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Assignment Submission Form / Ffurflen Cyflwyno Aseiniad

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Student Number: ____1911309____

Student's Name: ____Sophie Yaeger____

Tutor Name: ____Debbie Winter____

Assignment Title: ____Independent Study Module____

Module Code: ____Module BMPF7013

Submission Date: ____Friday 12th March____

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An investigation into the topics of vocal learning and neuroscience to clarify which motor learning principles are useful when applied to coaching an adult contemporary singer.

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1) The Portfolio

A: Introduction, rationale and the context of my work-based practice.

In this desktop study I will investigate the topics of vocal learning and neuroscience to further clarify which motor learning principles could be relevant to the developing singer. I had observed frustrations in students who came to me after already partaking in previous vocal training. Sources of this conflicting information were a combination of previous voice teachers, books and online resources. I noticed they had technical issues, were confused, lacking in confidence and were in a constant cycle of searching for an answer to 'how' to sing. Being a singer I could relate and realized this was affecting my coaching. I was cautious I did not want to add more turbulence to their already unfulfilled journey. This began my quest to find the most effective way to coach singing students. Initially I was extremely excited and interested to explore the idea of adopting the use of Motor Learning Principles (MLP). This propelled me to engage in a previous study into motor learning with a view to understanding how to coach a student.

Unsurprisingly, I discovered that motor learning (ML) research was largely based in sports and there was no research when applied to contemporary singing. I found some overlap from vocal learning and neuroscience research which seemed to align with ML. Indeed, I began to utilize what I had learnt into my practice. However, at the end of my study I was left hesitant towards MLP and lacking in confidence to apply this approach entirely in my voice studio. There were areas which resonated well with me and my practice, but others which did not. I was left with many questions, some of which I will explore in this study. To seek clarity on which elements of MLP can cross over from the sporting literature into the singing pedagogy, I have decided to investigate two areas, vocal learning and neuroscience as it relates to vocal learning. I hope that this will give me the confidence I need to continue to develop my practice with the added use of MLP.

I own and manage a contemporary focused voice and music studio where we have a large majority of adult clients and children from age 6. I employ five music tutors and it is my aim to develop a program tailored to the individuals needs while allowing for social collaboration, such as working together as part of a band or ensemble. I am eager to establish a well-rounded training regime grounded in evidence-based research for the contemporary singer, especially those who are age 18 and over. Just under half of my singing clients are also instrumentalists, learning additional instruments alongside singing. This is a growing area of my practice in which I also collaborate with instrumental tutors to develop a learning environment that is useful and fulfilling to clients.

Understanding how to implement MLP into my practice is crucial in providing an evidence-based approach. In this study I intend to expand on the knowledge I gained in my previous study and hope to discover insights within these different fields of research which will enhance this.

B. Planned Program of Study

My background, previous independent study, and practice-based experience has intrigued me into understanding the use of MLP by investigating human vocal behavior. I believe that if I can gain more confidence behind MLP as applied to singing, it will enrich my coaching practice. My aims and objectives for this study are:

Aims

- To expand my knowledge about vocal learning and the associated brain pathways.
- To gain a better understanding of the human vocal origins and evolution to enable me to coach my clients with greater depth.
- To identify similarities between motor learning and human vocal behavior.
- To gain insight into the most recent research and opinions within the vocal learning literature and assess how these align with the MLP.
- To Identify how and what is 'natural' to humans regarding singing.
- To identify future research areas and possible connections to other areas of my practice.

Objectives

- To conduct a search for relevant scientific papers, articles, reviews and identify major contributors to the area of vocal learning and elements of neuroscience.
- To consider how research from these areas supports the use of elements of MLP.

- To reflect on the implications for my professional practice and ongoing development.
- To identify any gaps in the current research or knowledge and what future studies may be needed.

A projected period for my process

Time Frame	Action
September	DEFINE 1. Agree topic as discussed with tutor 2. Decide and write up Aims and Objectives
October	SEARCH Gather literature from sources relevant to the topic.
November	SELECT 1. Select and Refine my samples. 2. Begin writing up the assignment.
December	Submit drafts for feedback from tutor.
January	Re-writes and edits.

C. Literature Review Process

Based upon my previous independent study into MLP along with my practical experience, I formulated seven questions to explore in this literature review.

1. Can research from vocal learning and neuroscience validate the use of **MLP** in my coaching practice?
2. Do motor learning principles align with human vocal behavior? Is singing all a **motor skill** which is learnt like that of physical movements using our external limbs?
3. What propels humans to make sound and is there an evolutionary need for it? If so, how can this be implemented into **feedback** to help **motivate** and aid my clients singing development?
4. Can vocal evolution help release limiting beliefs and **enhance expectations** during a student's vocal development process?
5. What is an appropriate model for human singing, and is imitation and **modeling** a useful tool in my voice studio?
6. How can social and environmental situations effect a singer's development and how does this align with **practice** and the **learning** delivery for my clients?

7. Are there differences between coaching singers and instrumentalists when utilizing **MLP**?

This project will involve reviewing peer reviewed literature from vocal learning and areas of neuroscience. Given the vast amount of literature I will choose a purposeful sample of data (Cooper, 1984) from these fields. This study is unlikely to be exhaustive considering the timeframe allotted and the complexity of the subjects. My aim is to clarify the validity of utilizing MLP within my practice, enabling me to choose wisely before adopting a framework directly from the current vocal pedagogy and sports literature.

For this study I have selected recent research and publications within the last ten years. These areas of research are rich with literature, by picking current opinions from these experts I aim to discover which areas of research appear to hold more weight. I also hope this will allow for a wider scope of opinions and will enable me to gain more specificity for future studies.

During this process it is my intention to continually acquire knowledge rather than positioning myself either objectively or subjectively (Kaushik and Walsh, 2019). Although my previous study made me cautious to utilize MLP fully into my practice I am in no way dismissing anything at this point in my learning development. I only seek to gain a more comprehensive understanding so that I can feel confident in working these new insights into my practice with my clients. It is important that I create a voice studio where clients can feel safe and secure during their own development. Notwithstanding, I do keep in mind that due to my own experiences, neutrality and objectivity may never truly be reached (O'Leary, 2017).

