amend draft		Turn in Final	
				💡					
		Apply		Cert. Vocology					
✓	✓	✓	✓	✓	☐	☐	☐		☐

Part 3

Methodology:

As an insider researcher, I have the advantage of substantial knowledge and experience in vocal modelling (Mayan, 2023). Based on my positive teaching experiences with modelling and the discovery from my research in Module 3, I am biased towards vocal modelling as an effective voice teaching tool. According to Cooper's (1988) Taxonomy of Literature Reviews, this literature review takes a neutral stance with a lean towards epousal. Due to limited singing-related literature and time constraints, the coverage is representative rather than exhaustive. By clearly articulating my positionality (Coe, 1991) and maintaining transparency regarding my data collection method, I aim to enhance the credibility of this review through reflexivity (Schon, 1987). Data organisation will be conceptual, using thematic analysis. The audience includes voice teachers, singers, and practitioners. The review focuses on the research results and practical applications of cognitive and neural mechanisms underlying vocal modelling, aiming to enhance pedagogical tools for teachers. I will adopt a pragmatic approach to employ various methods that best address the research question (Onwuegbuzie & Johnson, 2006) and are most applicable to voice pedagogy. I opted for a narrative literature review because it allows for the freedom to explore different viewpoints on the topic (Sukhera, 2022). Given the time constraint, a systematic review is unfeasible. Despite the advantages of being flexible and practical (Sukhera, 2022), narrative reviews have often been criticised as disreputable due to the lack of critical appraisal, the tools to assess the quality of reviews (Baethge et al., 2019), and the lack of replicability (Sukhera, 2022). I intend to mitigate these issues by maintaining transparency, staying goal-oriented and reflexive throughout the process of writing this narrative review (Sukhera, 2022).

Search strategy and data collection:

The University of Wales Trinity Saint David (UWTSD) online library and Google Scholar will be the primary search engines. Keywords for the preliminary search included combinations of "vocal modelling", "vocal imitation", "motor learning in singing" and "neuroscience in singing". Filters for "peer-reviewed articles" and "after the year 2000" are applied to exclude irrelevant materials. Boolean search will also be employed using AND, OR, and NOT to obtain more precise results (Lee, 2022). Utilising the inclusion and exclusion criteria, the selected articles are screened to ensure the relevance, quality, and validity of the literature (Meline, 2006). A traditional approach (Glass, 2000) to setting inclusion and exclusion criteria may not be applicable in this context due to time and resource constraints. Thus, I

chose Slavin's (1987) approach to select studies that only meet the set quality standards and exclude those that do not (Meline, 2006). Ideally, more recent peer-reviewed literature would be preferred. However, seminal materials may need to be referenced from more dated resources.

Inclusion criteria:

1. Peer-reviewed articles published in English.
2. Relevant to vocal modelling, vocal imitation, voice pedagogy, voice training, voice therapy, motor learning, mirror neurons and focus of attention.
3. Involved human participants, especially singers, and/or human participants with a healthy voice.
4. Articles published within the last 20 years, except for seminal materials.

Exclusion criteria:

1. Informal publications and non-peer-reviewed articles.
2. Irrelevant to the research topic. For example, virtual learning and instrumental music.
3. Involved non-human subjects or irrelevant populations (e.g., subjects with preexisting voice disorders).
4. Articles published more than 20 years ago, unless foundational to the topic.

Articles that meet the inclusion criteria will be screened by their titles and abstracts to determine their relevance (Randolph, 2009). Relevant articles are collected in Zotero for full-text review and annotations. A spreadsheet log is created to keep track of article collection records (Randolph, 2009). They are categorised by their populations (e.g., singers or non-singers), areas (e.g., singing-related, voice pedagogy or voice therapy) and dates (e.g., recent or foundational).

After a preliminary screening, I gained a better understanding of the topic, and some previously missing links, such as auditory prompts and auditory pathways, also became apparent. A second search is conducted with the new keywords: "auditory prompts", "auditory pathways", "imitation in singing", and "auditory mirror system in singing". The same filters applied in the preliminary search were used, along with Boolean searches. Selected articles are stored in Zotero and recorded on the log sheet.

Data extraction and evaluation:

Since managing multiple articles simultaneously is challenging (Boell & Cecez-Kecmanovic, 2010), I started reading the first ten articles in the third week of my study and identified a few core articles (Boell & Cecez-Kecmanovic, 2010), for example: Granot et al. (2013), Lévêque et al. (2012), Look et al. (2019), and Treinkman & Melissa (2022), that I can build my study upon. I used footnote chasing (Bates, 1989) to find more preceding articles that may be relevant. A coding book is devised to document the extracted body of text or quotations (Randoiph, 2009). Using an inductive thematic analysis (Braun and Clarke, 2006), three major themes have arisen: live human stimuli, the MNS, and the FOA. Using the hermeneutic circle, I move in and out of articles to identify their commonalities and contrasts (Boell and Cecez-Kecmanovic, 2010). Subsequently, I employ thematic analysis to categorise the extracted content and subcategorise it into smaller themes (Randolph, 2009), such as introduction, strengths, weaknesses, contradictions, comparison, and conclusion, facilitating data analysis and synthesis.

Project Report

Introduction:

Singing involves a complex neural network that extends across multiple brain regions, from perceiving a target sound to encoding it and subsequently executing it as a motor task (Granot et al., 2013). Due to its complex nature, voice teachers often sought various tools to facilitate skill acquisition in singing, and vocal modelling was one of the core strategies (Fonza, 2014; Milican & Forrester, 2019). In music, modelling has been defined as demonstrations by teachers, whether live or recorded, for students to imitate (Madsen, 1975). Hinkley's (2024) review on vocal modelling asserted that it is an effective pedagogical tool, ranging from pitch matching to tone building, among singers of different age ranges. To understand what underpins this phenomenon, it is essential to explore the types of stimuli presented, the complex neural network involved, and its impact on motor learning.

Modelling has proven to be more effective and efficient than verbal feedback during singing lessons, as excessive verbal instructions can distract students. (Dickey, 1992; Nápoles, 2016, 2017). However, long-term retention of acquired vocal skills remains weak when learning depends only on modelling (Look et al., 2019). Additionally, Look et al. (2019) found that modelling alone is insufficient to acquire vocal skills effectively. Although various researchers across different age groups have documented extensive literature in diverse

contexts that confirms the effectiveness of vocal modelling (Hinkley, 2024), the underlying mechanisms for its success remain underexplored.

As a voice teacher, I have observed the effectiveness of vocal modelling in my voice studio firsthand, from pitch matching and phrasing to tone quality. Additionally, modelling had emerged unexpectedly from my previous research in Module 3 (Tang, 2024) on implicit and explicit instructions for singing lessons; three out of four participants claimed they found it easiest to learn a new technique through modelling. This revelation has piqued my curiosity to explore the underlying reasons behind the effectiveness of vocal modelling. This narrative literature review will investigate the roles of the human voice stimuli (biological stimuli), the human mirror neuron system (MNS), and the focus of attention (FOA) in vocal modelling to gain insights into this topic.

Human Voice Stimuli:

Granot et al. (2013) found that live human voice stimuli yielded more accurate results from participants than piano stimuli in pitch and interval matching tasks. There was a noticeable advantage to using the human voice over piano sound, whether live or recorded (Granot et al., 2013). Despite inconsistent conclusions, past research had also suggested that imitation or modelling via live human stimuli proved substantially more effective in pitch matching (Granot et al., 2013). This sensitivity to (or preference for) human voices may be innate, as demonstrated by studies on newborns (Ecklund-Flores & Turkewitz, 1996; Hutt et al., 1968), especially to their mothers' voices (DeCasper & Fifer, 1980). Research in voice-selective areas of the human auditory cortex has also confirmed greater neuronal activity in response to live human stimuli compared to non-human stimuli (Belin et al., 2000).

Electrophysiological studies have also shown that our brain responds more quickly to human voice stimuli than to non-human stimuli (Charest et al., 2009). In singing, our brain first processes sound through the auditory pathway to recognise and encode the perceived sounds, the "what", and then through the motor pathway to plan how the sound will be produced, the "how". This connection between auditory perception and motor responses is evident when we instinctively tap our feet or hands to music (Lévêque, 2012). Our extensive experience with processing the human voice via this auditory-motor feedback loop suggests familiarity, which likely contributes to a more accurate response from singers when modelling with a human voice compared to other sound sources (Granot et al., 2013).

