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Title:

Motor Learning Theory Applied to the CCM Singing Studio:

How can the findings of motor learning research be applied to an online Contemporary Commercial Music singing studio, to optimise learning and performance?

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Assessment Component One: Portfolio

1. Introduction and Rationale

I am a freelance vocal coach / singing teacher, specialising in Contemporary Commercial Music (CCM) styles; my private singing studio is now exclusively online. I provide one-to-one lessons for my students, mostly adult singers, of varying levels of experience (generally intermediate to advanced).

For almost a decade, I have consistently engaged in continued professional development (CPD) training, in order to hone my craft as a singing teacher. This wide range of training, in addition to the training and research I have undertaken as part of this Master's degree, has given me an excellent grounding in voice science (for example, laryngeal physiology and vocal tract acoustics). However, my approach to *delivering* this knowledge has a less clear rationale.

Whilst my voice science training has resulted in substantial benefits to my practice, I found that "...as my knowledge of voice physiology increased, my ability to 'do it' and to 'teach it' was not necessarily improved proportionately" (Verdolini, 2000 p.1).

My training has shown me *what* to teach and *why*. Developing a solid understanding of *how* to teach singing would complement these elements and has the potential to transform my teaching, and consequently, the learning journey of every singer I teach.

To maintain a balanced perspective, I will draw on Brookfield's (2017) four 'reflective lenses', to view the issue from students' perspectives, colleagues' perceptions, personal experience and theory / research.

Students' perspectives

As my clients are adults, beginning lessons is something they have actively chosen to do. This demonstrates a certain level of motivation. Most are committed enough to adhere to regular personal practice.

However, despite good intentions, some students struggle to practice regularly. They may have work or family commitments, or it slips their mind. The additional challenges faced by many over the past year have further exacerbated this.

When they do find time to practice, they may feel unsure how best to structure their time.

They may think back to a vocal breakthrough they made in their last lesson. How should they train this new skill, so that (a) they can do it consistently and will not forget it, and (b) they can rely on it during a performance?

Lack of regular singing practice (or ineffective practice) is likely to lead to stagnation of progress, potentially resulting in the student terminating their lessons, and feeling disheartened. These singers would benefit from increased motivational support, and advice on practice structuring.

Personal experience

I assist my students in establishing singing goals, and encourage them to commit to a regular, achievable singing practice schedule; most do so. However, for those who do not, I do not have a clear way to address this. I feel it would be unhelpful to criticise, so I tend to listen to their reasons why, and suggest that they aim to find time each day (even if only five minutes) to engage in practice.

Whilst this sometimes works, developing my approaches to motivate students would help me to support these students much more effectively.

In lessons, I am clear on what to teach my students (and why), but I would like to have a clearer rationale to inform *how.*

For example, a student may wish to develop consistency in their application of a singing technique they have recently acquired. To successfully and reliably facilitate this, would drilling the same exercise repeatedly or switching between a number of exercises be most effective?

A better understanding of how to build consistency of a new singing skill, along with a knowledge of optimal ways to structure practice, would be of great benefit. It would also help me to advise students on how best to structure their own singing practice, between lessons.

Finally, I believe that when giving instruction and feedback during lessons, my communication could at times be more effective. At times, I have explained an exercise in terms of its physiological rationale, but this does not always translate into effective learning. If the student is interested in the topic, it may lead to discussion, which reduces practice time; if the student is not interested, it can cause them to disengage.

Developing an evidence-based understanding of how to optimise my delivery of instruction and feedback would enormously benefit my teaching practice.

Colleagues' perspectives

A number of recent studies on singing lessons offer insights into how singing teachers choose to give instruction and feedback.

Motivation

In a study of four classical singing teachers (who were each recorded for two lessons), Crocco, McCabe and Madill (2020) found low use of motivational techniques; of seven pre-practice instructions, it was the least commonly used.

Attentional focus of instruction

In a study on attentional focus in voice training, Treinkman (2020) surveyed 278 singers, who reported the specific wording of directives given to them by their teacher during lessons. The results showed that a combination of internal and external focus instructions were used by the teachers. Whilst more than half of instructions were externally focused, 39.42% of responses elicited an internal focus (see figure 1).

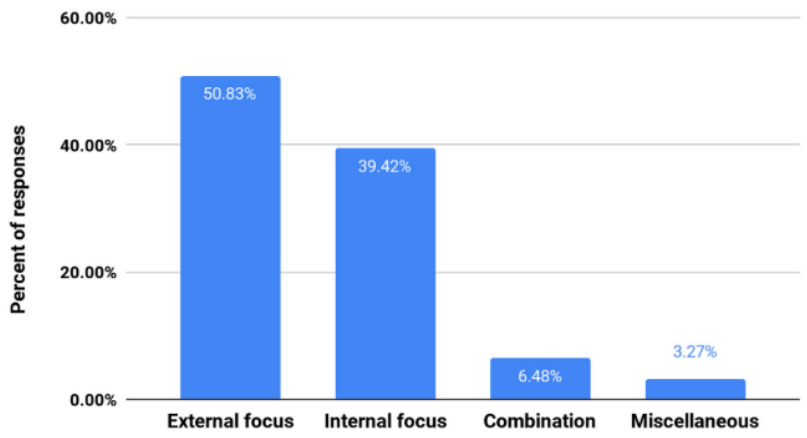


Figure 1: Percent of responses that induced various attentional foci (Treinkman, 2020 p.6)

Feedback

Studies suggest that teachers may spend more lesson time delivering feedback that their students spend singing (Crocco, McCabe & Madill, 2020; Johnson, 2020).

This may result in teachers dedicating a surprisingly small amount of lesson time to actual singing. For example, Crocco, McCabe and Madill (2020) found that student singing represented 12-44% of total lesson time (see figure 2).

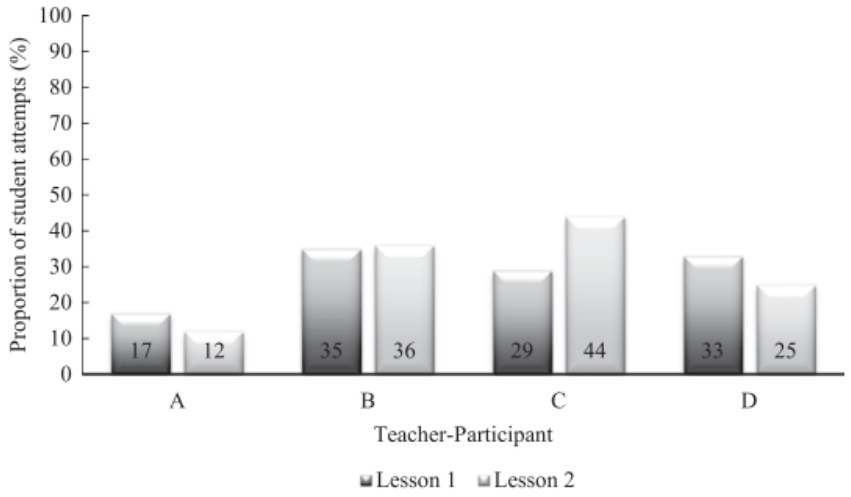


Figure 2 - Percentage of lesson time spent on student attempts per lesson
(Crocco, McCabe & Madill, 2020)

In a study on use of feedback, Johnson (2020) observed a total of 36 singing lessons, delivered by three collegiate voice teachers. He found that:

- 30% of instances of teacher feedback was concurrent (delivered whilst the student was singing);
- Teachers did not delay terminal feedback (average delay was -0.236 sec, suggesting that the student was interrupted);
- Teachers did not consistently change their feedback to reflect the level of learner skill.

Johnson (2020) also found a disparity between the teachers' perception of what they did, and what they *actually* did.

Although the teachers *thought* they were adapting to the needs of more skilled learners by reduced feedback frequency and duration, the results showed that this was not consistently achieved. Also, whilst the teachers were more aware of the content of their feedback, they were less aware of the frequency or the overall duration of their feedback.

In other words, the teachers knew *what* they were teaching, but were less aware of *how.*

<u>Existing theory / research</u>

The benefits of incorporating the principles of motor learning theory into singing pedagogy have been increasingly discussed by voice pedagogues over recent years (Helding, 2020b; Manternach, 2021).

A broad field encompassing a wide range of disciplines, motor learning has been researched for over a century (Titze & Verdolini, 2012). Studies specific to singing (or even to music) remain rare, although there does appear to be an increasing trend for ML research involving musicians (e.g. Atkins, 2017; Maxfield, 2011; Mornell & Wulf, 2019; Williams, 2019).

Nevertheless, voice scientists Titze and Verdolini (2012) maintain that "there is no compelling reason" (p.218) to think that the existing body of research (which mainly studies limb tasks) is not generalisable to singing, considering that the existing ML studies on voice are generally consistent with other findings.

Motivation

Crocco and Meyer (2021) emphasise that although "teachers may assume that because students are in singing lessons, they are intrinsically motivated" (p.694), explicit motivational behaviours are vital for successful singing training.

The impact of motivation on ML has been a growing area of research over the past two decades (Chiviacowsky, 2020; Wulf & Lewthwaite, 2016). For example, autonomy support (providing the learner with choices) and enhanced expectancies (enhancing the learner's sense of competence) have both been shown to improve motor learning (Wulf, Chivacowsky and Cardozo, 2014).