This literature review will focus on peer reviewed primary or original scholarship, and I will aim to summarize my findings as applied to my practice (Cooper 1989). I will use secondary resource material such as books sparsely. I have engaged in many online resource materials to aid me in this process, such as interviews and talks given by researchers, however, due to validity issues these will not be included in this review.

Preliminary research shows some neuroscientific studies as applied to singing but I have yet to find any studies which investigate the effectiveness of training methods on the contemporary singer from a neurological aspect. Therefore, I will expand my search across disciplines outside of the area of my practice specialism (Hart, 1998), but which pertain to the human voice or those seeking to gain an understanding of the human voice. It is my belief by gaining a deeper understanding of the human voice outside of singing technique, it will help me better coach a singer, as well as help me understand the use of MLP in my practice.

Research into vocal learning suggested a widening appreciation into various species further than that of songbirds (Martins and Boeckx, 2020; Tyack, 2020) such as I had previously discovered. This might prove useful in gaining insights which align with MLP as applied to singing. However, initial searches show no studies that apply principles from vocal learning research to the singer's development. To my knowledge there are no primary peer reviewed research which studies MLP as applied to the contemporary singer.

My previous study highlighted a few main researchers promoting the application of MLP to singing training, therefore I will use their peer reviewed articles as a base for comparison in this literature review. Generativity is a principal element to the literature review process, building off those who have come before is important to my practice (Boote and Beile, 2005). The Journal of Voice appears

a significant journal within the singing pedagogy literature and most of these articles were published here.

Since my interest for this study is 'sound' and not speech I have purposefully chosen not to focus on elements of speech motor learning, such as the lips and tongue for this study. However, one area of interest is the jaw and its connection with the voice. In neuroimaging studies on humans only two studies appear to have focused on depressing the jaw (Grabski *et al.*, 2012; Brown, Yuan and Belyk, 2021), both studies demonstrated an overlap with the motor-cortex for vowel vocalization. Other studies have focused on jaw elevation such as biting or closing the jaw (Brown, Yuan and Belyk, 2021). Looking into the relevance of MLP applied to singing I found this to be an insightful discovery towards clarifying its use and will investigate studies into the laryngeal motor cortex further in the study. I am intrigued as to how much the role of **motivation** within speech-therapy MLP plays a role in the success or lack thereof. This is also something I wish to consider with the MLP as applied to singing.

It is also worthwhile for me to keep in mind, that the importance of peripheral vocal anatomy and its characteristics as applied to speech has potentially been overestimated and indeed speech has very deep evolutionary roots (Fitch, 2018). This therefore further piques my interest of progressing my knowledge in the vocal evolution and vocal learning route for this study. Within the singing literature an anatomical and scientific approach of understanding 'what part of the vocal anatomy is doing what,' appears to be a dominating element of singing pedagogy since the 1960's (Hoch, 2019). It seems to be one reason Holding suggests looking towards cognition and motor learning could bridge this gap (Holding, 2007, 2009). I concur, a bridge between various approaches of singing would be advantageous to the developing singer and my practice as a voice coach.

I hope this literature review will help me understand the body of knowledge in more depth enabling me to evaluate the relationship, strengths, and weaknesses of MLP applied to my practice and give me focus for future studies, (Hart, 1998; Rhoades, 2011). To do this, I first engaged in literature searches through google scholar and The University of Wales Trinity St David online library which allows access to most all journal articles spanning across a wide range of subjects.

I used specific keywords to start my search, however I quickly adopted a reference snowballing approach in addition (Wohlin, 2014; Mu, 2019). Thirdly, I partook in citation tracking or pearl growing (Boell and Cecez-Kecmanovic, 2010) which enabled me to further collect literature I would not have found via a database search alone. Finding common threads by looking at the keywords and reading the abstracts helped me in determining which literature to read. I will need to develop a rigid organizational system if I am to gain the clarity I seek during this process (Cohen, Manion and Morrison, 2018). I store my data and research notes in the Mendeley reference management software (Bell and Waters, 2014). I intend to code this data systematically to enable me to recognize contrary findings or rival interpretations and maintain an orderly process (Randolph, 2009). I hope this ridged organizational system will allow me to connect my findings easily across the medium of motor learning as applied to singing, and indeed to my practice. I will approach this study with a hermeneutic approach and to start my process I will focus on literature that is accessible to me, but I understand this may cause important finding to be missed (Boell and Cecez-Kecmanovic, 2010). If the need arises and is possible, I will look at research or secondary pedagogical sources which require financial outlay.

I approach this study as a pedagogue and coach. My aim is to deepen my understanding and gain validity to support the use of implementing motor learning principles or not when coaching a singer. I have a varied background of experience and have studied voice from scientific, musical, and acting aspects. I am also a singer and performer so have experienced many of my client's issues firsthand. Notwithstanding, I remain objective and am extremely open to change and current ideas as I deepen my understanding and knowledge. I will critically examine the findings as they apply to my practice experience and search for answers to the above questions rather than to test a specific hypothesis (Bogdan and Biklen 1982, Ingleby, 2012).

Reflection

Hart (2014) promotes imagination and creativity when reflecting on a literature review, both of which resonate with me tremendously as a practitioner, however applying this to a review of scientific papers will be unfamiliar territory for me.

Reflection on my practice is essential for me to improve my research and writing skills. Training and working as a performer I have never undertaken a formal academic course. Reflecting on- my- actions Schon (1983) allows me the opportunity to gain new insights into my current practice. This will enable me to critically evaluate myself and improve my practice for future projects within an academic framework (Boud et al 1985, Jarvis 1992).

I resonated with Schon's theory immensely and agreed that professional practice is complex, unpredictable and messy and I do act both, intuitively and creatively during the art of coaching and teaching (Schon, 1983). This can be both rewarding and debilitating, often struggling to find clarity and focus. While I am used to working in my professional practice in this more unpredictable manner, this was not helpful to me during this study process. Dewey's (1933) method (reflection-in and on-actions) in a practical setting as a performer and voice practitioner, is something I am familiar with; I did not feel this was the right method for this task.

Argyris and Schons (1978) single and double loop learning created excitement within me, while understanding reflection is a circulative process, I felt I would benefit from a simpler approach for this assignment. I tend to become lost within a circle, resulting in a poorer performance. Gibbs Reflective Cycle (1988) expanded from Kolb's (1975) earlier model, seemed overwhelming in this new area of study when considering my weaknesses.