Inconsistencies Across Age Groups:

Hermanson's (1971) study demonstrated that kindergarten children matched pitches more accurately when listening to a woman's voice than to a piano or another child's voice. Similar findings were also identified by Yarbrough et al. (1991) in a study involving young children. Other studies (Demorest & Clements, 2007; Yarbrough et al., 1991; Bowers, 1991, cited in Granot et al., 2013) have found that adolescent males' pitch is better matched by modelling after a baritone voice. These results suggest that the mirroring mechanism might be involved in the learning process (Lévêque, 2012). Although studies with young children and adolescents seem to show congruent findings, the results from studies among adults are inconsistent (Lévêque et al., 2012). For example, Price (2000) used a recorded male voice stimulus and a recorded sine wave stimulus for his study on 141 non-music major college students from both genders. He found no significant differences or advantages in using human voice stimuli compared to other instruments for pitch and interval matching. Conversely, Lévêque et al. (2012) conducted a study with 32 male and female adults, who were screened for their singing ability and categorised into different proficiency levels. Using recorded synthesised stimuli and human voice stimuli, he found better pitch matching accuracy with the human voice stimuli. However, the stimuli in this study were presented matching the gender of the participants, unlike Price (2000), who only used male voice stimuli. Similarly, Granot et al. (2013) found that live human voice stimuli were more effective than recorded piano stimuli in pitch and interval matching tasks. The study involved 12 women and 8 men, without preliminary screening, relying solely on the participants' self-reported singing ability. Discrepancies in research results may occur due to differences in live versus recorded stimulus presentation, the gender of the stimuli compared to that of the participants, and the screening process used for participants. These factors must be carefully considered when analysing the findings (Granot et al., 2013).

Live Stimuli vs. Recorded Stimuli:

Watt and Hall (2008) digitally processed the vocal stimuli to minimise frequency fluctuations and vibrato. Although these adjustments may provide acoustic consistency, they can also weaken the connection between the tones and their natural sound source, whether instrumental or vocal (Granot et al., 2013). Moore et al. (2008) employed similar acoustic manipulations and identified no improvement in pitch-matching accuracy with a "neutral female voice" compared to synthesised stimuli. However, participants showed better pitch matching when the stimuli were sung with their voices; the results were especially noticeable among the four participants who had poor pitch matching ability out of the total twenty participants (Moore et al., 2008).

Role of Timbre Translation:

Hutchins and Peretz (2012) also found that participants performed more accurately when using human voice stimuli, particularly when their own voices were used. This was especially true among non-musician participants who had poorer pitch-matching abilities. Lévêque et al. (2012) also obtained similar findings; participants performed better in pitch-matching tasks using human voice stimuli versus synthesised stimuli, and the positive effect of human voice stimuli was more pronounced amongst participants previously scoring poorly in pitch-matching tests: “The more participants had trouble with vocal accuracy, the more the human model helped them to improve their performance” (Lévêque et al., 2012, p. 295). This result suggests that timbre translation may play a role in the success of vocal modelling (Hermanson, 1971; Yarbrough et al., 1991; Bowers, 1991; Demorest & Clements, 2007; Watts & Hall, 2008; Moore et al., 2008; Hutchins & Peretz, 2012). Based on the above findings, Watts and Hall (2008) proposed that the timbre effect could be explained solely through acoustic factors. However, Hutchins and Peretz (2012) suggested otherwise, that the ability to reproduce a pitch accurately is unrelated to perceptual accuracy. In their 2012 study, non-musician participants, who performed worse in vocal pitch matching compared to musicians, showed improved accuracy when using a slider. This instrument enables participants to match pitch without using their voice. Interestingly, both musicians and non-musicians performed better in pitch matching with the slider. The evidence suggests that poor pitch-matching is unlikely to be the result of poor pitch perception, except perhaps in a minority of individuals with congenital amusia, who have difficulty perceiving pitch (Hutchins & Peretz, 2012). Lévêque et al. (2012) also report similar findings from their pitch discrimination test, where several poor singers scored perfectly. “Thus, intonation difficulties do not seem to be systematically accompanied by a perceptual impairment. This study corroborates previous results on poor singers” (Pfordresher & Brown, 2007; Bradshaw & McHenry, 2005; Dalla Bella et al., 2007, cited in Lévêque et al., 2012).

Impact on Poor Singers and Non-Musicians:

Furthermore, the timbral effect or translation seemed only to impact poor singers or non-musicians, as the results of the control group showed no significant advantage from matching with the human model (Lévêque, 2012). This may be due to a ceiling effect within the control group, meaning there was limited or no room for improvement, or the improvement is so minimal that it is difficult to judge whether the human voice stimuli have any effect on their accuracy (Hutchins & Peretz, 2012). In addition, the sound processing pathway may vary between non-musicians and musicians; non-musicians or poor singers

may need to rely more heavily on kinematic indexes to imitate the perceived sound due to their unfamiliarity with it (Lévêque et al., 2012). Perhaps there are other factors influencing the ability to pitch matches accurately; motor control might be one of them, since non-musicians exhibited no improvement in pitch correction despite multiple attempts, according to Hutchins and Peretz's (2012) study. This result suggests a lack of motor skills or feedback mechanisms required to refine their vocal output (Hutchins & Peretz, 2012). Lévêque et al. (2012) proposed that the malfunctioning of the audio-motor loop might be the cause.

Auditory-Motor Loop:

Studies on the observation and imitation of movements also support the advantage of using human models over non-human models, such as robots. The mirroring system is a widely accepted explanation for such an advantage (Press et al., 2007; Gazzola et al., 2007). The mirror system is a specific neural network that is thought to recognise biomechanical gestures of the observed movement and create an “inverse model” for imitation. The preactivation of a particular representation of movement during perception enables faster imitation (Lévêque et al., 2012). Ellis and Tanaka (2003) found that modelling live human voice stimuli is more effective than using audio recordings in improving students' pronunciation and fluency in language acquisition. “In speech studies, the hypothesis of a dorsal stream that binds a perceived speech sound to its own articulatory movement is supported by a considerable amount of literature” (Hickok et al., 2003; Hickok & Poeppel, 2004, cited in Lévêque et al., 2012). Chang et al. (2009) demonstrated that this auditory dorsal pathway is activated when sounds are produced by the vocal tract, regardless of the context. Perhaps this sensorimotor link helps explain the effectiveness of using human voice stimuli over synthesised tones because they provide direct access to vocal gestures that can be readily mimicked (Lévêque et al., 2012). Suppose that human voice stimuli indeed enhance pitch-matching accuracy through activation of the sensorimotor loop, potentially supported by the MNS. In that case, the presence of a live human voice stimulus may lead to even greater results (Granot et al., 2013). Various studies on action imitation have also reported the advantage of using biological stimuli over non-biological stimuli and examined the possible role of the mirror system; however, its role in voice imitation remains underexplored (Lévêque et al., 2012).

Mirror Neuron System:

The MNS enables the observer to experience the sensation of engaging in the actions of others, as if they were performing those actions themselves (Tanaka, 2021). Mirror neurons are involved not only in perceiving and understanding motor actions in humans but also in more complex cognitive functions, such as imitation and language (Oberman & Ramachandran, 2007; Rizzolatti et al., 2001). “The mirror neuron system represents the neurophysiological mechanism underlying the coupling of perception and action. Mirror neuron activity is modulated by the appropriateness of actions and clarity of intentions, as well as emotional expression and aesthetic values” (Tanaka, 2021, p. 1).

Mirror neuron system in monkeys:

During the 1980s and 1990s, Giacomo Rizzolatti and his research team identified a type of brain cell, or neuron, while studying monkeys (Fadiga et al., 1995). They discovered that the neurons that would activate when the monkeys performed specific actions, such as reaching or grasping, would also discharge when the monkeys observed others performing similar actions (Fadiga et al., 1995). These visuomotor neurons are activated regardless of whether the monkey executes an action or observes another individual performing a comparable motor task (Fogassi et al., 2005; Gallese et al., 1996; di Pellegrino et al., 1992). Subsequent research indicated that, even without visual stimuli, these neurons could react to auditory cues associated with particular movements (Helding, 2010), suggesting that these premotor mirror neurons can represent actions autonomously, regardless of whether they are executed, heard, or observed (Kohler et al., 2002). This autonomy can perhaps facilitate vocal imitation/modelling, as the vocal system is non-observable (Crocco et al., 2020). By listening to the teacher’s model, students may be able to ‘mirror’ the operation of the internal mechanisms involved in singing (Belyk et al., 2016).

“Neurons with these ‘mirror’ properties have been described in both area F5 of the premotor cortex and in parietal area PF of the macaque brain” (Rizzolatti & Craighero, 2004, cited in Molnar-Szakacs & Overy, 2006, p. 235). Fogassi et al. (2005) suggested that the mirror neurons in the parietal area of the brain encode motor acts into action sequences, thereby predicting the anticipated outcome of a complex action. Consequently, it is believed that the F5 area of the ventral premotor cortex and the PF area of the inferior parietal lobule constitute the fronto-parietal MNS in monkeys, which is vital for the monkeys to comprehend what action is being performed and the intention behind the action (Rizzolatti et al., 2001; Rizzolatti & Craighero, 2004; Fogassi et al., 2005).