Structuring practice

There is an extensive body of research exploring the effects of different types of practice structure on motor learning. For example, distributed practice (involving rest periods) has been shown to be more efficient than massed practice (involving reduced rest), for both short-term performance and long-term retention (Bourne & Archer's, 1956, cited in Schmidt & Lee, 2014).

Attentional focus of instruction

In spite of a large body of research supporting the benefits of external focus of attention on motor learning and performance, its application to singers is still debated (Treinkman, 2021 p.407).

Leading ML expert and focus of attention specialist Gabriele Wulf (2015) strongly believes that the benefit of external focus on ML "applies to all human beings" (p.338).

However, leading singing pedagogue Lynn Helding (2019), who has written extensively on the application of ML principles to voice pedagogy, remains sceptical of the generalisability of this principle to all singers. She highlights gaps in research and methodological flaws, such as a

lack of studies on musicians/singers, fewer studies on complex motor skills, and lack of ecological validity.

Nevertheless, recent studies on instrumentalists and singers appear to address some of these concerns (Atkins, 2013; Mornell & Wulf, 2019; Williams, 2019).

Feedback

Although Johnson's (2020) study found frequent use of concurrent feedback, this has been shown to degrade long-term learning, despite improving short-term performance (Park, Shea & Wright, 2000; Sigrist *et al*., 2013).

Although the teachers studied by Johnson (2020) did not delay terminal feedback, Swinnen *et al.* (1990) found that instantaneous feedback degraded learning, in comparison to feedback given after a 3.2 sec delay.

In a study of eight college voice students, Maxfield (2011) found that whilst a higher *relative feedback frequency* (frequency of feedback in relation to number of trials) was more effective for novice singers (p.2), a *lower* relative feedback frequency resulted in better retention for more experienced singers. This supports the intention of Johnson's (2020) teachers to reduce feedback for more skilled learners, despite the reality that this did not in fact occur.

Potential impact on my practice

Clearly, there is a large body of ML research with direct implications for singing pedagogy. Motivational techniques, practice structuring, the attentional focus elicited by instruction and approaches to giving feedback are all variables which have been shown to affect motor learning.

Exploring these areas in depth has the potential to transform my practice as a singing teacher. It has fundamental implications for almost *every* aspect of my teaching, in *every* session, with *every* student. It would, therefore, help me to better serve my students.

In light of the recent studies on singing lesson delivery (Crocco, McCabe & Madill, 2020; Johnson, 2020; Treinkman, 2020), it appears that this research could also be of great benefit to other singing teachers.

2. Planned Programme of Study

i) Research aims

- Examine highly credible singing-specific primary and secondary ML literature, to establish relevance to singing pedagogy
- Compare and contrast this with non-singing ML literature, to allow critical evaluation and establish further validity
- Critically evaluate the existing body of literature on ML, identifying trends, areas of consensus / debate and gaps in research
- Establish ways to optimise practice structure, use of motivational techniques, instruction and feedback, in order to benefit learning and performance
- Design evidence-based teaching activities, to optimise learning and performance
- Draw conclusions and identify areas for further research

Expected learning outcomes

Upon completion of this study, I aim to have:

- Further developed my academic research and writing skills
- Developed a detailed knowledge and understanding of the key principles, concepts, themes and findings of ML theory
- Established how ML theory can be applied to my own teaching practice, and in particular:
    - How can I help motivate singers to maintain a regular practice schedule?
    - How can singing practice be structured (within lessons and the students own practice) to help students develop consistency of a new skill, and ensure that it is reliable when used in performance?
    - How can I optimise my delivery of instruction and feedback?
- Begun to apply this learning to my teaching practice
- Critically evaluated the actual and potential impact on my practice
- Considered how to utilise my new specialism in order to benefit the wider pedagogy community

ii) Methodology

Philosophical background

I approach this independent study from a subjectivist epistemological position, built on a Heraclitan *becoming* ontology; I believe in a changing, emergent world, and that truth is subjective (Gray, 2004 p.17).

However, I am keen to put metaphysical considerations aside, in order to place the research problem at the centre of this study. The problem-centred philosophy of pragmatism makes this an ideal research paradigm from which to draw influence. As a science-informed singing teacher, I aim to bridge the *rigor / relevance* gap (Schön, 1984) between theory and practice. As a practitioner-researcher, I aim to achieve this by finding evidence-based solutions to problems commonly encountered in the singing studio.

I will draw on pragmatism in order to guide my decision-making, ensuring that I maintain focus on finding solutions to the research problem (and avoid the distraction of theoretically interesting yet irrelevant areas). This is important, as it will help synergise my efforts towards improving my own teaching practice; this in turn will have a positive impact on my singing students.

Pragmatism proposes that human experience involves a reciprocal relationship between our beliefs and our actions (Morgan, 2007, p.71). In order to apply this principle to the research process, Dewey's (1910b/2008, summarised in Morgan, 2014) systematic approach to inquiry is a helpful framework for decision-making. Intended to be applied as a continuous, repeated process until the issue is resolved, the five stages are:

1. Recognizing a situation as problematic;
2. Considering the difference it makes to define the problem one way rather than another;
3. Developing a possible line of action as a response to the problem;
4. Evaluating potential actions in terms of their likely consequences;
5. Taking actions that are felt to be likely to address the problematic situation.

(Dewey, 1910b/2008, summarised in Morgan, 2014, p. 1047)

This abductive approach to inquiry is particularly apt, as it echoes the processes of *reflection-in-action* and *reflection-on-action* (Schön, 1984), which form the *modus operandi* of vocal coaching.

Literature review methodology

The assignment will take the form of an integrative literature review, which Torraco defines as "a distinctive form of research that uses existing literature to create new knowledge" (Torraco, 2016 p.1).

According to Cooper's (1988, p.109) Taxonomy, literature reviews are characterised by their **focus, goals, perspective, coverage, organisation** and **audience.**

The ***focus*** relates to "the material of central interest to the reviewer" (Cooper, 1988, p.108).
My aspiration is to find evidence-based solutions to real-world issues, by integrating the *relevance* of voice pedagogy practice, with the *rigor* of ML research and theory (Schön, 1984). Therefore, the review will have three foci: 'practices or applications', 'research outcomes' and 'theories' (Cooper, 1988, p.108).

In order to establish relevance to practice, highly credible ML literature authored by esteemed singing pedagogues will be examined; this will include peer-reviewed journal articles, published books and book chapters. To provide further validity, this will be compared with selected primary and secondary literature from the wider body of ML literature.

Of the five distinct ***goals*** of integrative literature reviews identified by Toracco (2016, pp. 8–9), this study aims to "review, critique and synthesize the literature" (p.8) and "answer specific research questions about the topic" (p.8).

I will critically evaluate the literature, identifying trends, areas of consensus and areas of debate, and will attempt to resolve any logical conflicts. I aim to answer specific practice-based research questions, and I will synthesise the findings of the review by creating singing activities, to be applied within my own teaching practice, which aim to solve the practice-based problems at the heart of this study.

Whilst I aim to write the review from a neutral ***perspective*** on the topic, it could be argued that all literature reviews are, to some extent, influenced by the researcher's own perspective on the topic (Hart, 1998; Morgan, 2014). As a practitioner-researcher, this is especially important to

acknowledge, due to potential for blind spots (Herrmann, 1989, p. 9; Saidin and Yaacob, 2017, p. 850) and lack of objectivity (Unluer, 2012, p. 3).

To mitigate any such issues, I will engage in a continual cycle of self-reflection, using Dewey's (1910b/2008, cited in Morgan, 2014, p. 1047) step-by-step approach to inquiry as a guide. This will facilitate transparency of my decision-making and thought-processes. To maintain a balanced perspective, I will also draw on Brookfield's (2017) four 'reflective lenses'. I will document this reflective process in part three of this portfolio.

Due to the limited scope of such a small-scale project, the ***coverage*** of this review will focus on central or pivotal literature.

As the research problems clearly link to the concepts of practice structuring, motivation, instruction and feedback, a conceptual ***organisation*** will likely be the most effective approach for this review.

The intended ***audience*** will consist of specialised singing voice pedagogy scholars, as this review forms part of my Master's coursework. However, depending on their own unique specialisms, this audience may be unfamiliar with the field of motor learning; I will therefore explain any esoteric ML terminology or concepts.

Inclusion criteria

Torraco (2016, p. 15) emphasises that "the criteria used for retaining or discarding the literature yielded by the literature search should be stated".

As there are few existing primary studies on motor learning involving singers, it will be necessary to examine motor studies relating to other fields, such as sports. In consideration of relevance and scope of this study, non-music-specific ML literature will be considered on a case-by-case basis.

Summary:

- Singing-related primary and secondary ML literature (such as peer-reviewed journal articles, books and book chapters) will be prioritised
- Music-related (not specifically singing) ML literature will also be considered
- Non music-related ML literature will be included on a case-by-case basis, to establish further validity

- Literature relating to healthy adults will be included
- Literature specifically focusing on children will be excluded
- Recent literature will be prioritised

Methods

Phase one - singing-related ML literature

Initial database search

Whilst the body of ML literature is vast, the ML literature relating to singing is limited. To ensure relevance to practice, I aim to first identify and examine this literature, as a first step.

I will use keyword search terms relating to motor learning and singing, narrowing the search where necessary using the boolean operators. When searching a non-singing-specific academic database, the terms **AND singing** may be required, such as: ("motor learning" OR "motor skill" OR "skill learning" OR "skill acquisition") AND (singing OR singer OR singers OR sing).