It is my aim to confront the complexity of my students learning, my own practice and overall subject matter of what it involves to coach a singer (Rodgers, 2002). I believe that reflection on my practice and into my academic studies will allow me this opportunity to learn to do so.

For these reasons I have decided to use Driscoll's (2007) approach based on Borton's (1970) model. What? So what? Now what?

What?

My aim was to clarify the validity of utilizing MLP within my practice of coaching adult singers by investigating the topics of vocal learning to find alignments.

My first undertaking was to source material relating to my area of research. I started with research from within vocal learning which appeared to relate to human voice evolution and gathered this into a reference management software. At this stage I was eager to discover answers to my questions relating to the use of MLP that I had discovered in the voice pedagogy research. I wanted to gain clarity and confidence of adopting a fully motor learning approach to my coaching practice. I felt I had a good idea regarding MLP but had underestimated the enormity of these new areas to which to seek insights. Nevertheless, I read a lot of literature over a few months being fascinated and drawn in, in awe of the content. During my excitement I had un-knowingly engaged in a 'surface approach' to my learning (Entwistle, 1991). The material was complex, and I had to engage in online materials to help try and make sense of what I was reading. I knew ultimately this learning process was going to take time and I was comfortable in this knowledge. Delving into these scientific papers had brought to light more information from different areas of research than I was ready for. I found myself in fields of study extremely alien to me. Many of the words and phrases I did not understand. This was exhausting and I was struggling to make sense of what I was reading.

Initially I had both clarify and focus (Schon, 1983). Halfway through this process however, this focus went, which resulted in a loss of clarity leading to a messy process. I was yet to notice that I had not followed my rigid organizational plan, this realization would come too late to rectify the issue. The primary resource material I had gathered was vast and complicated. I was aware that I was running out of time for this study and could feel my performance was beginning to operate from a panic state.

When the time came to attempt to synthesize what I had learnt I ran into problems due to the lack of origination of the literature. My references were not in an easy-to-manage system ready for cross referencing (Bell and Waters, 2014).

This frustration was then amplified when the reference management software, which was used to store the research, malfunctioned losing access to almost all my literature and notes. I was left with barely any record of the literature I had read over the past few months. This was a major setback with limited time to rectify the problem.

I attempted to remedy the situation, searching again for the literature based on scattered notes I had made. I categorized the data quickly but felt exasperated at the amount still missing. At the time outside influences of the COVID-19 pandemic had also affected my professional practice and I was struggling to adjust. Although my limits were being tested, I welcomed the opportunity to learn and grow. It allowed me to challenge which information and knowledge I had retained and not, this offered an opportunity to expand my memory and critical thinking on these topics. Secondly, I was able to formulate a plan to avoid such devastating issues in the future.

Some clarity was forming again, possible links and ideas still at odds were developing. However, it was doubtful at this late stage if I was going to be able to write up a comprehensive academic review. Being able to articulate my findings felt inconceivable at this stage. Nevertheless, time forced me to decide to either accept the misfortunes and give up, or to continue moving forward, learning and growing from my mistakes. Ultimately, it was my lack of organization that derailed my study. Something had to be written and presented. I was fully aware that some, if not all my review could be incorrect or misjudged and I struggled to tame this chaos into a cohesive study. In the end, I needed to be ruthless with the data and attempt to maintain a clear trajectory. I had attempted too

much in too short a time span and could not steady the reins this time. Grievously, once again at the very last hurdle, my reference management system once again failed. I understood that this process was essential and was determined to learn from it.

So what?

Is it obvious I must develop a solid and productive system of organization. Accademia is still a new world for me therefore this process has shown me if I am in any way disorganized with my literature it will drastically damage the quality of the research study. Indeed, I felt unequipped to critically examine my findings and collect answers to my questions in the depth I had initially aimed for (Bogdan and Biklen, 1982).

To stand a chance of delivering a comprehensive, transparent, and rigorous literature review a clearly defined and systematic approach is needed from the start (Aveyard, 2014). This is what I must be aiming for to meet my own standards of an evidence-based approach in my practice. I am aware that without a solid review of the literature, acquiring an understanding of the topic, what has already been researched and what the current themes are, will be unattainable (Hart, 2001).

Despite the amount of literature read and sourced, it is fundamentally useless if there is no clear plan from which I can create a summery off. Perhaps having one specific and focused question would have been beneficial for my study. My brain tends to emit fireworks when thinking and it can be challenge for me to stay on topic without wondering into another topic. This is something I must learn to manage. I need to work towards delivering a review which can assist others in understanding the body of research in existence (Rhoades, 2011), in turn, this will aid my development as a voice practitioner and coach.

I had wanted to identify any gaps or alignments between the scientific literature and the voice pedagogy literature regarding MLP, and seek relevance in ideas that perhaps seem irrelevant (Osterman and Kottkamp, 1993). I felt due to this poor organizational structure my process in this study resulted in an incomplete and unsuccessful result, leaving me indeed with an intense sense of internal discomfort (Boyd and Fales, 1983). Yet, this process has unearthed some information which offers me the opportunity to look closer at my coaching practice and grow. Continuing to develop my workflow within an academic application will be paramount to my future development.

Now what?

1. Develop a plan.

I will seek to develop a disciplined plan for future studies. I believe this will allow me to demonstrate my understanding of the topic in future studies (Bell and Waters, 2014). Secondly, this will enable me to systematically analyze and find connections or gaps in the research, providing me insights that develop my practice with more ease.

2. Create a reliable reference system.

I have created a spreadsheet which allows me to record each paper I read, as I read it. The spreadsheet allows me to document the title, author, date, the documents file name, where it is filed and notes to mark the main points of the literature. This will allow me to keep log of which literature I have read and where to find the document should Mendeley malfunction in the future. This will also give me a clearer picture of the literature for side-by-side comparisons. In Mendeley

one must open the file to see the notes on it and I find this troublesome and slows the process. I will still use Mendeley and learn to back up the catalog. Looking towards structures such as Coppers Taxonomy of Literature Reviews in more detail to help keep me on track will be worth my time. Keeping a visual printed copy of my process, questions and aims out in front of me may also help maintain focus and clarity.