Mirror neuron system in humans:

The comparable fronto-parietal system in the human brain, which supports similar functions, consists of “the posterior inferior frontal gyrus (BA 44), the adjacent ventral premotor cortex, and the inferior parietal lobule (BA 40)” (Rizzolatti & Craighero, 2004, cited in Molnar-Szakacs & Overy, 2006, p. 236). Numerous neuroimaging studies demonstrated that the human fronto-parietal MNS is activated during the observation and imitation of movement (Fadiga et al., 1995; Hari et al., 1998; Iacoboni et al., 1999; Johnson-Frey et al., 2003; Molnar-Szakacs et al., 2005, 2006; Aziz-Zadeh et al., 2006). Iacoboni et al. (2005) also discovered that the suggested frontal mirror neuron region in the human brain plays a role in comprehending the intentions behind others’ actions. Furthermore, the human MNS exhibits similar sensitivity to auditory cues associated with actions as observed in monkeys (Aziz-Zadeh et al., 2004; Buccino et al., 2005). According to Wilson et al. (2004), the motor regions for speech production are activated when participants listen to speech sounds, a human voice stimulus. “The existence of mirror neurons in humans is widely accepted by cognitive scientists, who speak of mirror neurons as a complex, interactive system. Hence, this accepted concept is expressed in the current terminology, the human mirror neuron system, or MNS” (Helding, 2010, p. 585).

Studies on the Human Neuron System:

Until recently, the majority of neuroimaging studies examining the similarities between the MNS in humans and monkeys have been focused on motor tasks (Molnar-Szakacs & Overy, 2006). “However, functions of this neural system have recently been linked to several high-level human cognitive functions such as empathy (Carr et al., 2003; Gallese, 2003; Dapretto et al., 2006), theory-of-mind (Williams et al., 2001, 2006), and self-other discrimination (Uddin et al., 2005, 2006)” (Molnar-Szakacs & Overy, 2006, p. 236). In speech perception and production, similar neurocognitive mechanisms are involved, as outlined in the Motor Theory of Speech Perception (Studdert-Kennedy et al., 1970; Liberman & Mattingly, 1985; Liberman & Whalen, 2000). This theory suggests that speech perception and production share neural representations, which allows for two-way communication when the sender and the perceiver co-activate them. This shared mechanism, which Liberman believed to be crucial for communication, may be supported by mirror neurons (Liberman & Mattingly, 1985; Rizzolatti & Arbib, 1998). Gallese (2003) introduced the idea that an automatic and unconscious simulation mechanism supports this link between perception and action. This link utilises the same neural resources to understand others’ actions as we do to perform our own, and it also enables us to comprehend speech, form social connections, and experience empathy (Wan et al., 2010; Molnar-Szakacs & Overy, 2006).

How the human mirror neuron system relates to music making:

Similarly, it could be contended that music appreciation is also a form of communication between musicians and their audience (Molnar-Szakacs & Overy, 2006). “The discovery of mirror neurons provided support for the involvement of the motor system in auditory speech perception” (Wan et al., 2010, p. 162). Since music has always been tied to motor activity, as its production involves coordinated actions that create sound vibrations, for example, in drumming and singing (Molnar-Szakacs & Overy, 2006). The proposed stimulation mechanism in the Motor Theory of Speech Perception (Studdert-Kennedy et al., 1970; Liberman & Mattingly, 1985; Liberman & Whalen, 2000), driven by the human MNS, allows a shared musical experience through the synchronised activation of similar neural mechanisms in both the sender and perceiver, facilitating communication akin to language or action (Molnar-Szakacs & Overy, 2006). “Indeed, one of the defining features of music is its ability to induce an emotional response in listeners (Gabrielsson, 2001), and one of the main reasons people give for listening to music is to experience or modulate their emotional state” (Molnar-Szakacs and Overy, 2006, p. 238). Various studies from multiple disciplines suggest that the perception of action, language, and music relies on shared neural infrastructures, which appear to be located in brain areas associated with the human MNS (Molnar-Szakacs & Overy, 2006).

The Role of Mirror Neurons in Vocal Imitation:

Theories of gestural imitation, which involve mirror neurons, have inspired and influenced the studies of neural models on vocal imitation (Belyk, 2016). Vocal imitation in humans plays a crucial role not only in childhood development but also in creating extensive and adaptable acoustic ranges for both speech and music (Trehub, 2001; Studdert-Kennedy, 2000; Kuhl & Meltzoff, 1996; Papousek, 1996; Poulson et al., 1991), as well as during adulthood, for the capability to, for instance, acquire musical tunes and articulate the sounds of a different language (Belyk et al., 2016). While direct evidence from single-cell studies confirming the existence of mirror neurons in humans has not yet been obtained, neuroimaging studies have revealed brain regions with cell populations that exhibit mirror-like activity (Gazzola & Keysers, 2009). One such region suspected to contain mirror neurons is the posterior part of Broca’s area, including Brodmann’s area 44 (BA 44) in the inferior frontal gyrus (IFG) pars opercularis (Belyk, 2016). “The role of the human mirror neuron system, Broca’s area in particular, in mediating the sensory-motor transformations underlying imitation is already well-established” (Iacoboni et al., 1999; Koski et al., 2002, 2003; Heiser et al., 2003; Molnar-Szakacs et al., 2005, cited in Molnar-Szakacs & Overy,

2006, p. 238). These imitative elements directly transfer sensory information into a motor plan, activating and co-engaging brain regions responsible for both the perception and production of music and language (Molnar-Szakacs & Overy, 2006). Imitation, as a direct transfer of sensory information to a motor plan (Iacoboni et al., 1999; Molnar-Szakacs et al., 2005), supports why vocal modelling can be a powerful tool, as students can learn by “mirroring” the teacher’s vocal actions without needing extensive verbal explanation (Hinkley, 2024).

Although there are varying theories regarding vocal imitation, the majority tend to concur on a model that involves sensorimotor translation of perceived sounds (Pfordresher et al., 2015; Pfordresher & Mantell, 2014; Hutchins & Moreno, 2013; Berkowska & Dalla Bella, 2009; Dalla Bella & Berkowska, 2009). Vocal imitation involves perceiving a target sound, translating its acoustic features into phonatory and articulatory motor commands through inverse modelling, and then producing those commands to vocally imitate the sound. Inverse models use an internal representation of sensorimotor relationships (Kawato, 1999), based on learned connections between motor actions and sensory feedback (Hanuschkin et al., 2013). These inverse models play a crucial role in vocal imitation, enabling imitators to plan motor movements, such as pitch patterns, particularly in acquiring novel vocal tasks (Pfordresher & Mantell, 2014). According to Cannon et al. (2014) and Brunsdon et al. (2020), mirror neuron activity is experience-dependent; the more experienced the observer is with the related task, the greater the mirror neurons react. Engaging with a piece of music one knows how to play, whether by listening, reading notation, watching performances, or playing it oneself, has been reported to activate a network of brain regions linked to the MNS (Wan et al., 2010; Overy & Molnar-Szakacs, 2009). “One of the most fascinating and potentially useful applications of the MNS for singers and other highly skilled performers who rely on their motor system is the ability of the MNS to keep on charging even when the actual muscles are at rest due to fatigue or injury” (Helding, 2010, p. 587).

Focus of Attention in Motor Learning:

Motor Learning:

“Motor learning refers to the acquisition, retention, and transfer of skilled movements over time” (Schmidt & Lee, 2011, cited in Look et al., 2019). Motor learning plays a crucial role in singing (Helding, 2015); it has been proven to provide valuable information for singing teachers to teach various tasks that require coordinated physical movement in performance skills (Bergan, 2010). The acquisition process in motor learning has been described as unfolding in two phases: the prepractice phase and the practice phase (Maas et al., 2008).

The prepractice phase is when learners are provided with the necessary information to complete a task before attempting it (Hodges & Franks, 2004). In speech therapy, the clients are guided to develop an inverse model correctly before moving into the practice phase (Look et al., 2019). This prepractice phase in voice therapy is essential, as erroneous hyperfunctional practice may cause further vocal harm. The prepractice phase ensures that patients can perform tasks correctly before further practice, thereby maintaining vocal health and benefits (Look et al., 2019). The same is true for the prepractice phase during skill acquisition in singing, where teachers model the vocal task, such as a musical note or phrase, for students to develop an internal model before practising on their own, ensuring vocal health and accuracy (Crocco et al., 2020).

According to Hodges and Franks (2004), once the learners attempt the task, it is already considered the beginning of the practice phase. In speech-language pathology (Maas et al., 2008) and voice pedagogy (Crocco et al., 2020), however, the practice phase does not begin until learners have achieved a certain level of proficiency in the task during the prepractice phase. The subsequent practice phase enables learners to build independence and consistently develop skills over time, ultimately leading to effective learning (Wulf & Shea, 2002). Importantly, performance during acquisition does not reflect successful learning until skills are retained and transferred (Look et al., 2019). Based on the principles of motor learning (PML), various variables affect how motor tasks are learned and performed; these variables include instruction, modelling, feedback, and verbal information (Wulf & Shea, 2002). Madill et al. (2018) proposed the Motor Learning Classification Framework (MLCF) in voice therapy, which outlines instructional behaviours, especially during the prepractice phase, for skills acquisition. “Five main instructional behaviors were identified—(a) motivation, (b) modeling, (c) verbal information, (d) feedback, and (e) physical attempts” (McIlwaine et al., 2010, cited in Crocco et al., 2020).