The date range of the search will be limited to literature published within the past 25 years. Relevant literature will be downloaded where possible, and organised into a folder within Mendeley Desktop.

Literature evaluation

I will take a problem-centred approach, using Dewey's (1910b/2008, summarised in Morgan, 2014) systematic approach to inquiry to guide my decision-making. Once the recent literature has been examined, pivotal literature older than 25 years may be considered on a case-by-case basis.

Organising and coding literature

Subfolders will be created for each of the key concepts, for example: practice structuring, focus of attention, instruction, feedback, motivation, and a folder for literature reviews giving an overview of motor learning.

During the reading process, papers will be organised into one of these folders. Any remaining irrelevant literature will be put aside. Key passages will be highlighted within Mendeley using a colour coding system (e.g. purple for primary study results, green for application to singing) and notes will be taken.

Phase two - other ML literature

The literature from the initial search will be used as a springboard to identify pivotal non-singing-related ML studies and theoretical literature. This literature will be located by scanning reference lists, then attempting to source and examine relevant papers; this process will be repeated as often as necessary (Randolph, 2009, p. 7; Torraco, 2016, p. 13).

iii) Proposed project timeline

Task	March					April				May					June		
	1	8	15	22	29	5	12	19	26	3	10	17	24	31	7	14	21
Consider possible topics																	
Agree topic with tutor																	
Background reading on topic																	
Research literature review methodologies																	
Write introduction & rationale																	
Write aims & expected learning outcomes																	
Write methodology section																	
Conduct literature search																	
Read and organise relevant literature																	
Write first draft of assignment																	
Write critical reflection of learning process																	
Draft submission - 11th June 2021																	
Re-draft assignment																	
Final submission - 25th June 2021																	

Element Three: Critical Reflection

In order to reflect on the learning process, I engaged in the processes of *reflection-in-action* (during study) and *reflection-on-action* (after study) (Schön, 1984), documenting these reflections in a learning journal.

Whilst my decision-making was guided by a pragmatic, problem-centred focus, discerning the most salient information to include was often challenging. For example, the mirror neuron system is a fascinating area of research, with considerable implications for singing practice (Helding, 2010a, 2020b), however on reflection, I decided that this was a digression from the main subtopics and beyond the scope of this study. Dewey's (1910b/2008, cited in Morgan, 2014) systematic approach to inquiry helped me repeatedly steer my decision-making back towards the research problem.

Literature search

I began by searching for singing-related ML literature. I searched the archives of specific journals (Journal of Singing, Journal of Voice, Voice and Speech Review) and databases (the University library, Researchgate, Google Scholar, Science Direct). I also identified singing pedagogy books and book chapters relating to motor learning.

I found a number of ML literature reviews within the voice pedagogy literature (e.g. Crocco & Meyer, 2021; Helding, 2020b; LeBorgne & Rosenberg, 2021; Titze & Verdolini, 2012; Treinkman, 2021). Close examination of these gave me an invaluable overview of the topic, and insights into application. Key pedagogue authors (e.g. Lynn Helding, Lynn Maxfield, Katherine Verdolini) were identified, and further searches were conducted to find more of their work.

They also provided a wealth of references, which enabled me to identify and locate the most salient non-singing-specific literature. One such text was Schmidt and Lee's (2014) 'Motor Learning and Performance'. An important and frequently cited secondary source, the authors are highly respected within the field. Rich with primary source references, the book was an invaluable source of information; ordering it from the library was a decision I did not regret.

Delving deeper into primary studies was a fascinating process. The body of ML research is vast; I could have continued indefinitely, gaining ever deeper insights. However, the point came when I had already read far more than I could include within this small-scale study, and I had to stop reading and begin the writing process.

Considering different perspectives

I used Brookfield's (2017) 'reflective lenses' in order to maintain a balanced perspective during the writing process.

Colleagues' perceptions were considered through examination of singing pedagogy literature. Primary studies on singing teachers' typical approaches to lesson delivery also provided valuable insights into current practice.

Theory and research were considered both through the highly credible singing pedagogy literature I consulted and by delving deeper into non-singing-related ML research.

Students' perspectives were considered throughout the process, through a focus on the research problem, which aimed to help me better assist my students.

The learning process: my personal experience

Researching this topic has further convinced me of the value of sourcing and reading the primary studies, *even when the secondary source is a peer-reviewed journal article.* I almost dismissed apparent inconsistencies in journal articles, as I thought I must have been mistaken or not fully understood the issue. In future, I would feel more confident to listen to my own instincts when I encounter inconsistencies, even in peer-reviewed literature.

I noticed a gradual shift in my own perspective, as I explored the literature on *focus of attention.* My introduction to the topic was from Helding (2020b), who is rather sceptical about its universal application to singers.

Whilst further research with singers is required before solid conclusions can be drawn, I did find myself increasingly convinced by the overwhelming body of literature in support of the benefits of external focus of attention, especially after examining recent studies (e.g. Mornell & Wulf, 2019) which begin to address key criticisms.

Using an external focus within my teaching has been an overwhelmingly positive experience, allowing for exploration of some of the more expressive elements of singing, while still finding success with addressing technique.

In a process of reflection-in-action (Schon, 1984), I recognised that I was still finding it a challenge to find proximal external focus alternatives to some internal instructions. (e.g. 'open your mouth more').

In a process of reflection-on-action (Schon, 1984), I questioned whether the belief that external focus is not always effective with singers may suggest more about our own level of skill

with finding creative solutions; this is perhaps difficult to admit. Perhaps we just need to redefine what is possible.

Using “reflection-for-action” (Ghaye’s, 2010, p. 7) I planned to take positive steps for change by creating a ‘phrase list’ of internal instructions which I found difficult to express any other way.

I will follow this up with “reflection-with-action” (Ghaye’s, 2010, p. 7) , by taking active steps to find creative solutions to frame each instruction externally; I will apply this to my practice and continually refine the process.

Whilst there were still moments of self-doubt, during this project I found that I was more able to relax and enjoy the research process compared to my last project; researching the concept of desirable difficulties (Bjork & Bjork, 2020) helped me to recognise temporary confusion as a necessary part of the learning process.

My biggest personal aspiration for my final project is to enjoy the entire process, completing my Master’s degree with a sense of calm assurance and satisfaction.

Considering my own learning journey through the lens of *self-determination theory,* (Deci & Ryan, 1985, cited in Deci & Vansteenkiste, 2004), I have a high degree of *autonomy,* and my level of perceived *competence* has gradually increased with each successive project. However, I feel that accessing more *relatedness support* during my next project (by booking in for more regular tutorials) would provide reassurance, making the process more enjoyable.

I have met all of my intended learning objectives. I have improved my academic research and writing skills, and have developed an in-depth understanding of ML theory and its application to my teaching practice. I have successfully begun to apply this to my own practice, with promising results so far; I have also created teaching materials (see appendices 3-6) to assist this.

Finally, I have considered how to utilise my new specialism in order to benefit the wider pedagogy community. I plan to do this in three ways:

1. I will create a free pdf resource, designed to help singers to optimise their own personal singing practice using ML theory. I will make this available via my website *(to complete within six weeks);*
2. I will design and market an online teacher training workshop and/or an online video course, to allow me to share this research and help others to optimise their own teaching *(to complete within three months);*

3. ML theory will influence the design of a ‘belting’ training programme for CCM singers, which my next research project aims to create *(to complete by March 2022).*

Assessment Component Two: Written Assignment

Context

I am a freelance vocal coach / singing teacher, specialising in Contemporary Commercial Music (CCM) styles. I provide online one-to-one lessons for my clients, mostly adult singers, of varying levels of experience.

I have undertaken extensive training over the past decade, which has significantly elevated my understanding of voice science. Whilst this knowledge has been invaluable, it has not always facilitated optimal learning and performance. My experience echoes that of voice scientist and pedagogue Katherine Verdolini (2000): "...as my knowledge of voice physiology increased, my ability to "do it" and to "teach it" was not necessarily improved proportionately" (p.1).

This study aims to establish the most effective ways to optimise practice structure, use of motivational techniques, instruction and feedback. These approaches have the potential to transform my teaching, and thus the learning journey of my students.

Motor learning research and singing pedagogy

For five decades, laryngeal physiology and vocal tract acoustics have dominated science-informed singing pedagogy; more recently, cognitive science has emerged as a crucial element, providing insights into *how* we learn (Crocco & Meyer, 2021; Helding, 2020b).

The application of motor learning theory to singing has been increasingly discussed by voice pedagogues over the past few years (Manternach, 2021). The Journal of Singing's 'Mindful Voice' column (created by Lynn Helding in 2009) has been one prominent forum for this discussion, featuring articles authored by Christine Bergan, John Nix and Lynn Maxfield, in addition to more than 30 by Helding herself.

Whilst motor learning (ML) has been studied for more than a century (Titze & Verdolini, 2012 p.220), most of the existing primary studies on ML are not singing (or even music) specific. It is, therefore, reasonable to question to what extent these findings are generalisable to singing. However, highly-esteemed voice scientists Titze and Verdolini (2012) believe that "there is no compelling reason" (p.218) to think otherwise, considering that the existing ML studies on voice are generally consistent with other findings.

Motor learning theory

Highly-esteemed motor learning (ML) researchers Schmidt & Lee (2014) define motor learning as: “a set of ***processes*** associated with ***practice*** or experience leading to ***relatively permanent*** gains in the ***capability*** for skilled performance” (p.178).