3. Topic and Focusing

I am guilty of attempting too much in a brief time. Proof of this can be observed in this study. I struggle not go into tangents and wonder off. This is more problematic in complex scientific areas. Since I am new to this method of study it might be beneficial to study a topic more familiar to me before jumping ahead into complex topics. I do this as my goal is to learn, develop and grow and by pushing my limits and challenging myself into areas I am more unfamiliar, I believe will make me a better practitioner in the future. This also allows me to remain openminded to finding solutions in areas I would not think of otherwise (Hart, 2001). Notwithstanding, I realize If I am unable to develop a solid process correctly this will not be a success. I am aware that in not having an exact or clear picture in the field of vocal learning, neuroscience and in cognitive science for motor learning, I risked my study being too wide or unfocused (Rodgers, 2002). Therefore, I will proceed with a less complex topic in the future and continue to develop both my practice and academic skills.

4. Applied to practice.

I have discovered and learnt a huge amount of valuable knowledge during this study that I believe will be helpful to my client's issues in practice. If I can learn from this process from an academic lens this will enable me to develop more skill when applying this to my practice. I am aware that coding information carefully is vital to not misrepresent, be misled or produce a bias in my practice. My goal is to operate mainly from an evidence-based practice so I must also make sure the research behind what I say is accurate and has been well understood (Howard-Jones, 2014). Structure will help me towards this goal, as well as gaining further knowledge. I believe this will allow me to keep the sense of joy in not knowing while highlighting the possibilities to be found (Ghaye and Lillyman, 2010), albeit with more structure and less chaos.

Part 2 – Assignment

An investigation into the topics of vocal learning and neuroscience to clarify which motor learning principles are useful to apply to coaching an adult contemporary singer.

This independent study aims to examine literature from the field of vocal learning to find relevance to motor learning principles as it applied to singing. Motor learning has interested me and literature from voice pedagogy as prompted questions to if I should adopt principles into my voice studio. As a reflective practitioner I endeavor to provide my clients with lasting changes to their voice and help them gain an understanding of what holds their voice back. It is my duty as a professional practitioner to search out good practice (Schon, 1983). My experiences have propelled me to be openminded to discovery to questions from many unexpected disciplines but, although learning may

start from an experience it cannot succeed without reflection and action (Osterman and Kottkamp 1993).

Humans are unrivaled in their capacity to acquire and perform a vast amount of motor skills. Easily observed in babies acquiring skills, crawling, walking, and multiple physical actions. As we practice this process of muscle activity, mostly permanent movements are observed in our motor behavior. Further practice can develop into advanced motor performances. "We are born to move but learn to move skillfully" (Magill & Anderson., 2014, p. 2). Motor learning across singing and the motor learning states that, motor learning is the term to describe the internal neurological process of acquiring and refining such motor skills (Verdolini, 1997; Holding, 2008; Mann, 2011; Natale and Politis, 2018).

The majority of motor learning research is rooted within other industries, mainly sports with little focus or research within singing (Zarate, 2013; Atkins, 2016). It has been suggested that the complex system of motor movements used for singing could be why research is lacking in singing discipline (Holding, 2015). Indeed, while similarities apply, differences between other motor skills and voice motor skills are apparent by its nature alone, "the vocal motor system is different in nature from the peripheral motor system" (Kleber *et al.*, 2010).

This study seeks to investigate some of these natural differences or find similarities as they apply to motor learning (ML). I remain cautious and curious to apply a direct framework from motor learning alone and question if all the principles are valid to singing, "It is important to consider the wealth of information available in this domain and to determine which, if any, of the principles can or should be attempted in the voice studio" (Bergan, 2010). This study will attempt to collect evidence which work towards determining the use of these principles or not.

Keeping with Driscoll's practical reflection framework; What, so what and now what, will allow me to navigate through my findings which come from complex backgrounds. I believe this will create a clearer pathway for implementing my findings into my practice in addition.

In looking at the question, do motor learning principles align with human vocal behavior? This study will look towards vocal learning for some of these natural differences, and first ask, What?

Vocal learning in a broad sense is the ability to modify vocal production (output of sound) based on experience, and unlike language, vocal learning is not unique to humans (Zhang and Ghazanfar, 2020). Fitch argues, despite earlier claims, nor is the human larynx (Fitch, 2005). Vocal learners have been accepted in the literature as songbirds (Smulders *et al.*, 2020) and mammals (Petkov and Jarvis, 2012). While birds are quite distant to humans in a biological sense, they have been considered closest for the study of vocal learning. In fact, researchers attested humans to be the only primate considered capable of vocal learning, therefore non-human primates were thought to offer little relevance in this area of study (Martins and Boeckx, 2020; Tyack, 2020).

Humans have learned vocalizations (voluntary vocalizations) (Jürgens, 2009) observed in language and singing, and are considered unique to humans (Simonyan *et al.*, 2009; Fitch, 2018). Humans also have innate vocalizations (involuntary vocalizations), such as crying and laughter, which are also seen in non-human primates (Jürgens, 2002). Learned vocalizations involve modifications which require various abilities and behaviors and require some *form* of learning and experience, unlike those which are innately produced (Martins and Boeckx, 2020). This would seem to align with the

suggestion that singing is a motor skill which needs to be learned (Helding, 2008) and treated as such in a voice studio (Nix, 2017). Still, we are left with the question, what is this *form* of learning needed, could MLP be useful here?

We can observe this innate vocal behavior in babies, from birth they can signal to their parents by crying (Messaoud and Tadj, 2010). Many studies in infant directed singing has shown the benefits of humming (Jordania, 2009) as a soothing mechanism for humans as soon as we are born, with mothers intuitively utilizing acoustic properties of the voice, rhythm changes and various pitches (Etoile, 2006). If on an evolutionary level humans can hum and appear to process some musical ability (Habibi and Damasio, 2014), singing would be linked to our survival as a species (Fancourt and Perkins, 2018). Could this intuitive approach be utilized when coaching a singer, and could this be at odds with some MLP if taking into account singings evolutionary principles (Monti, Aiello and Carroll, 2016; Pisanski *et al.*, 2016)?