Focus of Attention (FOA):

Within the framework of motor learning, FOA refers to the direction learners should focus their attention, whether inward (focusing on the involved bodily parts) or outward (focusing on the desired outcome of the movement) (Helding, 2015). Hodges and Franks (2000) and Tzetzis et al. (1997) found that goal-related instruction and/or feedback, which is an external FOA, are more effective for motor skill acquisition compared to movement-related instruction and/or feedback, which is an internal FOA. The large majority of studies on the FOA have demonstrated that an external FOA leads to more efficient learning and performance compared to an internal FOA (Treinkman, 2022). Research indicates that instructions or feedback promoting an external focus can enhance performance and learning across

various tasks, skill levels, and age groups: benefits include improved movement effectiveness (e.g., accuracy, balance) and efficiency (e.g., muscle activity, force, cardiovascular responses) (Wulf, 2013). However, these studies are predominantly on sports performance (Wulf, 2013; Wulf & Lewthwaite, 2016). Only recently has there been a growing number of FOA studies involving instrumentalists and singers; the findings align with research conducted in other disciplines, supporting the benefits of external FOA in music performance (Treinkman, 2021). “Wulf and numerous other researchers have noted that the effect of an external focus is extremely robust, as evidenced by what researchers call its “generalizability” to different skills, to varying levels of expertise, and among many different populations of learners in the physical realm, including musicians” (Helding, 2015, p. 89). Nonetheless, Treinkman (2021) cautioned us to be aware of the distinctions between athletic performance and musical artistry when implementing these motor learning principles to vocal training. That said, music performance and athletic performance share many similarities, ranging from the intricate level of motor control required to the high-pressure environment during performance, thereby enabling singers and singing teachers to leverage valuable insights from sports motor learning research (Treinkman, 2021).

Relevance of FOA in Voice Pedagogy:

“In all of motor learning theory, focus of attention is, arguably, the area of research that has the most relevance to singers” (Treinkman, 2022, p. 21). Helding (2015) asserted that the FOA is a fundamental concern for singers or performers in achieving optimal muscular efficiency, or the ability to execute precise movements effortlessly. It is a day-to-day question during voice lessons as to where singers should focus their attention when singing (Treinkman, 2022). According to Treinkman's (2022) study on FOA in voice training, which examined the frequency of external and internal focus of attention used by voice teachers, the study concluded that although voice teachers may employ both directives, external focus appears to be used more frequently. One example would be if a voice teacher would like to refine the vowel /i/; instead of instructing the student to “raise the back of the tongue” (an internal FOA), the teacher can ask the student to “say the word ‘key’” (an external FOA) and then sing with the same true vowel quality. This external focus redirects attention to the goal of the action, rather than focusing on the action itself (Treinkman, 2021). Similarly, by focusing on the targeted pitch or voice quality rather than the internal FOA of the bodily mechanics, vocal modelling can also be viewed as an external FOA (Look et al., 2019).

Kal et al. (2013) introduced the “constrained action hypothesis”, stating that internal FOA encourages conscious control of body parts that suppress the motor system, thus impeding the body’s natural tendency to self-organise automatically. Conversely, external FOA

facilitates automatic control processes, resulting in smoother and more consistent movements. This automaticity may also reduce the adverse effects of performing under pressure (Kal et al., 2013). Titze (2021) also discussed self-organisation in vocal mechanics and cautioned against the excessive manipulation of individual components in the vocal system. “Let the vocal system organize itself. Give it the right output targets and it will find a way to get there with lots of alternative solutions” (Titze, 2021; cited in Treinkman, 2022, p. 26).

Vocal Modelling as an External FOA:

Vocal modelling is considered external FOA, as it utilises an external stimulus to direct attention to the desired outcome rather than towards the involved bodily parts of the learners (Look et al., 2019). “Asking a student to listen and then imitate is an example of implicit learning and the epitome of an external focus of attention cue” (Treinkman, 2022, p. 25). Modelling can also occur mentally using imagination, which is also an external focus tool (Treinkman, 2022). This is often referred to as “mental rehearsal/practice” in voice pedagogy (Lotze, 2013). Mental practice is a powerful tool to help singers maintain their proficiencies, especially when they are fatigued, physically ill, or vocally injured (Helding, 2010). Additionally, modelling uses an external stimulus to reveal subtle skill components that are difficult to teach through verbal instruction (Look et al., 2019). “Goal-related instruction combined with modeling has been found to increase consistency and accuracy of a complex motor skill, rather than instruction and modeling singularly employed” (Hodges & Franks, 2000; Janelle et al., 2003, cited in Crocco et al., 2020, p. 576).

Crocco et al. (2020) found a relatively high use of modelling by voice teachers in their research on PML in classical singing teaching, confirming Zhukov's (2005) earlier findings that music educators often utilise modelling. The prevalence of voice teachers employing modelling may reflect its efficacy (Treinkman, 2022). Although modelling after expert musicians and teachers may seem more straightforward during the prepractice phase, we must be aware of the risk of merely imitating the experts' models and neglecting skill acquisition (Lee et al., 1994; Higgins, 1991). Furthermore, observing peers with a similar skill level to the learners proves equally beneficial in developing motor skills (Hodges & Franks, 2002). Hodges and Franks (2002) argued that, for optimal learning outcomes, it is advisable to avoid modelling at the initial stage of learning complex skills, allowing learners the opportunity to familiarise themselves with the task before instruction and modelling (Hodges & Franks, 2002). This encourages active listening and/or observation, as passive listening and/or observation have been proven to be insufficient for producing consistent and demonstrable learning outcomes (Alain et al., 2007). “Current motor learning research

suggests that 'correct' modeling and detailed and/or high amounts of instruction and feedback may be inefficient in the learning of a new skill" (Hodges & Franks, 2001; Hodges & Lee, 1999, cited in Crocco et al., 2020, p. 576). Perhaps allowing learners to explore the task by providing fewer instructions or models can be more effective (Hodges & Williams, 2012).

Potential Application in Voice Pedagogy:

Leveraging on the effectiveness of live human voice stimuli (Granot et al., 2013), teachers should prioritise live vocal demonstrations over recorded or synthesised models. Age, gender, and voice types should be taken into consideration when modelling for the students. For example, we can use a lighter voice without vibratos when modelling for young children. Matching the vocal quality of the student can be helpful due to the nature of timbre translation (Hutchins & Peretz, 2012). Teachers should also consider students' skill levels; demonstrating at a master's level may not be the best approach for beginners (Crocco et al., 2020). Often, modelling peers with similar skill levels can be equally helpful for developing motor skills (Hodges & Franks, 2002).

Furthermore, incorporating the concept of the MNS into voice pedagogy provides a neurophysiological basis for imitation-based learning. Voice teachers can utilise the mirroring system to model more complex vocal tasks, such as tone quality, phrasing, or dynamics, without relying on complicated verbal explanations (Look et al., 2019). Excessive verbal instructions (teacher's talk) can be distracting and impede learning efficiency (Crocco et al., 2020), whereas allowing students to explore with their bodies actively can enhance perceptual awareness (Helding, 2015).

Helding (2010) proposed a technique she dubbed "The No-Practice Practice Routine." Leveraging the experience-dependent nature of the MNS (Cannon et al., 2014; Brunsdon et al., 2020), singers can continue practising without physically executing the task, but merely through observation or imagination (Helding, 2010). Voice teachers may advise students to "mentally sing" or "mentally rehearse" during periods of fatigue or illness (Helding, 2010).

Given that goal-related instruction (an external FOA) enhances the consistency and precision of complex motor tasks when combined with modelling (Hodges & Franks, 2000; Janelle et al., 2003), voice teachers may foster automaticity and muscular efficiency (Kal et al., 2013) by guiding students to concentrate on the desired outcome (e.g., a targeted pitch or tone quality) rather than internal bodily mechanisms (e.g., the larynx or tongue).

Voice teachers should also be aware of the directives they give during lessons, because students might revert to earlier learning experiences under the pressure of performance anxiety (Crocco et al., 2020). Treinkman (2021) suggests that external FOA may help reduce the detrimental effects of performance anxiety.

Conclusion and Future Recommendations:

This review aimed to explore how the cognitive and neural mechanisms involved in human voice stimuli, the MNS, and the FOA contribute to the effectiveness of vocal modelling. After examining the relevant theories and research findings, this review concludes that the biological aspect of human voice stimuli, whether live or recorded, contributes to the effectiveness of vocal modelling due to the timbre effect or translation (Watts & Hall, 2008) and the human MNS (Crocco et al., 2020). The human MNS allows direct transfer of auditory information to a motor plan in the Broca area of the brain via the auditory-motor loop (Iacoboni et al., 1999). This allows the learners to “mirror” the vocal gestures of the teacher, effectively connecting perception and action for vocal imitation (Kawato, 1999), which is particularly beneficial for non-musicians and poor singers, as they rely more heavily on auditory and kinematic cues for pitch accuracy (Lévêque et al., 2012). These findings corroborate my observations from Module 3, where three out of four participants claimed that they found modelling to be the most effective method for learning a new vocal task (Tang, 2024). The external FOA of vocal modelling also contributes to reducing cognitive load and promoting automacity by enabling participants to self-organise motor tasks (Kal et al., 2013; Titze, 2021).