Fundamentally differing from motor *performance*, motor learning is a dynamic *process* (not a fixed state). Whilst ML leads to a *long-term* improvement in *capability* of performance, this underlying level of skill may not be reflected in a given performance (Schmidt & Lee, 2014 p.178). For example, illness may cause a singer’s performance to fall short of their actual capability. Conversely, short-term gains in performance do not necessarily result in long-term skill retention. For example, a singer who experiences a vocal ‘breakthrough’ during a master class, might be unable to replicate this later, a phenomenon dubbed ‘master class syndrome’ by Lynn Helding (2010b, 2020b). It must therefore be recognised that in a singing lesson, when a student successfully demonstrates a new task, this may be a temporary performance shift; it does not necessarily mean that learning has taken place. *Desirable difficulties* (Bjork, 1994;1999, cited in Zepeda, Martin & Butler, 2020), ***(***such as *random practice*) create a short-term negative performance shift, but ultimately result in improved long-term retention and transfer.

Unlike performance, learning cannot be observed directly, so must be *inferred* (Helding, 2008; Schmidt & Lee, 2014 p.178; Titze & Verdolini, 2012). This is possible via use of *retention* or *transfer* tests, which allow true learning to be distinguished from temporary performance shifts (Schmidt & Lee, 2014 p.193).

ML is a type of *procedural* learning; it is implicit, and can happen without the learner’s conscious awareness. Voice scientist and ML expert Katherine Verdolini (2000) describes implicit memory as “involv[ing] learning without awareness, yet attention is required” (p. 4). By *attention*, she means ‘being in the moment’, receptive to sensory information; the absence of *awareness* means not consciously analysing. In other words: simply noticing, without judgment.

Stage models

Voice pedagogues emphasise the importance of identifying which phase of learning the singing student is currently at, to allow the teacher to adapt their approach accordingly (Crocco & Meyer, 2021; Helding, 2020b; LeBorgne & Rosenberg, 2021; Nix, 2017).

Of the various stage models of ML learning, variations of the ‘cognitive-associative-autonomous’ model (see figure 1) feature prominently in the literature.

These appear to be based on the Fitts model (1964; Fitts & Posner, 1967; both cited in Titze & Verdolini, 2012), which comprises three stages:

(i) *cognitive* - a verbal, conscious phase in which the student pinpoints *what* to do;

(ii) *associative* - focusing on *how* to execute the skill;

(iii) *autonomous* - automaticity is achieved, i.e. no (or very little) conscious effort is required;

This model places strong emphasis on *perceptual-motor* learning, viewing the process through the lens of cognitive processing. Schmidt & Lee (2014) believe that models such as Fitts' "retain considerable merit" (p.212), whilst acknowledging that the stages should be seen as broad descriptions of a snapshot in the learning process, and only *relatively* distinct (pp.211-212).

Stage of Learning	Mechanisms	Attention
Early Stage (Cognitive stage)	Information is initially stored in the immediate (ultra-short-term) memory and moves to the short-term memory due to repetitive practice (no anatomical change) (Squire & Kandell, 2009). Translating declarative knowledge into procedural knowledge.	Use of language and words to direct action. Attention is on how the movement is performed: exploring, analysing and directing the body's movements (Adams, 1971; Schmidt & Lee, 2005). Memory load is heavy (Hattie & Yates, 2014).
Middle Stage (Associative stage)	Information shifts from short-term to long-term memory, causing long-term changes in synaptic connectivity – an anatomical change (Squire & Kandell, 2009). Consolidation occurs due to the strengthening of synaptic patterns between sensory and motor neurons. Memory load is reduced. A bigger shift from declarative to procedural knowledge.	The performer's concentration is more on patterns of movement and refinement of the skill (Newell, 1985). Attention shifts from directing movements to checking if the result fits the desired outcome.
Later Stage (Autonomous stage)	Consolidation is complete. Actions are well organised, reliable and involve large-sized chunks. Memory load is low as recognition is being activated.	Movements are produced with little or no conscious attention. Attention is on strategy or movement form or style (Schmidt & Lee, 2005).

Figure 1: Stages of learning, mechanisms involved, and role of attention (Williams, 2019)

Practice

As Schmidt and Lee (2014 p.199) emphasise: “the most important variable for learning is practice itself”. However, rather than endless repetition of the *solution* to a motor problem, effective practice should engage the learner in the process of *solving* the problem in endlessly different ways, honing the technique with each successive repetition (Bernstein, 1967, cited in Schmidt & Lee, 2014).

For a singer, ‘practice itself’ means time spent *singing* (rather than simply discussing singing). Despite this, recent studies (Crocco, McCabe & Madill, 2020; Johnson, 2020) suggest that an astonishingly low percentage of lesson time is dedicated to singing (see figure 2).

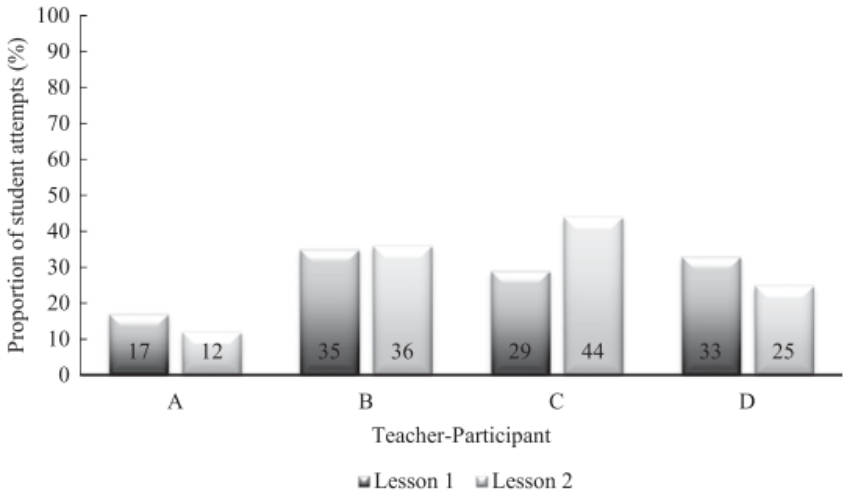


Figure 2 - Percentage of lesson time spent on student attempts per lesson
(Crocco, McCabe & Madill, 2020)

Encouraging transfer of learning

Schmidt and Lee (2014 p.217) suggest that when a student is attempting to acquire a new skill, the teacher could facilitate transfer from past learning by noting the new skill’s similarity to a previously learned skill; it may also be helpful to identify the differences. When teaching a CCM singer, this could involve an instruction to ‘hold heavy suitcases’, to engage the pectorals and latissimus dorsi in preparation for belting (York, 2021).

Transfer to future learning may be facilitated through approaches such as variable practice Schmidt & Lee (2014, p.217), as discussed below.

Structuring practice

Distributed versus massed practice

Extensive research shows that when structuring a single practice session of continuous tasks (such as singing), *distributed practice* (involving longer rest periods) is *more efficient* than *massed practice* (reduced rest), both on short-term performance and long term retention (Schmidt & Lee, 2014 p.238). For example, in Bourne & Archer's (1956, cited in Schmidt & Lee, 2014) separated 30 second trials of a pursuit motor task with rest periods of between 0-60 seconds; the longest rest period resulted in the most optimal performance and learning.

Applied to singing, this may also reduce the likelihood of voice injury (Helding, 2020b, p.109), as massed practice is more vocally fatiguing (Nix, 2017).

However, if long rest periods during sessions reduce the overall time spent engaging in actual practice, this may result in reduced effectiveness; using 'rest time' for activities such as mental practice, observation or reflection may increase the overall effectiveness of a distributed practice session (Schmidt & Lee, 2014, pp.239-240).

A singer could take a short break between each song or exercise, reflecting on what they have just sung. Alternatively, they could record themself, and pause to listen back to the recording.

Whilst Helding (2019) and Bergan (2010) recommend using a distributed weekly practice schedule, its effectiveness has been less extensively researched (Schmidt & Lee, 2014), and "the optimal dosage for voice...training is unknown" (Meerschman, 2018). However, as "musician guilt over lack of preparation may feed prerehearsal panic" (Helding, 2020b, p.109), distributing practice throughout the week may be advisable, in order to minimise anxiety levels and reduce the temptation to resort to intensive massed practice sessions.

Nevertheless, to help singers develop stamina for long performances, some use of massed practice appears essential (Nix, 2017).

Random versus blocked practice

Random (or *interleaved*) *practice,* whilst degrading short-term performance, results in *better long-term retention* than *blocked practice*; this counterintuitive principle was demonstrated by Shea & Morgan (1979, cited in Schmidt & Lee, 2014) in a highly influential, groundbreaking study, and has since been replicated by extensive research.

In random practice, the type of task practised keeps changing (e.g. frequently switching between songs and/or vocal exercises in a random order); this creates a high level of *contextual*

interference (Schmidt & Lee, 2014), which is a *desirable difficulty* (Hodges & Lohse, 2020) resulting in improved learning.

However, ML researchers and pedagogues are in agreement that for absolute beginners practising a difficult task, blocked practice is preferable at first (Bergan, 2010; Helding, 2020b; Nix, 2017; Schmidt & Lee, 2014). This avoids cognitive overload (Merbah & Meulemans, 2011).