Fitch (2018) explains that evidence in vocal learning now indicates that the difference between non-human primates' vocal behavior and humans learnt vocalizations is not an anatomical one. Indeed, suggestions now indicate that some non-human primates' vocal tracts are 'speech ready' (Fitch *et al.*, 2016). It is proposed the major difference is neurological (Fitch, 2018). Researchers therefore, are proposing incorporating a more diverse range of species in the view to understanding vocal learning within humans (Wirthlin *et al.*, 2019). However, it is also argued that it was both brain and anatomy which enabled full human speech (Lieberman, 2017). Research into brain and music appears to have some rich data (Koelsch, 2020). In either instance, the brain seems important to vocal production in humans and the difference between the neural process of speech and song would seem a relevant exploration (Peretz and Zatorre, 2005).

Helding (2007) suggests looking towards cognitive science could help bridge a gap of dichotomy within voice pedagogy (Helding, 2007). Indeed she suggests that looking towards the brain for discoveries which would benefit singing (Helding, 2009). Helding offers her 'Cheesecake Theory' as one use of teaching with the brain in mind (Helding, 2014). Here she experiments with the ideas of mirror neurons, motor learning, community of practice and rewarding where she assigned students to post reflections and a reliving of their lessons on her social open forum. Students were able to see and comment on each other's master class performances. Students who posted a lot where socially rewarded while those who didn't engage in posting where 'instantly exposed' (Helding, 2014, p. 345). They were given the message that their actions where not appreciated and that they must not have had enough motivations to change and therefore where not rewarded. This resulted in some students leaving the voice studio altogether if they didn't choose to engage in being 'socially rewarded via posting' and labeled duds. I feel uneasy about applying this experiment to my studio, for many reasons. For one, evidence on mirror neurons in humans has been proposed as weak and appears conflicting (Turella *et al.*, 2009). Suggestions of their existence, and hypotheses require further research (Farina, Borgnis and Pozzo, 2020). In the few studies that investigated mirror neurons associated with motor empathy found no significant relationships (Bekkali *et al.*, 2020). It appears there is still a lot to be discovered in way of mirror neurons, therefore, I would want to have engaged in more research before applying this in my studio. Helding leaves us with the ultimate conundrum of, what does **motivate someone?**

With the addition of voice science into singing training it would be beneficial to explore which is the ideal approach to utilize scientific concepts of voice (Latukeyfu and Verenikina, 2011) and looking to

MLP could offer some insight as Holding suggests. Some contemporary voice models go into detail about the movement of the vocal anatomical structures, directing singers to consciously modify these structures to create certain sounds (Steinhauer, Kilmek McDonald and Estill, 2017). I concur that a scientific understanding can indeed be useful to the developing singer however, how this is applied in coaching or teaching singers is intriguing and I believe the brain may provide answers. Motor learning research suggests an internal focus would not be effective for creating ease of movement and advocates that an external focus is more conducive for motor learning behavior (Wulf, Shea and Lewthwaite, 2010; Holding, 2015; Atkins, 2016).

It is hypothesized that the vocal learning area of the brain was a duplication of the motor learning part of the brain that evolved into vocal learning part of the brain (Feenders *et al.*, 2008). Suggesting MLP and movement could be of benefit here. Indeed, literature is emerging on the connection between movement and voice is and being investigated (Nafisi, 2013; Kilpatrick, 2020) and would be an exciting area for further exploration and perhaps this could align with some MLP. Within neuroscience music is used to support rehabilitation for movement suggesting a connection between movement, brain and music (Schaefer *et al.*, 2014), showcasing an intuitive connection within humans. Evolutionary the use of movement and rhythm has been linked with vocal behavior and communication, as can still be observed today in African apes (Ackermann, Hage and Ziegler, 2014).

Evolutionists and anthropologists discuss how instruments are an extension of the first instrument, the voice (Monti *et al.* 2016). Returning to the mother's 'hum', also links movement to enhance the soothing effect (Falk 2004). It has been suggested that loud rhythmic shouting accompanied with aggressive body movements and throwing of objects, was a form of defense in hominids (Jordania, 2009). Thomas Geissmann suggested that old world monkeys and apes could be a likely model for a precursor of human singing and music. He discusses the similarities to music by way of rhythm, clapping, stomping and that of an emotional tie such as is seen old world monkeys. However, differences are noted, such as steady beating, and the ability humans have to invent new signal patterns, through improvisation or to spontaneously repeat exact patterns (Geissmann, 2000).

Woodard (2009) discusses how to reconnect musicians to their spirit through movement, enhancing fluidity and musical expression. It is argued, an individual's path of movements was consistent with their perception of how their body worked, therefore, by 'body mapping,' which correlates to neuroscience research, would allow them to connect with their instrument (Woodard, 2009). There is valuable and growing research in support of the Feldenkrais method for motor learning (Worth, 2015; Mattes, 2016), and Zeller utilizes Feldenkrais for the voice (Nelson, 2002). The Dalcroze Method may offer opportunity for enhanced musical expressiveness (Seitz, 2005). Briggs (2020) presents advice on incorporating movement into a choral setting, using gestures to match the desired sound. Liao (2016) found gesture had a positive effect on children's pitch accuracy, correlating with previous studies which showed a link between gesture and tonal patterns could benefit intonation. The Estill Model includes hand signal gestures within their vocal learning model (Steinhauer, Kilmek McDonald and Estill, 2017). Research into the Laban movement theory could prove beneficial in the exploration, in one study it was proposed that the use of Laban movement could help adopt emotional resilience (Tsachor and Shafir, 2017). Perhaps insights here could be extremely useful for the developing contemporary singer who works with a lot of emotion.

Secondary voice pedagogy sources also highlight the connection between movement and voice (Adrian, 2008; Callaghan, 2014).

So What?

In reflecting on the use of movement in my practice, I found a large amount of movement use in my coaching. However, I have had little real understanding of why. One of my students is blind and so this allowed me the opportunity to teach singing in a way that I had never thought of before for the last couple of years. I acknowledge that in the past I was ignorant to the advantage that vision and imagery allowed for those who have it. I believe visualization and imagery to be powerful tool for those who have it and it could further enhance the **mental practice** of a singer or instrumentalist (Hartwigsen *et al.*, 2020). Although more research would be need here to determine the usefulness and application to practice. Utilizing the use of movement with more of my students because of the work I was doing with my client who is without vision was having a positive effect on their singing also. Yet, I was met with some **resistance** from many of my clients. In my practice I am keen to be inclusive of all my student's needs, so further discovering what the objection for movement is and how movement connects to the voice might allow clients who are resistant to movement an insight which can **motivate** them to utilize the tool to their benefit. Therefore, motivating and providing other forms of **feedback** in their practice and learning (Wulf and Lewthwaite, 2016; Maxfield, 2019).