While substantial evidence from cognitive science and neuroscience supports the effectiveness of vocal modelling, there is also evidence suggesting that modelling alone may be inadequate for effective motor learning (Hodges & Franks, 2001). The long-term retention of acquired vocal skills when using vocal modelling independently is subpar (Look et al., 2019). Conversely, the integration of modelling with verbal instructions has been demonstrated to improve skill acquisition in complex vocal tasks (Look et al., 2019). The combination of modelling with goal-related directives has also been shown to improve the consistency and precision of complex motor skills relative to modelling in isolation (Hedges & Franks, 2000). These findings suggest that additional measures are necessary to optimise the effectiveness of motor learning.

Future research should examine the gaps between modelling and optimal motor learning, including aspects such as skill acquisition, retention, and transfer over time. Conducting longitudinal studies to assess the long-term impacts of vocal modelling and FOA on skill

retention and transfer in singing would be valuable. Voice teachers should stay informed about the latest research in motor learning and neuroscience, incorporate these insights into their lesson planning, and continually reflect on their teaching methods to elevate their pedagogical tools, teaching skills, and self-efficacies.

Critical Reflection:

Reflection, critical reflection and reflexivity are all reflexive practices. Despite many similarities between them, there are considerable differences (Fook et al., 2006). Reflexive practices have gained significant popularity across different professional fields and in education (Finlay, 2008) because they are easily relatable on a personal level (Loughran, 2000). Reflexive practice is generally regarded as a tool for self-improvement or enhancing future practices in various professional areas (Finlay, 2008). In this critical reflection on my journey in writing this narrative literature review, I will adopt Gibbs' Reflective Cycle (1988) model due to its simplicity and personal approach, which involves the stages of description, feelings, evaluation, analysis, conclusion, and action plan (Heoi-Seon, 2022). I would like to reflect on my procrastination, organisation and time-management skills in this reflective journal.

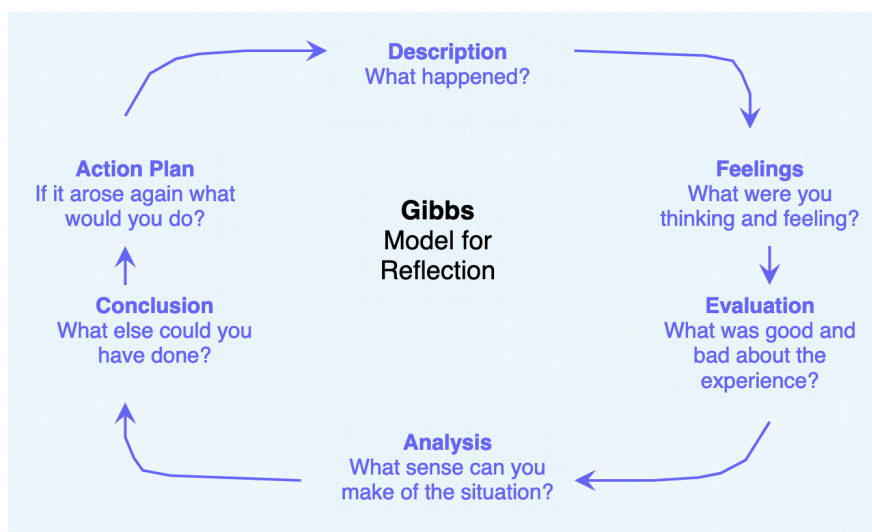


Figure: Gibbs' reflective cycle adapted from Finlay, 2008.

Description:

Procrastination has consistently been a personal challenge for me. Knaus (2000) defines it as the inability to self-regulate and a tendency to postpone tasks necessary for achieving one's goals. To tackle this, I opted for better time management and planning, both in the short term and long term (Macan, 1994). I started planning for this assignment early in

Module 4 to improve my time management strategically (Macan et al., 1990). I divided the assignment into smaller, manageable tasks and created a Gantt chart to help organise my writing within a timeline. In addition, I also switched from using Mendeley to Zotero for organising articles and taking notes. I was making good progress with part one of this assignment until I travelled to Japan, Taiwan, and France in May and June, which interrupted my work. Distractions and activities made resuming difficult.

Feelings:

While searching for solutions to tackle my procrastination, I realised that the root cause might be anxiety. Barlow (2002) defined anxiety as a future-oriented state of mind that anticipates possible adverse events. As my anxiety grew, I would freeze, which stopped me from finishing any tasks. This avoidance coping mechanism (Chu et al., 2005) is unhelpful, mainly because I am still working on improving my academic writing and research skills. I felt frustrated and anxious about not being able to complete the assignment on time.

Evaluation:

A positive outcome of my efforts to address procrastination was the discovery of numerous videos that effectively helped reset my vagus nerve. The vagus nerve is a key component of the parasympathetic nervous system (PNS), which counteracts the fight-or-flight responses of the sympathetic nervous system (SNS). It regulates many vital organs, most notably the heart (Goyal et al., 2024). I tried these exercises during times when I thought I was not feeling anxious. To my surprise, I felt much calmer afterwards. The experience suggested that I have been anxious consistently without realising it. This experience made me realise that I need to address my anxiety, which affects not only academics but life in general. Although I managed to find methods to soothe my nerves, I continued to struggle with my writing, primarily due to the frequency of my travel and my inability to stay focused.

Another positive result of this experience was that I gained more confidence in my academic writing. I find it easier to search for articles and organise them. I switched from using Mendeley to Zotero, which I found to be better for note-taking. However, I am still exploring how to categorise and retrieve information from Zotero effectively. I also devised a daily schedule and organised my workspace to improve my time management and focus (Macan et al., 1990).

Analysis:

Reflecting on the above, I should have maintained my boundaries and refused unnecessary travel; however, I went along with it to avoid upsetting others, despite the stress it caused me (Hunter, 2021). I believed it was related to my avoidance coping mechanism (Chu et al., 2005) to steer clear of confrontations, and I neglected my own needs. As I explore the possible root cause of my anxiety more deeply, I realise that fear is a recurring theme.

I believe this fear has been ingrained since birth, as my biological mother took me from her care when I was a baby, and I only learned this as an adult. Although I was able to handle the situation well as an adult, I believe it had a subconscious impact on me. According to attachment theory (Bowlby, 1969), insufficient bonding or the absence of bonding between the infant and the mother can lead to insecure attachment, which affects an individual's ability to regulate emotions effectively and results in anxiety-related avoidance behaviour (Esbjörn et al., 2012).

Conclusion:

This persistent fear has affected many aspects of my life, including academic work and personal relationships (Esbjörn et al., 2012). However, I believe I have made gradual progress over time. This critical reflection has helped me identify the possible root cause of my procrastination, allowing me to address it more effectively and positively.

Action Plan:

Moving forward, my priority is to work on remediating my fear. I plan to reduce my stress level and improve my concentration by engaging in mindfulness practices, such as vagus nerve reset exercises, meditation, and Qi Gong (Kabat-Zinn, 2003). This traditional Chinese discipline cultivates energy and promotes overall well-being (Wang et al., 2021). In terms of executing practical tasks, better time management (Macan et al., 1990; Stute & Lozza-Fiocco, 2022) and clear boundaries (Hunter, 2021) are also crucial in my situation. I will block out specific time slots for studies and writing and adhere to them regularly (Macan et al., 1990).

Furthermore, learn and practice how to reject people without feeling bad about it (Hunter, 2021). After conducting some research, I found a free course on Coursera, "Work Smarter, Not Harder: Time Management for Personal and Professional Productivity", and a course on Mind Tools called "Assertiveness Techniques". I plan to attend these courses after completing Module 4. Hopefully, they will provide me with some valuable insights and practical guidance. For academic skill development, I am planning to attend or rewatch the academic boot camp at the Voice Study Centre.

Reference:

Alain, C., Snyder, J.S., He, Y. et al. (2007) 'Changes in auditory cortex parallel rapid perceptual learning', *Cerebral Cortex*, 17, pp. 1074–1084.

Aziz-Zadeh, L., Iacoboni, M., Zaidel, E., Wilson, S. and Mazziotta, J. (2004) 'Left hemisphere motor facilitation in response to manual action sounds', *European Journal of Neuroscience*, 19(9), pp.2609-2612.

Aziz-Zadeh, L., Koski, L., Zaidel, E., Mazziotta, J. and Iacoboni, M. (2006) 'Lateralization of the human mirror neuron system', *Journal of Neuroscience*, 26(11), pp.2964-2970.

Bates, M.J., 1989. The design of browsing and berrypicking techniques for the online search interface. *Online review*, 13(5), pp.407-424.

Baethge, C., Goldbeck-Wood, S. and Mertens, S. (2019) 'SANRA—a scale for the quality assessment of narrative review articles', *Research integrity and peer review*, 4, pp.1-7.

Bandura, A. (1977) 'Self-efficacy: Toward a unifying theory of behavioral change', *Psychological Review*, 84(2), 191.

Barlow, D.H. (2002) *Anxiety and its disorders: The nature and treatment of anxiety and panic*. 2nd edn. New York: Guilford Press.

Belin, P., Zatorre, R., Lafaille, P. et al. (2000) 'Voice-selective areas in human auditory cortex', *Nature* 403, 309–312.