Hodges & Lohse (2020) note that "errors in practice have both informational and motivational effects, which may conflict in value to overall learning" (p.456). The beneficial learning effects of random practice need to be balanced against the potential decrease in the learner's perception of competence.

A hybrid schedule involving moderate levels of random practice may provide the learner with a more accurate sense of progression (Schmidt & Lee, 2014, p.251). This may increase their perception of competence, which as Wulf & Lewthwaite (2016) emphasise, increases learner expectation of future performance success, leading to improved motor learning.

Variable versus constant practice

Variable practice benefits learning, as it enhances *generalisability* (Helding, 2020b; Schmidt & Lee, 2014). This allows application of the learned skills to "the performance of a novel task and...novel variations of the task...(e.g., private lesson performance versus live peer-reviewed per-formance in a concert hall)" (Bergan, 2010, p.461). In other words, variable practice facilitates more secure performance under varied conditions, even those which have never been encountered before.

For a singer, these varied conditions might include differing performance environments, voice qualities, keys, tempos, volumes, amplification, emotional expression or accompanying instruments. Incorporated into singing practice, this might involve activities such as: singing an /i/ vowel on a variety of scales/arpeggios, staccato/legato, volumes (Nix, 2017), or singing with and without a microphone.

Part versus whole practice

The merits of *part practice* depend on whether the parts being practised in isolation will be eventually performed consecutively or concurrently (Schmidt & Lee, 2014; Titze & Verdolini, 2012). Whilst used frequently in voice training, part practice "may have questionable value when a parallel task must later accompany the task" (Zavala *et al.,* 1965, cited in Titze & Verdolini, 2012 p.234); for singing, this may apply to interactive components as breathing, vocal fold coordination and vocal tract adjustments.

Evidence suggests that practice of consecutive elements is beneficial (e.g. Seymour, 1954, cited in Titze & Verdolini, 2012), e.g. individual phrases within a song. However, for concurrent elements (e.g. pitch, rhythm, lyrics), whole practice may be a better approach, allowing coordination between the interactive component parts (Maxfield, 2018, p.71; Titze & Verdolini, 2012).

Maxfield (2018) recommends slow practice, to facilitate “part practice of serial elements" (p.71); shorter phrases are preferable, so that additional breaths are not required at the slower tempo. After a few attempts, the tempo should also be gradually increased, in order to avoid the task becoming too easy (Maxfield, 2018).

Attentional focus of instruction

Focus of attention has been researched extensively over the past 20 years, chiefly within the athletics field. Until recently, no focus of attention studies had been conducted into music performance of any kind (Mornell & Wulf, 2019). However, this area of research appears to be growing, with a number of notable studies relating to attentional focus and music performance emerging over the past decade (Atkins, 2017; Duke, Cash, & Allen, 2011; Mornell & Wulf, 2019; Williams, 2019).

Distinguishing internal from external

An **internal** focus of attention means that, during learning or performance, the performer’s attention is directed towards their *own body movements*. Conversely an **external** focus directs attention towards the *effects* of the movement, with no direct reference to the body (Wulf & Lewthwaite, 2019).

This could mean the difference between an instruction to “raise the back of the tongue higher” (Treinkman, 2021 p.408), or “speak the word ‘key’ and then sing that same intensely true vowel when you sing it” (p.408) (see appendix 1 for further examples). If they do not reference the body, analogies and imagery are frequently classed as external focus (Guss-West & Wulf, 2016, cited in Treinkman, 2021), as well as emotional affect (Williams, 2019).

A subtle change in wording to remove direct reference to the body may create significant benefits (Wulf & Lewthwaite, 2016). For example, Wulf, Höß and Prinz (1998 p.169) asked two groups of participants using a balance platform to exert force either on their *feet*, or the platform’s *wheels*; although the wheels were “directly under the feet” (p.169), the difference in wording resulted in improved learning in the external focus group (p.174).

The *constrained action* hypothesis (Wulf, NcNevin & Shea, 2001), theorises that an internal focus results in attempts to consciously control movements that are already well-automated, thereby increasing demands on attention and diminishing performance outcomes, compared to an external focus.

Debate

Despite a large body of research which overwhelmingly supports the benefits of external focus (Treinkman, 2021; Wulf, 2013; Mornell & Wulf, 2019), its application to singers is still debated (Helding, 2020b;Treinkman, 2021).

Helding's (2020b) concerns include:

- A lack of studies on musicians, expert participants or complex motor skills;
- A lack of ecological validity of existing studies (i.e. a laboratory rather than performance environment) (Burgess *et al.,* 2006, cited in Helding, 2020b, p.145);
- Novices may be unable to acquire a skill without explicit reference to the body.

These issues have been addressed by recent studies (e.g. Mornell & Wulf, 2019; Williams, 2019).

An important study (Mornell & Wulf, 2019) involved expert musicians (instrumentalists and singers), examined complex motor skills (a complex 3-minute piece of music of choice) and adopted "a more ecologically valid approach" (Parsons & Simmons, 2021 p.154) such as attempts to mimic a pressured performance environment. An external focus (on the audience and the expressive sound) resulted in improved performance compared to the internal focus (on the precision of finger / lip movements), both in terms of musicality and technical precision (as evaluated by expert listeners).

This adds credibility to the idea that external focus is preferable for **expert singers/musicians.**

Another recent study (Williams, 2019) involved expert and novice musicians and "three increasingly complex field environments that also involved learning" (Williams, 2019, p.61), thereby achieving a degree of 'ecological validity'. External focus approaches resulted in improved intonation accuracy.

Supporting research from other fields (Wulf, 2013), the results suggest that an external focus is preferable for **both expert and novice musicians**, and for **both the early and**

advanced stages of the learning process (Williams, 2019 p111). This calls into question the claim, made by stage models of motor learning, that the 'cognitive' first phase requires an internal focus on *how* the task is executed.

More distal external foci appear to be more effective, particularly for ***experts***.

In a study of 20 trained singers (Atkins, 2017), external focus enhanced resonance/ring; this improvement was magnified for distal (e.g. back of the hall), rather than proximal (e.g. a nearby tripod) focus (Whilst 'fill the room with sound' was found to be the most effective instruction, most participants had previously used this within lessons, so familiarity may have contributed to its success).

This suggests that a **more distal external focus** would be preferable when teaching **advanced adult singers**.

However, Singh & Wulf (2020) suggest that in the ***early stages*** of learning a new technique, a ***more proximal (technique-directed)*** external focus may be more beneficial. Thus for novice singers, a proximal external focus instruction may assist initial skill acquisition.

In a study involving a complex balance task, (Wulf & McNevin, 2003) a group given external focus instructions (to focus on the tube they were holding) made fewer errors than a group who focused on their hands; this was the case through the initial practice phase, as well as in the retention and transfer tests. This suggests that external focus has a positive effect on ***both performance and learning.***

There is also evidence to suggest that training approaches which limit explicit awareness of body movements may result in "skills that are more robust under performance pressure", thereby guarding against 'choking' (Lee *et al.,* 2019, p. 279).

Overall, the body of evidence in favour of an external focus of attention is overwhelming. Williams (2019) believes that "there is as yet no robust empirical evidence to show that internal focus can be more beneficial than external focus for motor learning and performance" (p.45).

Whilst there clearly needs to be further research in order to replicate and build on these findings, the recent studies discussed above address some key criticisms, and suggest that the existing findings are applicable to musicians (and, more specifically, to singers).

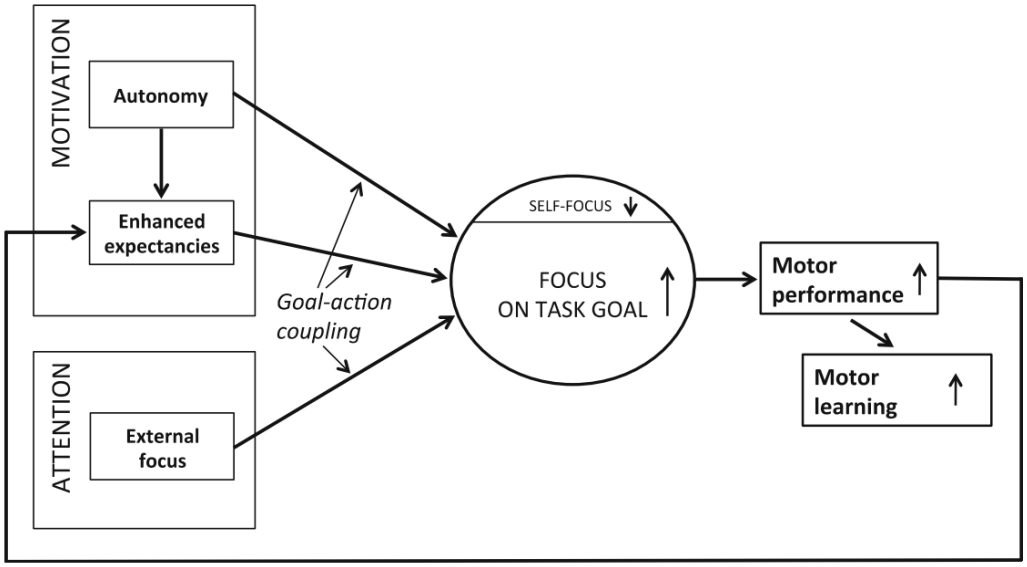
Treinkman (2021) suggests that singing teachers should use external focus instructions first, and only if this does not produce the desired effect, to consider an internal focus instruction.