So, what? Can the brain help us understand the motor connection in voice? Would this align with the application of MLP when coaching a singer? It seems relevant to my practice if I am to utilize MLP applied to voice, that I understand the connection between motor movement, voice and the human brain. For example, one way I currently utilize movement is when giving feedback to clients and some further clarification would be beneficial to me. Research suggests **feedback** is a fundamental aspect of motor learning (Helding, 2008) and distinguishing between sensory feedback and augmented feedback is advantageous to the voice practitioner (Bergan, 2010). The suggest a multimodal system use could prove useful in giving feedback resonates with me (Barton, no date; Jakus *et al.*, 2017).

It is suggested that while proprioception is a helpful source of feedback, in rapid movements this feedback source is not useful to make movement adjustments due to the time limitations (Magill and Anderson, 2014). It is proposed that verbal directions are too slow for the motor learner, by the time the brain has processed the words the movement has passed (Magill and Anderson, 2014). Nix (2017) suggests that combining techniques into one word is an effective way combat this issue. I agree and experimented with another option which would be to work with the singer to develop a complimenting movement, this would also be replicated in giving feedback to them. This is not to underestimate the usefulness from other senses including auditory and visual receptors (Barton, no date).

I observed that while movement was benefiting the clients who committed to it, I was struggling to convince those who remained hesitant and realized I need a better understand of what was going on.

Returning to find more, what. I found that despite the importance of vocal learning research for humans there is little research performed on humans. It is argued that diversity across many species could be crucial to determining human vocal behavior in addition to the studies into songbirds (Lieberman, 2012, 2017; Lattenkamp and Vernes, 2018; Nieder and Mooney, 2020).

Notwithstanding, the need for more human research is apparent as cells and functions may be different from those in other primates (Belyk, Lee and Brown, 2018).

When looking at voluntary vocalizations, researchers attest that a complete understanding of laryngeal and vocal motor production is lacking and not fully understood (Fitch, 2017; Lattenkamp and Vernes, 2018). One study found no evidence that phonated pitched vocalizations were encoded in the primary motor cortex when studying trained singers (Belyk, Lee and Brown, 2018). Research suggested, while the laryngeal motor cortex seems the most conceivable area for pitch control, coordination of laryngeal muscles for speech, song and emotional expression remains elusive.

It was proposed, due to the nature of the vocal fold's symmetry, i.e., both folds working together symmetrically, their movement may work on principles that promote symmetry rather than asymmetry, as would be observed with external limbs (Belyk and Brown, 2017). However, intrinsic muscles around the larynx are asymmetrical, they state that "despite an unusually asymmetric innervation pattern, the larynx motor system seems to operate in a bilateral fashion to innervate the two vocal folds in a symmetric and synchronous manner" (Belyk and Brown, 2017, p. 181).

So what? This was extremely insightful to me and could aid in which choice of movements I use when coaching a singer, further helping me explain to the singer why this may help. In using some of the Estill voice gestures at times have felt at odds with some clients on an unexplainable level. I have found in my clients that when they have a sense of progress in their learning this helps their **motivation** to continue to move forward, but when they retreat into a more negative 'stuck' place their progress halts. Thinking of the vocal folds for example as one fluid symmetrical movement rather than two chords coming together to make sound seemed to prove helpful in those who chose to commit to the use of movements. This information allowed me to coax some clients who were undecided on the usefulness of movement to try, they also found more freedom in their voice. This then motivated them to practice more as they felt their **expectations had been enhanced**. Motor learning research showed that in normative feedback enhancing expectations or even 'false feedback' was helpful to the learning process (Wulf and Le 2016). This also altered the way I demonstrated the movement as matched to sound, perhaps this was more effective **model** movement.

A recent study conducted on humans discovered that only part of the larynx (the dorsal portion) is represented in the primary motor cortex, but the ventral part is not (Eichert *et al.*, 2020). It is hypothesized the ventral larynx would lie in the premotor cortex and is involved in basic control of the vocal folds producing sound, as seen in primates (Eichert *et al.*, 2020). It is theorized that the dorsal larynx is involved in pitch control and is unique to humans (Belyk and Brown, 2017; Belyk, Lee and Brown, 2018; Kleber *et al.*, 2019). Which could open questions regarding the location of the larynx's representation in the motor cortex (Simonyan and Horwitz, 2011). I would want to stay current with developments here to explore further the use of movement, brain connection and how to utilize this with regards to MLP in my voice studio.

Motor learning research indicates that **modeling or demonstration** is more effective under certain circumstances over others, therefore the coach/practitioner should consider this before deciding on using demonstration (Magill and Anderson, 2014). Indeed, what the observer 'perceives' is especially important and is not necessarily what the coach believes they have demonstrated. Prof. Rich Masters research into perception offer some fascinating insights into human perspectives. On

reflection, I noticed when I demonstrate with my voice, I asked the client what did they observe? What did they hear? In addition, we take time to discuss what they are 'perceiving' in famous voices or performers. This allows me to determine how my client is approaching the singing task from within in their mind and not mine.

Usually, their perceptions are not an accurate account of reality (Magill and Anderson, 2014), and can cause them to tense trying to 'do' or 'copy' what they 'think' needs to be done to make this sound. Much of this is based however on visual demonstrations but voice training obviously has an audible element. In a voice therapy study, it was shown that demonstration and instruction improved performance but was not sufficient in retaining a complex voice motor skill when video modeling (Look *et al.*, 2019). This is especially intriguing for my practice due to the digital technology changes being made in my voice practice. Madill *et al.* suggest that other preparative variables would need to be considered.

A study into classical singing suggested two major feedback circuits, auditory and kinesthetic act as control systems of the laryngeal musculature during phonation, with auditory feedback more prominent in preliminary stages of vocal training being crucial to pitch development (Kleber *et al.*, 2010) and that an auditory model alone was not conducive to learning how to sing (Zarate, 2013).