Belyk, M., Pfordresher, P.Q., Liotti, M. and Brown, S. (2016) 'The neural basis of vocal pitch imitation in humans', *Journal of Cognitive Neuroscience*, 28(4), pp.621-635.

Bergan, C. (2010) 'Motor Learning Principles and Voice Pedagogy: Theory and Practice', *Journal of Singing*, 66(4).

Berkowska, M., & Dalla Bella, S. (2009) 'Acquired and congenital disorders of sung performance: A review', *Advances in Cognitive Psychology*, 5, 69–83.

Boell, S.K. and Cecez-Kecmanovic, D. (2010) 'Literature reviews and the hermeneutic circle', *Australian Academic & Research Libraries*, 41(2), pp. 129–144.

Bowlby, J. (1969) *Attachment and loss. Vol. 1: Attachment*. New York: Basic Books.

Bowers, J.K. (1991) 'The effect of vocal models, curriculum, and grade level on the pitch matching accuracy of adolescent male singers in various stages of vocal development', *Missouri J Res Music Ed*, 28, pp.1-15.

Bradshaw, E. and McHenry, M.A. (2005) 'Pitch discrimination and pitch matching abilities of adults who sing inaccurately', *Journal of Voice*, 19(3), pp.431-439.

Braun, V. and Clarke, V. (2006) 'Using thematic analysis in psychology', *Qualitative Research in Psychology*, 3(2), pp. 77–101. doi: 10.1191/1478088706qp063oa.

Brown, S., Martinez, M.J., Hodges, D.A., Fox, P.T. and Parsons, L.M. (2004) 'The song system of the human brain', *Cognitive Brain Research*, 20(3), pp.363-375.

Brunsdon, V. E. A., Bradford, E. E. F., Smith, L., and Ferguson, H. J. (2020) 'Short-term physical training enhances mirror system activation to action observation', *Soc. Neurosci.* 15, 98–107. doi: 10.1080/17470919.2019.1660708

Buccino, G., Riggio, L., Melli, G., Binkofski, F., Gallese, V. and Rizzolatti, G. (2005) 'Listening to action-related sentences modulates the activity of the motor system: a combined TMS and behavioral study', *Cognitive Brain Research*, 24(3), pp.355-363.

Cannon, E. N., Yoo, K. H., Vanderwert, R. E., Ferrari, P. F., Woodward, A. L., and Fox, N. A. (2014) 'Action experience, more than observation, influences mu rhythm desynchronization', *PLoS One* 9:e92002. doi: 10.1371/journal.pone. 0092002

Carr, L., Iacoboni, M., Dubeau, M.C., Mazziotta, J.C. and Lenzi, G.L. (2003) 'Neural mechanisms of empathy in humans: a relay from neural systems for imitation to limbic areas', *Proceedings of the national Academy of Sciences*, 100(9), pp.5497-5502.

Chang, S.E., Kenney, M.K., Loucks, T.M., Poletto, C.J. and Ludlow, C.L. (2009) 'Common neural substrates support speech and non-speech vocal tract gestures', *Neuroimage*, 47(1), pp.314-325.

Charest, I., Pernet, C.R., Rousselet, G.A., Quiñones, I., Latinus, M., Fillion-Bilodeau, S., Chartrand, J.P. and Belin, P. (2009) 'Electrophysiological evidence for an early processing of human voices', *BMC neuroscience*, 10, pp.1-11.

Chu, A.H. and Choi, J.N. (2005) 'Rethinking procrastination: Positive effects of "active" procrastination behavior on attitudes and performance', *The Journal of Social Psychology*, 145(3), pp. 245–264.

Coe, D. (1991) 'Levels of knowing in ethnographic inquiry', *International Journal of Qualitative Studies in Education*, 4, pp. 313–331.

Cooper, H.M. (1988) 'Organizing knowledge synthesis: A taxonomy of literature reviews', *Knowledge in Society*, 1, pp. 104–126.

Crocco, L., McCabe, P. and Madill, C. (2020) 'Principles of motor learning in classical singing teaching', *Journal of Voice*, 34(4), pp. 567–581.

Dalla Bella, S., Giguère, J.F. and Peretz, I. (2007) 'Singing proficiency in the general population', *The Journal of the Acoustical Society of America*, 121(2), pp.1182-1189.

Dalla Bella, S., & Berkowska, M. (2009) 'Singing proficiency in the majority: Normality and "phenotypes" of poor singing', *Annals of the New York Academy of Sciences*, 1169, 99–107.

Dapretto, M., Davies, M.S., Pfeifer, J.H., Scott, A.A., Sigman, M., Bookheimer, S.Y. and Iacoboni, M. (2006) 'Understanding emotions in others: mirror neuron dysfunction in children with autism spectrum disorders', *Nature neuroscience*, 9(1), pp.28-30.

Dickey, M. R. (1992) 'A review of research on modeling in music teaching and learning', *Bulletin of the Council for Research in Music Education*, 113, 27–40.

Di Pellegrino, G., Fadiga, L., Fogassi, L., Gallese, V. and Rizzolatti, G. (1992) 'Understanding motor events: a neurophysiological study', *Experimental brain research*, 91, pp.176-180.

DeCasper, A.J. and Fifer, W.P. (1980) 'Of human bonding: Newborns prefer their mothers' voices', *Science*, 208(4448), pp.1174-1176.

Ecklund-Flores, L. and Turkewitz, G. (1996) 'Asymmetric headturning to speech and nonspeech in human newborns', *Dev Psychobiol*, 29, 205–217.

Esbjörn, B.H., Bender, P.K., Reinholdt-Dunne, M.L., Munck, L.A. and Ollendick, T.H. (2012) 'The development of anxiety disorders: Considering the contributions of attachment and emotion regulation', *Clinical Child and Family Psychology Review*, 15(2), pp. 129–143.

Tanaka, K. and Ellis, R. (2003) 'Study abroad, language proficiency, and learner beliefs about language learning', *JALT journal*, 25(1), pp.63-85.

Fadiga, L., Fogassi, L., Pavesi, G. and Rizzolatti, G. (1995) 'Motor facilitation during action observation: a magnetic stimulation study', *Journal of neurophysiology*, 73(6), pp.2608-2611

Finlay, L. (2008) *Reflecting on 'Reflective practice'*.

Fogassi, L., Ferrari, P.F., Gesierich, B., Rozzi, S., Chersi, F. and Rizzolatti, G. (2005) 'Parietal lobe: from action organization to intention understanding', *Science*, 308(5722), pp.662-667.

Fonza, F. R. (2014) 'Tone building strategies used for beginning high school choirs' (Doctoral dissertation, Florida State University). *ProQuest Dissertations and Theses Global*.

Fook, J., White, S. and Gardner, F. (2006) *Critical reflection: a review of contemporary literature and understandings*, in S. White, J. Fook and F. Gardner (eds.) *Critical reflection in health and social care*. Maidenhead, Berks: Open University Press.

Gallese, V., Fadiga, L., Fogassi, L. and Rizzolatti, G. (1996) 'Action recognition in the premotor cortex', *Brain*, 119(2), pp.593-609.

Gallese, V. (2003) 'The manifold nature of interpersonal relations: the quest for a common mechanism', *Philosophical Transactions of the Royal Society of London. Series B: Biological Sciences*, 358(1431), pp.517-528.

Gazzola, V., Rizzolatti, G., Wicker, B. and Keysers, C. (2007) 'The anthropomorphic brain: the mirror neuron system responds to human and robotic actions', *Neuroimage*, 35(4), pp.1674-1684.

Gazzola, V. and Keysers, C. (2009) 'The observation and execution of actions share motor and somatosensory voxels in all tested subjects: single-subject analyses of unsmoothed fMRI data', *Cerebral cortex*, 19(6), pp.1239-1255.

Glass, G.V. (2000) *Meta-analysis at 25*.

Goyal, M., Goyal, R. and Sanguinetti, J.L. (2024) 'Ultrasound stimulation of the vagus nerve as a treatment modality for anxiety', *Frontiers in Psychiatry*, 15 (October).

Granot, R.Y., Israel-Kolatt, R., Gilboa, A. and Kolatt, T. (2013) 'Accuracy of pitch matching significantly improved by live voice model', *Journal of Voice*, 27(3), pp.390-e13.

Hanuschkin, A., Ganguli, S., & Hahnloser, R. H. R. (2013) 'A Hebbian learning rule gives rise to mirror neurons and links them to control theoretic inverse models', *Frontiers in Neural Circuits*, 7, 106.

Hari, R., Forss, N., Avikainen, S., Kirveskari, E., Salenius, S. and Rizzolatti, G. (1998) 'Activation of human primary motor cortex during action observation: a neuromagnetic study', *Proceedings of the National Academy of Sciences*, 95(25), pp.15061-15065.

Heiser, M., Iacoboni, M., Maeda, F., Marcus, J., Mazziotta, J.C. (2003) 'The essential role of Broca's area in imitation', *The European journal of neuroscience*, 17, 1123–8.

Helding, L. (2010) 'The Mind's Mirrors', *Journal of Singing*, 66, pp.585–89.

Helding, L. (2015) 'Motor Learning and Voice Training: Locus of Attention', *Journal of Singing*, 72, pp.87-91.