However, this may prove unnecessary if teachers can find creative ways to reframe or rephrase any internal focus instructions they may typically use, thereby expanding their vocabulary of external focus phrases. Williams (2019 pp.115-116) suggests this may involve use of approaches such as imagery, metaphor, mood or emotion, emphasising that "external focus for musicians is music: focussing on expression and communicating through sound" (Williams, 2019 p.115).

Intrinsic motivation

The effect of motivational factors has been a growing area of ML research over the past two decades (Chiviacowsky, 2020; Wulf & Lewthwaite, 2016).

Wulf and Lewthwaite (2016) argue that motivation combines with attentional focus to impact ML and performance "by strengthening the coupling of goals to actions" (p.1382).



Schematic of the OPTIMAL theory

Figure 3: Schematic of the OPTIMAL theory (Wulf & Lewthwaite, 2016 p.1391)

According to the influential *self-determination theory* (Deci & Ryan, 1985, cited in Deci & Vansteenkiste, 2004) humans have three fundamental psychological requirements: *autonomy* (having choices), *competence* and *relatedness* (a sense of belonging and connection with others).

Wulf, Chivacowsky and Cardozo (2014) demonstrated that the already-established positive effects on ML of autonomy support (providing choices) and enhanced expectancies (enhancing sense of competence), have additive effects; i.e. to achieve the best result, these factors should be combined. Also, even seemingly inconsequential choices (which colour ball to use within a throwing task) resulted in significant improvements to both retention and transfer.

Until recently there has been a dearth of research into the impact of *relatedness* support. However, a recent study on 45 young adults learning to swim (Gonzales & Chiviacowsky, 2018) demonstrated that relatedness support (provided through instructions emphasising "acknowledgement, caring, and interest in the participants' experiences" p.439) did in fact enhance ML.

Wulf & Lewthwaite's OPTIMAL theory (2016) identifies two key motivational factors: *autonomy* and *enhanced expectancies*. The authors hypothesise that increased motivation triggers a dopaminergic response; this improves memory consolidation and creates a positive association with practice, resulting in a *virtuous cycle* of increasingly effective learning (see figure 5).

A recent study on the impact of motivation on ML and eye blink rate (considered to be associated with dopamine response) lends support to this hypothesis (Chiviacowsky *et al.*, 2019).

Approaches to enhance motivation

Motivational Interviewing (MI)

Voice pedagogues Meyer and Helding (2021) recommend motivational interviewing, to assist singing students in implementing changes in behaviour. Whilst rooted in the field of addiction recovery counselling (Bigby, Barnes & Girard, 1988), Meyer and Helding (2021) emphasise that many of its principles can be used ethically by voice teachers.

Applied to teaching, MI involves a democratic partnership between teacher and student, rather than an authoritative approach (Meyer and Helding, 2021).

MI assists the student in exploring and addressing their natural ***ambivalence*** (Bigby, Barnes & Girard, 1988, p.40). A singer may want to practice regularly but may also have conflicting feelings discouraging them from doing so, presenting as a lack of motivation. This approach is echoed by Zepeda, Martin and Butler (2020), who recommend 'finding value' and

'reducing cost' in order to engage students in desirable difficulties. Finding *value* may be achieved by reflecting on a task's *utility value* (usefulness/relevance to the individual's goals), *intrinsic value* (enjoyability), and *attainment value* (importance to self-worth or identity). To reduce *cost,* the learner could identify what sacrifices they may need to make to achieve their goals, and reframe these.

There are five key principles of MI (Bigby, Barnes & Girard, 1988; Meyer & Helding, 2021):

1) expressing empathy - via reflective listening and asking open ended questions

2) developing discrepancy - between the singer's goals / values and current behaviour.

This would perhaps be useful if a student is not adhering to their own practice goals.

3) avoiding argument

4) adjusting to client resistance

5) supporting self-efficacy - e.g. by encouraging the student to set achievable goals

This approach clearly addresses the psychological needs of autonomy and relatedness. It appears particularly applicable to the beginning of a lesson; when getting to know a new student, or when reviewing personal practice. It appears to be an ideal precursor to the goal-setting process.

Goal-setting

Whilst this is a vast area of research, a few relevant points will be discussed.

Goal-setting theorists Locke & Latham (2015 p.265) state that extensive research has shown that ***challenging, specific*** goals are more effective than "easy goals or vague, abstract…'do [your] best'" goals. They also identify "the key moderators of goal setting" (p.265) as:

- ***Task complexity*** (echoing the concept of desirable difficulties)
- ***Feedback*** (to review progress)
- ***Commitment***
- ***Situational constraints***

The last two appear to tessellate with the previously discussed ideas of 'value' and 'cost' (Zepeda, Martin and Butler, 2020) which conflict to create *ambivalence* (Bigby, Barnes & Girard, 1988, p.40).

Setting and reviewing goals provides autonomy-support and builds the student's sense of competence (or *enhanced expectancies*), as the goals are achieved and progress is made;

therefore, goals must be an *achievable* challenge. Additionally, if the teacher's approach incorporates relatedness-support via "acknowledgement, caring, and interest in the participants' experiences" (Gonzales & Chiviacowsky, 2018 p.439), then all three basic psychological needs are being met (Deci & Vansteenkiste, 2004).

Williams (2019) recommends setting:

- Long-term goals (idealised scenario)
- Medium-term goals (e.g. 6-12 months)
- Short-term goals (to achieve by next lesson)

She also suggests tailoring practice to meet short and medium-term goals (Williams, 2019).

Motivational feedback

Choices over feedback

Providing learners with choices over feedback has been consistently shown to enhance ML (e.g. Janelle *et al.,* 1997). Providing feedback only upon a singer's request *(self-controlled feedback)* would therefore encourage autonomy and improve learning.

However, in the early stages of learning, singers may prefer the reassurance of more frequent feedback, in order to increase their perception of competence. In a study involving eight college voice students, Maxfield (2011) found that whilst a **lower** *relative feedback frequency* (frequency of feedback in relation to number of trials) led to better retention in the more experienced singers, a **higher** relative feedback frequency was more optimal for the more novice singers (p.2).

A ***faded feedback*** approach, in which more frequent feedback is given at first and then gradually reduced, would increasingly facilitate autonomy (Helding, 2020b p.134).

Positive comparative feedback

Whilst both positive social-comparative feedback (comparing against others) and temporal-comparative feedback (highlighting to a learner that their performance over time is improving) have both been demonstrated to improve ML (Chiviacowsky, 2020), the latter is likely more relevant in the context of one-to-one singing tuition.

Positive temporal-comparative feedback (i.e. highlighting to a learner that their performance over time is improving) has been shown to improve ML in comparison to a control group (e.g. Chiviacowsky, Harter, Gonçalves, & Cardozo, 2019, cited in Chiviacowsky, 2020). This is easily applied within the context of a singing lesson, by highlighting specific examples

which demonstrate improvement since the singer first attempted the exercise or song, thereby enhancing perception of competence.

Feedback after successful trials

In a very recent journal article on ML and singing pedagogy, Crocco and Meyer (2021) recommend several times that feedback should be given on larger rather than smaller errors; they claim that this enhances student motivation, citing Chiviacowsky & Wulf (2007).

However, examination of the original study reveals that its findings appear to contradict this statement. It asserts that, although the guidance hypothesis (e.g. Salmoni et al 1984; Schmidt et al 1991, cited in Chiviacowsky & Wulf, 2007) appears to *suggest* that "feedback should be more beneficial if presented after larger rather than smaller errors" (Chiviacowsky & Wulf, 2007 p.44), the esteemed researchers' findings in fact demonstrate that "learning is facilitated if feedback is provided after good rather than poor trials" (Chiviacowsky & Wulf, 2007, p.40). This is a well-established principle (e.g. Badami *et al.,* 2012; Chiviacowsky *et al.,* 2009; Saemi *et al.,* 2012). Further, motivation and ML research expert Chiviacowsky (2020) emphasises that if learners are usually able to tell the difference between a 'good' or 'poor' performance, feedback on "larger errors would be redundant and probably frustrating, and would potentially decrease motivation and learning" (p.3).

Therefore, Crocco and Meyer's (2021) recommendation appears to be inaccurate, and will be disregarded. Instead, feedback will be given on more successful attempts of a song or scale, with the less successful attempts mostly disregarded.

Feedback - other considerations

A variety of information is received by the learner during a singing lesson (see figure 4).

Inherent feedback is received during singing, comprising *proprioceptive feedback* (from sensory receptors such as *pacinian corpuscles* (Sundberg, 1979 p.59)) and *exteroceptive feedback* (e.g. hearing, vision). There may also be task-unrelated feedback (distractions).

As cognitive resources are limited, providing too much *augmented feedback* (extrinsic feedback such as verbal feedback provided by the teacher, or visual feedback using acoustic analysis software) may result in cognitive overload (Helding, 2020b, p.137).