Vocal learning in songbirds offers stimulating findings. It was shown that numerous brain regions are involved in vocal learning with "integrations within the auditory lobule being critical for learning to occur" (Pagliaro *et al.*, 2020, p. 5). Therefore, "vocal learners must hear sounds they will later imitate" (Jarvis D, 2004). It was suggested that an "**appropriate model**" was required for vocal learning in birds (Nieder and Mooney, 2020 p2). If we consider humans remember vocal melodies more than instrumental, the 'voice-advantage', this could also offer support for imitation, with listeners remembering melodies sung by a voice (without lyrics) better than melodies played on instruments (Weiss and Peretz, 2019). One explanation is, the voice is a "conspecific signal" which "compared to other sounds, human vocalizations elicit enhanced attention from early in life" Vouloumanos & Werker (2007, cited in Weiss and Peretz, 2019 p35). Thus, enhancing arousal and distinct neural processing compared to instrumental sounds.

In the book *The Musicians Mind*, Holding (2020) couples together singers and instrumentalists into one category: 'musician.' I find this to be problematic, as while similarities surely occur, I argue that from a brain perspective alone they cannot be interchangeable. Singing appears to be an evolutionary trait which has been observed across many species including humans (Martins and Boeckx, 2020; Nieder and Mooney, 2020). Playing an instrument such as piano or guitar is not. This appears to make sense when considering the 'voice-advantage,' suggesting perhaps a human evolutionary difference between singing and instruments.

Research on understanding the exact differences between singers and instrumentalists does not appear plentiful, but there are some recent contributions. One study on the similarities of the brain networks in singers and cello players showed some overlap, but prominent differences between the two were observed (Segado *et al.*, 2018). A study concluded that while singers and musicians were identical in their ability to perceive musical stimuli, the ability to imitate foreign speech was unsurprisingly, significantly higher in vocalists than of the instrumentalists. The researchers state that due to these differences vocalists and instrumentalists should be regarded as individual categories in language acquisition research and not summed up under the term "musicians"

(Christiner and Reiterer, 2015). Many of my clients are musicians or learning an instrument alongside voice. Understanding these differences between the two will help in program development encompassing both singing and instrumental learning. Often, as an alternative to my own voice I will use an instrument in my vocal studio, such a piano or guitar to 'model' the notes for example. I begin to wonder should the singing coach be less behind a piano and more engaged with the singer?

So, in searching for answer to what is an **appropriate model** looking to vocal learning here could provide some insights.

Some opinions place a large focus of attention on **imitation** throughout vocal learning research, though current researchers claim it is still a largely mysterious phenomenon (Tchernichovski and Marcus, 2014). As seen in birdsong, the theory assumes a juvenile acquires a template by listening to an appropriate tutor at a critical period of development (Jarvis D, 2004; Jarvis, 2019). This memorized acoustic template is then used as a guide to develop his own closely matched song (Margoliash, 2002). This tool of mimicking requires the ability of audible learning and memory, two areas I consider important aspects of singing training. Extensive research has shown that like songbirds, humans use imitation or auditory templates for learning singing or speaking (Tyack, 2020).

From experience, I would propose that imitation is used substantially in singing training, e.g., call-and-response exercises and tutor **demonstrations**. Yet, from a vocal learning stand point, the argument that imitation alone is simply not enough persists (Wirthlin *et al.*, 2019). In contrast, I have also observed lessons with barely any imitation or **modeling**, with learning focused on verbal instruction during vocal lessons. I have wrestled with the implications of utilizing imitation, and frequently contemplate the benefits to my students and how social environments effect the model? In reflection, I would want to look more into this connection and seek further analysis.

Questions of these social aspects of learning in vocal communication have been around for some time. Vincent Janik and Peter Slater distinguished vocal learning i.e.: learning sounds, because of interactivity with another individual and communication affected by behavior, auditory or experiential approaches (Janik and Slater, 2000). They attest that improvisation or random sound generation could showcase vocal flexibility and that an animal which used this kind of improvisation could "learn different parts of other individuals' calls and combine them to form a new call" (Janik and Slater, 1997, pp. 61–62). This could be similar to how some of my contemporary singer clients might be inspired by another voice model rather than imitating it exactly.

The role of play within children's early years learning has been prominent, with researchers claiming the effectiveness of guided play (Weisberg, Hirsh-Pasek and Golinkoff, 2013) as it allowed the learner to engage implicitly, which imparting information does not allow. Improvisation therefore could be beneficial to my practice. Especially for the contemporary singer who is creative and inspired by other artists unlike other genres which favor imitation of a pre-determined sound or style. In my experience with acting voice, playing with sound and movement is often encouraged (Colaianne, 2000; Anderson and Colaianne, 2003; Linklater, 2006; Shewell, 2009). Inspired by this, I attempt to create a highly playful environment for my clients of all ages, which is also suitable for the non-actor. I find this creates a fun, relaxed environment where clients can learn without judgement. For example, we may improvise with sounds or melodies, encouraging my students to be creative rather than solely prescribing certain exercises or imitating a certain song pattern or others

voice. However, if this research is currently limited in diversity from the social elements it is hard to make a full conclusion currently.

Imitation could be seen as a natural process of learning to sing as it is seen in songbirds. Perhaps this is true of children but how would it differ in adults over 18? Additionally, the use of the word 'natural' could be problematic, implying that any other means of learning or singing is 'unnatural' (Gudmundsdottir, 2020). If future research finds alignments with Janik (1997) then improvisation would also be a natural form of vocal learning. I have observed singers battling with the notion of whether they are being 'natural.' This usually results in a disjointed or disappointing vocal performance and has potential to cause damage (Howard and Harris, 2018).

Evidence on imitation in singing is emerging to help develop a valid training strategy for facilitating neural and vocal plasticity for singing novices and semi-professional singers' (Frühholz *et al.*, 2020). However, there are limitations to this study, as it was only conducted on one highly experienced and skilled vocal impersonator. If my clients had a deeper understanding of what was 'natural' from an evolutionary point of view I believe this could offer some light into mitigating tensions caused from what they perceive is natural or not. In motor learning it was pointed out that when learning of a new motor movement, **demonstration** has greater influence (Magill and Anderson, 2014). Yet is all singing a 'new skill' or somewhat innate? Could clarity here help my clients understand what is 'natural' and could this be developed, rather than taught or learned?