Hendricks, K. S. (2016) 'The sources of self-efficacy: Educational research and implications for music', *Update: Applications of Research in Music Education*, 35(1), 32-38.

Hermanson, L.W. (1971) 'An Investigation of the Effects of Timbre on Simultaneous Vocal Pitch Acuity of Young Children', *Columbia University*.

Hickok, G., Buchsbaum, B., Humphries, C. and Muftuler, T. (2003) 'Auditory–motor interaction revealed by fMRI: speech, music, and working memory in area Spt', *Journal of cognitive neuroscience*, 15(5), pp.673-682.

Hickok, G. and Poeppel, D. (2004) 'Dorsal and ventral streams: a framework for understanding aspects of the functional anatomy of language', *Cognition*, 92(1-2), pp.67-99.

- Higgins, S. (1991) 'Motor skill acquisition', *Physical Therapy*, 71(2), pp. 123–139.
- Hinkley, S.P. (2024) 'Vocal Modeling: A Review of Literature', *Update: Applications of Research in Music Education*, 42(2), pp.23–30.
- Hodges, N.J. and Lee, T.D. (1999) 'The role of augmented information prior to learning a bimanual visual-motor coordination task: do instructions of the movement pattern facilitate learning relative to discovery learning?', *British Journal of Psychology*, 90(3), pp. 389–403.
- Hodges, N.J. and Franks, I.M. (2000) 'Attention focusing instructions and coordination bias: implications for learning a novel bimanual task', *Human Movement Science*, 19(6), pp. 843–867.
- Hodges, N.J. and Franks, I.M. (2001) 'Learning a coordination skill: interactive effects of instruction and feedback', *Research Quarterly for Exercise and Sport*, 72(2), pp. 132–142.
- Hodges, N.J. and Franks, I.M. (2002) 'Modelling coaching practice: the role of instruction and demonstration', *Journal of Sports Sciences*, 20(10), pp. 793–811.
- Hodges, N.J. and Franks, I.M. (2004) 'Instructions, demonstrations and the learning process'. In: Williams, A.M. and Hodges, N.J. (eds.) *Skill acquisition in sport: research, theory and practice*. London: Routledge, pp. 145–174.
- Hodges, N.J. and Williams, A.M. (2012) *Skill Acquisition in Sport: Research, Theory and Practice*. 2nd edn. New York: Routledge.
- Hutchins, S.M. and Peretz, I. (2012) 'A frog in your throat or in your ear? Searching for the causes of poor singing', *Journal of Experimental Psychology: General*, 141(1), p.76.
- Hutchins, S., & Moreno, S. (2013) 'The linked dual representation model of vocal perception and production', *Frontiers in Psychology*, 4, 825.
- Hunter, M.S. (2021) 'Cognitive behavioral therapy for menopausal symptoms', *Climacteric*, 24(1), pp. 51–56.
- Hutt, S., Hutt, C., Lenard, H., Bernuth, H., Muntjewerff, W. (1968) 'Auditory responsivity in the human neonate', *Nature*, 218, 888–890.
- Iacoboni, M., Woods, R.P., Brass, M., Bekkering, H., Mazziotta, J.C. and Rizzolatti, G. (1999) 'Cortical mechanisms of human imitation', *Science*, 286(5449), pp.2526-2528.

Iacoboni, M., Molnar-Szakacs, I., Gallese, V., Buccino, G., Mazziotta, J.C. and Rizzolatti, G. (2005) 'Grasping the intentions of others with one's own mirror neuron system', *PLoS biology*, 3(3), p.e79.

Janelle, C.M., Champenoy, J.D., Coombes, S.A. and Mousseau, M.B. (2003) 'Mechanisms of attentional cueing during observational learning to facilitate motor skill acquisition', *Journal of Sports Sciences*, 21(10), pp. 825–838.

Johnson-Frey, S.H., Maloof, F.R., Newman-Norlund, R., Farrer, C., Inati, S. and Grafton, S.T. (2003) 'Actions or hand-object interactions? Human inferior frontal cortex and action observation', *Neuron*, 39(6), pp.1053-1058.

Kal, E., van der Kamp, J. and Houdijk, H. (2013) 'External attentional focus enhances movement automatization: a comprehensive test of the constrained action hypothesis', *Human Movement Science*, 32, pp. 527–539.

Kawato, M. (1999) 'Internal models for motor control and trajectory planning', *Current Opinion in Neurobiology*, 9, 718–727.

Kim, H.-S., Ju, D. and Lee, J.-A. (2022) 'Development and preliminary evaluation of the effects of a preceptor reflective practice program: a mixed-method research', *International Journal of Environmental Research and Public Health*, 19(21), p. 13755.

Knaus, W.J. (2000) 'Procrastination, blame, and change', *Journal of Social Behavior and Personality*, 15, pp. 153–166.

Kohler, E., Keysers, C., Umiltà, M.A., Fogassi, L., Gallese, V. and Rizzolatti, G. (2002) 'Hearing sounds, understanding actions: action representation in mirror neurons', *Science*, 297(5582), pp.846-848.

Koski, L., Wohlschläger, A., Bekkering, H., Woods, R.P., Dubeau, M.C., Mazziotta, J.C. and Iacoboni, M. (2002) 'Modulation of motor and premotor activity during imitation of target-directed actions', *Cerebral cortex*, 12(8), pp.847-855.

Koski, L., Iacoboni, M., Dubeau, M.C., Woods, R.P. and Mazziotta, J.C. (2003) 'Modulation of cortical activity during different imitative behaviors', *Journal of neurophysiology*, 89(1), pp.460-471.

Kuhl, P. K., & Meltzoff, A. N. (1996) 'Infant vocalizations in response to speech: Vocal imitation', *Journal of the Acoustical Society of America*, 100, 2425–2438.

Lee, T.D., Swinnen, S.P. and Serrien, D.J. (1994) 'Cognitive effort and motor learning', *Quest*, 46(3), pp. 328–344.

Lee, S. (2022) *Scholarly Research in Music*, 2nd Edition, Routledge.

Lévêque, Y., Giovanni, A. and Schön, D. (2012) 'Pitch-matching in poor singers: human model advantage', *Journal of Voice*, 26(3), pp.293-298.

Liberman, A.M. and Mattingly, I.G. (1985), 'The motor theory of speech perception revised', *Cognition*, 21(1), pp.1-36.

Liberman, A.M. and Whalen, D.H. (2000) 'On the relation of speech to language', *Trends in cognitive sciences*, 4(5), pp.187-196.

Look, C., McCabe, P., Heard, R. and Madill, C.J. (2019) 'Show and tell: Video modeling and instruction without feedback improves performance but is not sufficient for retention of a complex voice motor skill', *Journal of Voice*, 33(2), pp.239-249.

Lotze, M. (2013) 'Kinesthetic imagery of musical performance', *Frontiers in Human Neuroscience*, 7.

Loughran, J.J. (2000) 'Effective Reflective practice, A paper presented at Making a difference through Reflective practices: Values and Actions conference', *University College of Worcester*.

Maas, E., Robin, D.A., Austermann Hula, S.N., et al. (2008) 'Principles of motor learning in treatment of motor speech disorders', *American Journal of Speech-Language Pathology*, 17(3), pp. 277–298.

Macan, T.H. (1994) 'Time management: Test of a process model', *Journal of Applied Psychology*, 79, pp. 381–391.

Macan, T.H., Shahani, C., Dipboye, R.L. and Phillips, A.P. (1990) 'College students' time management: Correlations with academic performance and stress', *Journal of Educational Psychology*, 82, pp. 760–768.

Madill, C.J., McIlwaine, A., Russell, R. et al. (2018) 'Classifying and identifying motor learning behaviors in voice-therapy clinician-client interactions: a proposed motor learning classification framework', *Journal of Voice*. Submitted.

- Madsen, C.K. (1975) *Research in music behavior: Modifying music behavior in the classroom*. New York: Teachers College Press.
- Mayan, M. J. (2023) *Essentials of Qualitative Inquiry*. 2nd edn. New York, NY: Routledge.
- McIlwaine, A., Madill, C. and McCabe, P. (2010) 'Voice therapy prepractice and the principles of motor learning', *ACQuiring Knowledge in Speech, Language and Hearing*, 12(1), pp. 29–32.
- Meline, T. (2006) 'Selecting studies for systemic review: Inclusion and exclusion criteria', *Contemporary issues in communication science and disorders*, 33(Spring), pp.21-27.
- Mercado, E., III, Mantell, J. T., & Pfordresher, P. Q. (2014) 'Imitating sounds: A cognitive approach to understanding vocal imitation', *Comparative Cognition & Behavior Reviews*, 9, 1–57.
- Millican, J. S., & Forrester, S. H. (2019) 'Music Teacher Rankings of Selected Core Teaching Practices', *Journal of Music Teacher Education*, 29(1), 86-99.
- Molnar-Szakacs, I., Iacoboni, M., Koski, L. and Mazziotta, J.C. (2005) 'Functional segregation within pars opercularis of the inferior frontal gyrus: evidence from fMRI studies of imitation and action observation', *Cerebral cortex*, 15(7), pp.986-994.
- Molnar-Szakacs, I., and Overy, K. (2006) 'Music and Mirror Neurons: From Motion to 'e'motion', *Social Cognitive and Affective Neuroscience* 1, no. 3: 235–41.
- Moore, R.E., Estis, J., Gordon-Hickey, S. and Watts, C. (2008) 'Pitch discrimination and pitch matching abilities with vocal and nonvocal stimuli', *Journal of Voice*, 22(4), pp.399-407.
- Nápoles, J. (2006) 'The relationship between type of teacher talk and student attentiveness', *Journal of Music Teacher Education*, 16(1), 7–19.
- Nápoles, J. (2017) 'The effect of duration of teacher talk on the attitude, attentiveness, and performance achievement of high school choral students', *Research Perspectives in Music Education*, 11(1), 22–29.