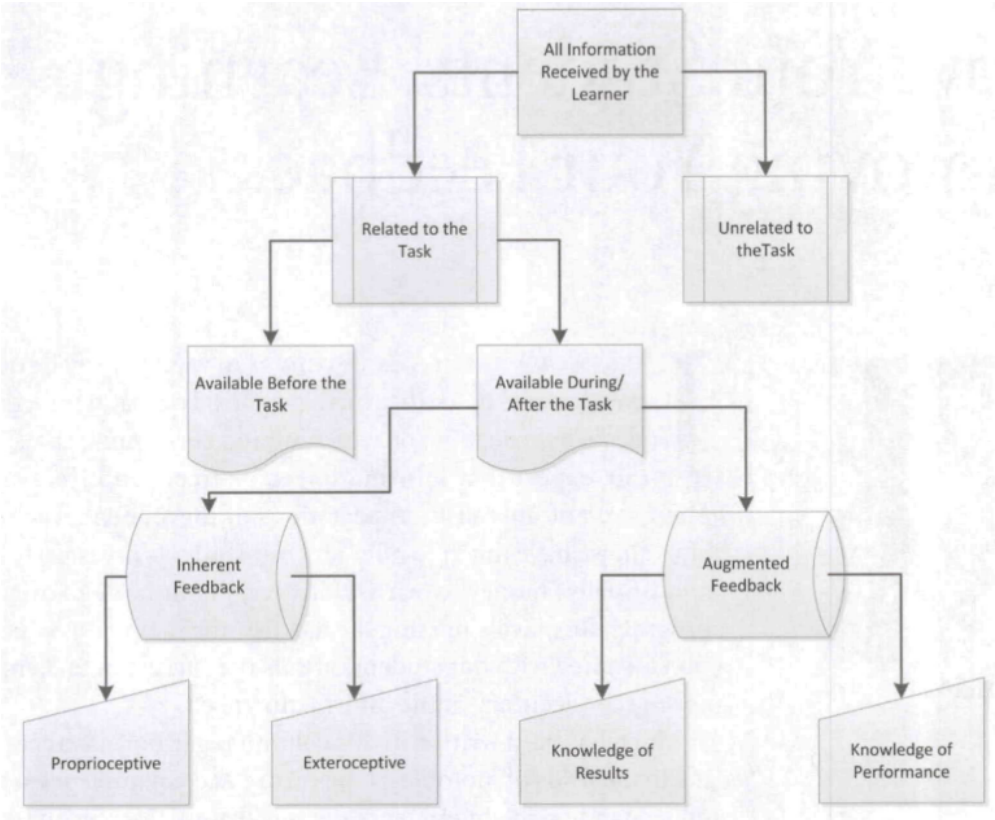


Figure 4: Divisions of feedback (Maxfield, 2013, p.472)

Timing of feedback

Leading voice pedagogues recommend the use of ***terminal feedback*** (given after completion of a task) rather than *concurrent* feedback (given while the student is performing the task) (Helding, 2020b; Maxfield, 2020). Consistent with the *guidance hypothesis (*Salmoni, Schmidt & Walter, 1984, cited in Schmidt & Lee, 2014), concurrent feedback has been shown to inhibit long-term learning, despite improving short-term performance (Park, Shea & Wright, 2000; Sigrist *et al*., 2013).

Delaying feedback

Voice pedagogues recommend delaying feedback by several seconds, in order to optimise long-term retention (Helding, 2020b; Maxfield, 2020). Whilst feedback delivered instantaneously after the student has completed a trial may be preferable to concurrent feedback (Maxfield, 2020), it still reduces autonomy, by inhibiting the student from actively processing what they have just done (Helding, 2020b). Conversely, leaving a delay creates a desirable difficulty (Helding, 2020b; LeBorgne & Rosenberg, 2021), and encourages the student to develop their

own reference-of-correctness (independent error-perception ability). This is supported by research conducted by Swinnen *et al.* (1990) which demonstrated that in comparison to KR feedback given after a 3.2 s. delay, instantaneous KR degraded retention. Leaving a pause of 5 seconds is beneficial, however longer delays do not reap any additional benefits (Weinberg, Guy & Tupper, 1964, cited in Schmidt & Lee, 2014).

Maxfield (2020) notes that although leaving a pause before giving feedback may feel awkward, the removed nature of online teaching "makes the silence less uncomfortable" (p.93).

To avoid confusion, it is arguably worth explaining in advance that this pause is intentional, and inviting them to use this time to reflect.

Student self-evaluation

Inviting the learner to self-evaluate (before offering augmented feedback) is another way of encouraging active perceptual training (Schmidt & Lee, 2010, cited in Titze & Verdolini, 2012), allowing them to further develop their internal reference-of-correctness (which is, of course essential for their own personal practice). This could simply involve asking a singer "what did you see/feel/hear/notice about what you just did?" (Crocco & Meyer, 2021 p.695).

Knowledge of Results *(KR)*, an important type of augmented feedback, provides "information about the success of an action with respect to the environmental goal" (Schmidt & Lee, 2014 p.258); conversely, ***Knowledge of Performance*** *(KP)* provides technique-based information about the movement itself. Clearly, KR has an external focus, whereas KP elicits an internal focus.

Crocco and Meyer (2021) suggests that ***prescriptive*** KP (i.e. instructing how to 'fix the movement error) may be useful in the early stage of learning, whereas an intermediate student may also respond well to ***descriptive*** KP (what they did). Arguably, this gives the learner more autonomy. The authors also suggest that the simplicity of KR may be more applicable to an advanced student, who has a more developed reference-of-correctness.

As external focus has consistently been shown to be beneficial, even for novices, subtly reframing prescriptive or descriptive KP to elicit an external focus may be of benefit. A proximal (i.e. technique-based) external focus, which appears to be effective for novices (Singh & Wulf, 2020), could be elicited by using a subtle change in wording to avoid direct reference to the body.

The ***precision*** of feedback is another consideration. Expressing the direction of error (e.g. whether the pitch was sharp or flat) is critical, in order to allow coordination to be realigned more successfully; however, expressing the magnitude of error (e.g. a semitone flat), is more applicable to more advanced singers, as beginners have not yet developed the precise motor control to implement this feedback (Schmidt & Lee, 2014 pp.267-268).

Less talk, more singing

Recent research suggests that singing teachers spend a larger proportion of lesson time talking than the student spends singing (Crocco *et al.,* 2020; Nisbet, 2003), despite singing practice being "the most important variable for learning" (Schmidt and Lee (2014 p.199). In addition to the areas discussed already, teachers can redress this balance by simply talking less; clear and concise communication (whether instructions, feedback, or otherwise) would allow more time for singing.

Conclusions

Whilst voice pedagogues and teachers have been influenced by physiology and acoustics for many decades, cognitive science is now gaining increasing recognition as a crucial facet of science-informed singing pedagogy, informing us how to optimise learning and performance.

Recent studies on how lessons are taught suggest that singing teachers would benefit from training in the principles of ML. Key findings on the topics of practice structuring, focus of attention, motivation and augmented feedback have the potential to transform how teachers facilitate learning, to more skilfully assist singers to identify and achieve their own (specific and challenging) singing goals.

A recent trend has been the importance of **motivation** on ML, which has been gaining increasing attention over the past two decades. Increasing learners' sense of autonomy, competence and relatedness have all been shown to optimise ML. However, the effects of relatedness have only recently been examined, so further research in this area would be of benefit. Wulf and Lewthwaite's (2016) OPTIMAL theory synthesises recent findings on motivation into a theoretical framework, and makes hypotheses, to be investigated further.

Despite a vast and robust body of research supporting the benefits of **external focus of attention** on motor learning and performance, its application to singers is still debated. The last decade has seen an increasing number of recent studies on musicians / singers which address key methodological criticisms, and results appear consistent with the existing findings.

Nevertheless, further research clearly needs to be conducted with singers, in order to replicate and expand on these findings.

Whilst motor learning has been studied for more than a century, there are still very few studies on musicians; fewer still are specific to singing. Although this type of research has been gradually increasing over the past decade, further ML research involving singers is required, in order to more firmly establish whether existing ML findings are generalisable to singing.

Ideas for future research

Additional research on the impact and application of attentional focus in singing training and performance would be particularly useful. Whilst there is a pervasive belief among some pedagogues that training novice singers is not possible without at least some use of internal focus instruction, reframing an internal focus instruction as an external one may be as subtle as changing a word or two, to remove direct reference to the body.

A phrasebook of 'translated' instructional phrases could be developed, each designed to elicit a particular singing technique coordination, whilst maintaining an external focus. These could be trialled, and compared with a second group receiving internal instruction, with retention and transfer tests conducted to infer learning.

Impact on teaching practice

(For a full summary of findings that have shaped my practice, see appendix 2)

The findings of this research are already beginning to have a positive impact on my practice.

To help motivate singers to maintain a regular practice schedule, I have created a series of open-ended personal practice and goal review questions (see appendix 3), influenced by motivational interviewing. These are helping me to steer discussion at the beginning of each session (towards 'finding value' and 'reducing cost'), provide *relatedness support* through reflective listening (to ensure the singer feels heard) and encourage self-reflection (to foster *autonomy*).

I have also created and shared a goal-setting template, with sections for long/medium/short term (weekly) goals, with each student; I have assisted them in identifying their own specific, challenging and achievable goals, based on their singing aspirations. During sessions, I make sure that I highlight examples which show that the singer is making continued progress over time; this helps to foster their sense of *competence.*

To optimise my delivery of instruction, I have used an external focus instruction wherever possible. When I occasionally cannot think of one, I make a note of the internal focus directive; I aim to create a 'translation' for each of these phrases, to use in future. Using distal external focus more has placed much greater emphasis on more expressive aspects of singing, successfully facilitating technique in a more intuitive and artistic way. Communication of narrative informs emotional intent, which may intuitively inform technical aspects such as tone or dynamics.