The Primal Sound method Chapman (2020) and to some extent the Estill voice method both rely on emotional or primal sounds to trigger singers' vocal abilities. From experience using the Estill method, I have found some of these triggers to cause confusion and internal panic when attempting to use them. Chapman suggests a primal sound such as someone stamping on a person's foot can be used to awaken a singer's connections to their emotional motor system, which can then be trained for singing (Chapman, 2020).

Research into classical singing, suggested to produce vocalizations including speech and song, the control of all muscles along the vocal tract requires the concerted effort of a vast network of brain regions (Kleber *et al.*, 2019). Studies into learned and innate vocalizations have concluded that separate pathways control vocalizations in mammals and in songbirds (Arriaga and Jarvis, 2013). A hierarchical system of the vocal systems neural pathways seems agreed on by many researchers to guide an understanding of the vocal systems neural pathways (Jürgens, 2002, 2009; Simonyan and Horwitz, 2011; Ackermann, Hage and Ziegler, 2014; Kumar, Croxson and Simonyan, 2016). "The primary motor neurons that control the larynx and vocal articulators are located in the brainstem" (Fitch 2018 p267). This is where 'innate' vocalizations are formed based on a monosynaptic connection from the motor cortex to the medulla which controls the laryngeal muscles controlling phonation (Fitch 2018). Indeed, humans born without a cortex can still produce sound. The periaqueductal grey (PAG) activates these innate vocal pattern generators in the brain stem, initiating vocalizations and controlling intensity, but they do not seem to control vocal patterns (Jurgens 2009). PAG is responsible for unplanned innate and emotional vocal behavior resulting from a painful stimulus resulting in a cry, moan or laugh. It seems that voluntary vocal initiations would involve the anterior cingulate cortex (ACC) (Simonyan and Horwitz, 2011). Jurgens states that therefore, "voluntary control of vocal initiation, for instance, during the utterance of a faked pain cry by an actor on the stage, involves in addition the cortex of the medial frontal lobe, more specifically, the anterior cingulate cortex" (Jürgens, 2009,p4). This seems to suggest that choosing to

produce a sound and innately producing the sound involve different neurological brain pathways (Fitch, 2017, Martins and Boeckx, 2020; Tyack, 2020).

Studies into laughter showed that engagement in premotor and motor cortex activating during the suppression of laughter and not in production of it, further listeners brain regions differed when hearing a 'real' (involuntary laugh), versus a voluntary laugh (Scott *et al.*, 2014). A fascinating study into listeners perception of genuineness when listening to actor singers voices, showed that "vocalists with more years of acting experience were rated as more genuine than vocalists with less acting experience" (Livingstone, Choi and Russo, 2014, p. 1).

If this is correct, neuro-scientifically speaking these sounds can never truly be primal if singers choose to activate them. This might prove problematic when applying these 'emotional' trigger sounds in singing, confusing the singer with what is natural to them. Secondly, emotional triggers can be unhelpful and exhausting. From an acting perspective I would encourage a singer to play the action, not the emotion. When using 'intentions' rather than emotional triggers I observe my clients have more freedom in their voices rather than being focused on how to evoke an emotion which can be draining in training and in performance or invite tensions.

So what? Is motor learning a complex motor skill to be learnt? The research into innate vocal learning could be problematic to MLP. If singing is innate to our survival as humans evolutionary speaking, then do our bodies and brains already know how to sing on some level? If a singer wishes to become highly skillful, does this mean adjusting or learning a new motor skill and therefore how would the principles differ from that of learning to play the piano or playing football for example? Would using the innate vocalizations as a starting point such as Chapman appears to suggest, be useful? Do I need to consider if we even can, such as the science could suggests?

Working with adults I have observed that many seem to have vocal issues which are derived from previously 'mimicking' or 'imitating' either other singers, tutors or a combination. Usually accompanied by some scientific knowledge that is bitty and confusing. This can contribute to them feeling stuck, limited and tense when singing, often worried about being 'correct' or sounding a 'certain way'. This tends to cause further conflict with if they are being natural. I have been careful not to inflict another form of 'imitation' or bitty information onto their voices because of this. Instead, we explored the idea that by limiting their singing to specific imitated sounds they might be limiting their own vocal possibilities. When discussing the evolutionary purpose of singing with them this seemed to create more ease, as if they in fact did have a right to sing. Working from this mindset appeared to allow their voices a sense of joy and ease, even in emotional songs. Letting go of the 'mimic' appeared to encourage a sense of freedom, as a singer I could relate. However, this is not to suggest that imitation has no place in the voice studio, I believe it does. I also cannot be completely sure of what is working and why yet. I ask the question, how, why and in what situations or environments should these tools be used? I am aware that I don't have the full understanding yet in this area or how it relates to voice in its entirety, nor does it appear science has all the answers yet either. Nevertheless, it is an area I am very keen to continue to learn about as I feel finding a balance between these two elements of vocalization and their connection to us as a human singer, could benefit my practice further in the future.

Now What?

In summary, I am still interested in motor learning principles and how they apply to coaching a singer. However, across the vocal learning and neuroscience spectrums there does seem to be some conflictions and indeed critical gaps in the knowledge of vocal control, vocal learning and how the brain is involved in humans (Belyk and Brown, 2017). Some of these discoveries appear relativity new in the scientific studies and more time would seem needed to establish further consensus. Thus, I believe caution should be taken before applying this theory wholesale and more research would be needed for clarity before I can apply them fully in practice.

Ideally, this study could form the basis for further research into other learning theories within coaching and psychology. Here perhaps more alignments between these other theories can be made giving rise to tools which seems supported from multiple disciplines.

This study has made me more aware of my clients evolutionarily vocal behavior traits and this information is allowing me to be more sensitive towards their needs. Understanding human vocal behavior, I believe will help me coach and mentor my clients more efftetely in the future as my knowledge grows.

I have noticed scope for further investigation into the areas of this study. A deeper investigation into the movement connection and in-depth study on individual motor learning principles, such as feedback and motivation, might prove beneficial. However, since my focus is on coaching and mentoring a singer, I want to remain relevant to that area of study so I must keep this in mind as I move forward.

In conclusion it appears that utilizing motor learning principles as applied to coaching singers seems to have contradictions and alignments with these scientific areas. I continue to strive towards finding a balance between the scientific lens and that of the real world when coaching adult contemporary singers.

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