Oberman, L.M. and Ramachandran, V.S. (2007) 'The simulating social mind: the role of the mirror neuron system and simulation in the social and communicative deficits of autism spectrum disorders', *Psychological Bulletin*, 133(2), p.310.

Ogawa, Y. and Murao, T. (2004) 'Flat pitch production by accurate singers: Relationship among pitch discrimination, stimulus model, and pitch-interval matching accuracy', In *Proceedings of the 8 th International Conference on Music Perception & Cognition (Evanston, IL)* (pp. 723-724).

Onwuegbuzie, A. and Johnson, R. (2006) 'The validity issues in mixed research', *Research in the Schools Mid-South Educational Research Association Research in the Schools*, 13, pp. 48–63.

Overy, K. and Molnar-Szakacs, I. (2009) 'Being together in time: Musical experience and the mirror neuron system', *Music perception*, 26(5), pp.489-504.

Papousek, M. (1996) 'Intuitive parenting: A hidden source of musical stimulation in infancy', in I. Deliège & J. Sloboda (Eds.) *Musical beginnings: Origins and development of musical competence*. Oxford: Oxford University Press, pp. 88–112.

Pfordresher, P.Q. and Brown, S. (2007), 'Poor-pitch singing in the absence of "tone deafness"', *Music Perception*, 25(2), pp.95-115.

Pfordresher, P. Q., Demorest, S. M., Dalla Bella, S., Hutchins, S., Loui, P., Rutkowski, J., et al. (2015) 'Theoretical perspectives on singing accuracy: An introduction to the special issue on singing accuracy (Part 1)', *Music Perception*, 32, 227–231.

Pfordresher, P. Q., & Mantell, J. T. (2014) 'Singing with yourself: Evidence for an inverse modeling account of poor-pitch singing', *Cognitive Psychology*, 70, 31–57.

Poulson, C. L., Kymissis, E., Reeve, K. F., Andreators, M., & Reeve, L. (1991) 'Generalized vocal imitation in infants', *Journal of Experimental Child Psychology*, 51, 267–279.

Press, C., Gillmeister, H. and Heyes, C. (2007) 'Sensorimotor experience enhances automatic imitation of robotic action', *Proceedings of the Royal Society B: Biological Sciences*, 274(1625), pp.2509-2514.

- Price, H.E. (2000) 'Interval matching by undergraduate nonmusic majors', *Journal of Research in Music Education*, 48(4), pp.360-372.
- Randolph, J. (2009) 'A guide to writing the dissertation literature review', *Practical assessment, research, and evaluation*, 14(1).
- Rizzolatti, G., Arbib, M. (1998) 'Language within our grasp', *Trends in Neurosciences*, 21, 188–94.
- Rizzolatti, G., Fogassi, L. and Gallese, V. (2001) 'Neurophysiological mechanisms underlying the understanding and imitation of action', *Nature reviews neuroscience*, 2(9), pp.661-670.
- Rizzolatti, G. and Craighero, L. (2004) 'The mirror-neuron system', *Annu. Rev. Neurosci.*, 27(1), pp.169-192.
- Sander, L. (2020) 'The music teacher in the mirror: Factors of music student-teacher self-efficacy', *Visions of Research in Music Education*, 37(1), p.6.
- Schmidt, R.A. and Lee, T.D. (2011) *Motor Control and Learning: A Behavioral Emphasis*. Champaign, IL: Human Kinetics.
- Schmidt, R.A., Lee, T.D., Winstein, C., Wulf, G. and Zelaznik, H.N. (2018) *Motor control and learning: A behavioral emphasis*: Human Kinetics.
- Schon, D. (1987) *Educating the reflective practitioner*. San Francisco: Jossey-Bass. Let me know if you need further assistance!
- Slavin, R. E. (1987) 'Best-evidence synthesis: Why less is more', *Educational Researcher*, 16, 15–16.
- Studdert-Kennedy, M., Liberman, A.M., Harris, K.S. and Cooper, F.S. (1970) 'Motor theory of speech perception: A reply to Lane's critical review.'
- Studdert-Kennedy, M. (2000) 'Imitation and the emergence of segments', *Phonetica*, 57, 275–283.
- Stute, P. and Lozza-Fiacco, S. (2022) 'Strategies to cope with stress and anxiety during the menopausal transition', *Maturitas*, 166, pp. 1–13.
- Sukhera, J. (2022) 'Narrative reviews in medical education: key steps for researchers', *Journal of Graduate Medical Education*, 14(4), pp.418-419.

- Titze, I. (2021) 'Self-organization in vocal mechanics and physiology', *Journal of Singing*, 78(2), pp. 233–234.
- Tzetzis, G., Kioumourtzoglou, E. and Mavromatis, G. (1997) 'Goal setting and feedback for the development of instructional strategies', *Perceptual and Motor Skills*, 84(3), pp. 1411–1427.
- Trehub, S. E. (2001) 'Musical predispositions in infancy', in R. J. Zatorre & I. Peretz (Eds.) *The biological foundations of music*. New York: New York Academy of Sciences, pp. 1–16.
- Treinkman, M. (2021) 'Focus of attention research: a review and update for teachers of singing', *Journal of Singing*, 77(3), pp. 407–418.
- Treinkman, M. (2022) 'Focus of attention in voice training', *Journal of Voice*, 36(5), pp.733-e1.
- Uddin, L.Q., Kaplan, J.T., Molnar-Szakacs, I., Zaidel, E. and Iacoboni, M. (2005) 'Self-face recognition activates a frontoparietal “mirror” network in the right hemisphere: an event-related fMRI study', *Neuroimage*, 25(3), pp.926-935.
- Uddin, L.Q., Molnar-Szakacs, I., Zaidel, E. and Iacoboni, M. (2006) 'rTMS to the right inferior parietal lobule disrupts self–other discrimination', *Social cognitive and affective neuroscience*, 1(1), pp.65-71.
- Ramachandran, V.S. and Oberman, L.M. (2007) 'Broken mirrors: a theory of autism', *Scientific American*, 17(2), pp.20-29.
- Wan, C.Y., Demaine, K., Zipse, L., Norton, A. and Schlaug, G. (2010) 'From music making to speaking: Engaging the mirror neuron system in autism', *Brain research bulletin*, 82(3-4), pp.161-168.
- Wang, R., Huang, X., Wu, Y. and Sun, D. (2021) 'Efficacy of Qigong exercise for treatment of fatigue: A systematic review and meta-analysis', *Frontiers in Medicine*, 8.
- Watts, C. R., and Hall, M. D. (2008) 'Timbral influences on vocal pitch-matching accuracy', *Logoped Phoniatr Vocol*. P.33:74–82.
- Williams, J.H., Whiten, A., Suddendorf, T. and Perrett, D.I. (2001) 'Imitation, mirror neurons and autism', *Neuroscience & Biobehavioral Reviews*, 25(4), pp.287-295.

Williams, J.H., Waiter, G.D., Gilchrist, A., Perrett, D.I., Murray, A.D. and Whiten, A. (2006) 'Neural mechanisms of imitation and 'mirror neuron' functioning in autistic spectrum disorder', *Neuropsychologia*, 44(4), pp.610-621.

Wilson, S.M., Saygin, A.P., Sereno, M.I. and Iacoboni, M. (2004) 'Listening to speech activates motor areas involved in speech production', *Nature neuroscience*, 7(7), pp.701-702.

Wulf, G. (2013) 'Attentional focus and motor learning: a review of 15 years', *International Review of Sport and Exercise Psychology*, 6(1), pp.77-104.

Wulf, G. and Lewthwaite, R. (2016) 'Optimizing performance through intrinsic motivation and attention for learning: The OPTIMAL theory of motor learning', *Psychonomic Bulletin & Review*, 23, pp.1382-1414.

Wulf, G. and Shea, C. (2002) 'Principles derived from the study of simple skills do not generalize to complex skill learning', *Psychonomic Bulletin & Review*, 9(2), pp. 185–211.

Yarbrough, C., Green, G., Benson, W., Bowers, J. (1991) 'Inaccurate singers: an exploratory study of variables affecting pitch-matching', *Bull Counc Res Music Educ*, 23–34.

Zhukov, K. (2005) *Teaching styles and student behaviour in instrumental music lessons in Australian conservatoriums*. [Dissertation]. Available at: ProQuest Dissertations and Theses database.