I have also made changes to the way I deliver feedback; in conjunction with the distributed practice approach, this is allowing my students more space to process sensory information and self-reflect. Leaving a five second pause before giving feedback felt like a long time at first, but is becoming more comfortable; I ensure that I smile when they finish singing, to help them feel acknowledged and supported whilst they reflect.

I have also used whole-practice of concurrent elements, at a slow tempo, to work on challenging elements such as riffing (melisma) or fast-paced lyrics.

To incorporate random practice structuring (to enhance long-term retention of a new skill), and variable practice structuring (to enhance generalisability of a skill thereby improving reliability in performance), I have designed two singing activities (see appendices 5 & 6), designed for CCM singers. I plan to build on these, adding further options.

I believe that fully integrating these approaches will transform my teaching practice.

Wider impact

- These findings will influence the design of a 'belting' training programme for CCM singers, which I will create as part of my next research project.
- Within the next six weeks, I plan to create a free pdf resource, available to download from my website, designed to help singers to optimise their own personal singing practice.
- Finally, within the next three months, I will design and market an online teacher training workshop and/or an online video course, to allow me to share this research and help others to optimise their own teaching.

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Appendices

Appendix 1 - Instructions given to singers in voice lessons, based on a survey of 278 singers (Treinkman, 2020 p.4)

Representative Responses in Each Category—Internal Focus, Combination, and External Focus.

	Internal Focus	Combination	External Focus
Posture	• Sternum high • Shoulders back • Tuck hips • Ribs out • Knees not locked • Elongate the spine • Don't drop the chest • Pecs up	• Imagine having a string at the crown of the head pulling you up • Chest should be open and expanded—think Wonderbra • Plant your feet like the roots of a tree	• Noble posture • Tall and vertical • Feel buoyant like you could move at any moment • You are a tree. Grounded, tall, and poised • Root into the ground • You're a marionette
Breath/Support	• Breathe from your diaphragm • Breathe from the bottom of your lungs • Keep your belly out (but don't push) as you exhale • Breathe into your back • Epigastrium!! • Push the ribs out for support • Don't raise your shoulders • Free the ribs • Engage the lower abs	• Breathe low, fill the bottom of lungs first • Expand your ribs/abdomen/back in all directions, as if to fill a barrel • Expand your lungs like two balloons • Open throat/silent breath • Breath fills all the way around the stomach and waist like an innertube of air • Breathe low, relax the belly and air will flow in	• Fill the pitcher • Sip air, don't gulp • Innertube expansion • Float on the breath • Take the "smell the flower breath" • Sob/primal noises for connection/support • Inhale in the shape of the vowel • Feeling of fogging a mirror • She will have me sit on the edge of a chair and sing through the chair • Appoggio
Tone clarity/Onset	Keep the pharyngeal space the same from the initial onset of tone to the end of the phrase, coordinating the onset and release with abdominal muscles • Keep zygomatic muscles activated • Keep it on the hard palate • Open aperture in the throat • Let's make sure your cords are achieving full closure • Bring it all up into your nose • Keep the tongue forward • Place it forward in the mask • Open mouth more • Loose jaw • Low voice box	• Onset requires open throat—imagine that your starting a phrase with an H in front of it • Feeling wideness in the neck upon inhalation and acting as if I were going to fog up a mirror improves onset • Use fast air and clean cords • We sing lines not notes, don't move pitch with your tongue! • Practice gentle staccato onsets to reinforce singing on "thin edges" of cords • Funnel with small end at nose • Trumpet lips • Start with a few gentle glottals to feel cord closure	• Grow high notes from the "kernel" of the tone • Sigh into it • Drink in the tone/sound/breath • Bell-like • Singing is like a light switch, 100% on at the beginning of the note not a dimmer switch • Vibrato everywhere • Think of a whine, or the most piercing part of the sound • Chiaroscuro • Repeat the vowel (subdivide, don't hold) • Hear the sound before inhalation, shape the vowel then simply add the breath • "Thread the needle" in middle voice • Ghosty wiggle
Space/Resonance	• Space in throat • Lift the soft palate • Low laryngeal position/laryngeal tilt • Feel lift in cheekbones and nostrils • Get the tongue up, and narrowed at the sides to allow more pharyngeal space	• Drop your jaw, and think of a yawning sound • Imagine a balloon in your mouth and throat • Tall narrow vowels with low released larynx • Try to make the ugliest, brightest sound you can, up and back on top of your soft palate	• The whole room is yours—fill it up with warmth • Bite the apple • More sneeze up top • Ich-laut feeling • Sing through a yawn-like space/snorish space • Preacher man! • Breathe in surprised breath • Look of dumb

(*Continued*)

	• Jaw releases down and back • Lift upper back molars • Make sure you have a mouth full of tongue, not a throat full of tongue • Vertical mouth	• Think of a reverse ice cream cone so that your space at the front is focused and gets bigger as you go back into the lofted palate space • Egg in back of the throat	• Pear-shaped tone • Find the dome • Remember the emotion of the song. Does your tone match the emotion? • Smell the roses
Articulation	• Use lips and tongue, not jaw to articulate • Feel the mid-back of the tongue make contact with the back molars for the closed vowels such as [i], [e] • Maintain stable pharyngeal stretch behind articulation • Slightly show front teeth • Open your mouth more • Round the corners of your mouth as you move past passaggio • Don't move your jaw for different vowels • Release tongue from the root • Front of tongue articulates	• My best vowel is [i]. We aim to have other vowels placed in the same resonance/tongue position as my [i] • Use rounder lips between B4-E5. Above that gets sneezy • Consonants are tiny, creaky, and done with small articulations of the to- of the tongue against lips and teeth • Don't chew your words... less jaw more lips • Relaxed tongue - imagine the bottom of your tongue is covered in purple paint - let it paint the entire lower inside of mouth	• Sing as if the vowels are your clothes line and the consonants are clothes pins • Picture consonants as pearls on the string of the voice, rather than separate entities • It feels like a tap dance, no pressing the point of articulation • Use consonants to propel the sound forward • Sing like you are projecting to the back of the room • Sing vowel to vowel with quick consonants (imagine a wave form - the peak is the consonant, valley is the vowel)
Reducing tension	• Relax neck • Relax jaw • Don't open mouth so much • Loosen up your shoulders • Use more of the pelvic floor to support • Support in abs instead of throat • Don't "help" with the muscles of the back of the tongue • I need you to support with ribs, not shoulder • Forehead relaxed	• Feel grounded, think about your back muscles • Sing it to "Blah blah blah" with a slack jaw • The jaw should be "novocaine jaw"- completely relaxed and slightly back in its neutral position. • Finding a lower position of the larynx, release of the jaw with an expression guttural like "huh" or "duh" • Dead face	• Let yourself feel like jello • Always be able/ready to take a step forward • Practice in cat position • Catch! (As they throw a ball a me while singing) • Pant like a doggy • Two martini tone • Feel like you are laughing or sobbing as you ascend • go "ba ba ba" while sort of bouncing and squatting at the same time • Relax • Focus on the character • Walk around while singing

<u>Appendix 2</u> - Summary of how these findings will shape my teaching practice:

<u>Stage of learning</u>

- Identify which stage of motor learning the student is likely in, for the specific skill being developed

<u>Structuring practice</u>

- Distributed practice
    - Allow a short break between each 'attempt' - student to self-reflect
    - Could also use the time for mental practice, observation, listening back to a recording
- Random/blocked practice
    - Advanced - rotate different types of task (exercise or song), in a random order
    - Beginners - blocked practice at first (repetition of the same task)
    - Consider using a hybrid of of these
- Variable practice
    - Vary elements such as key, tempo, volume, emotional expression, amplification
- Part practice of song sections or phrases
- Slow tempo whole practice for challenging phrases (e.g. melisma or fast-paced lyrics)

<u>External focus of attention</u>

- Minimise discussion of the body processes involved in movement
- Use external focus of attention instructions wherever possible during practice
    - Advanced - use a distal (far away from body) external focus, such as expression, communication, meaning of the song, 'singing to the gallery'
    - Beginners - use distal focus instructions (e.g. emotional affect). If unsuccessful, try a more proximal focus (e.g. gesturing, or imagery such as 'hold heavy suitcases' (York, 2021)).
- Encourage use of external focus during performance

<u>Motivation</u>

- Provide choices, even seemingly inconsequential ones, to support autonomy
- Encourage a sense of competence, enhancing expectancies of future performance
- Demonstrate a sincere "acknowledgement, caring, and interest in the participants' experiences", providing relatedness support (Gonzales & Chiviacowsky, 2018, p.439)
- Use 'Motivational Interviewing' approaches (e.g. exploring ambivalence by finding value and reducing cost) as a precursor to goal-setting

- Goal-setting - set long term, medium term and short term goals, which are challenging (yet achievable). Ensure goals are specific; avoid ‘do your best’ goals. Review goals to track progress.

Motivational feedback

- Faded feedback
    - More frequent feedback to reassure novices
    - Gradually reduce frequency of feedback
    - Self-controlled feedback for advanced singers
- Highlight that the singer’s performance over time is improving
- Give feedback on more successful attempts, mostly ignoring less successful ones

Feedback - other considerations

- Avoid giving feedback during, or immediately after, the student’s attempt at a task
- Leave a pause of 5 secs after the student has finished before speaking, to allow them to process intrinsic feedback.
- Ask “what did you see/feel/hear/notice about what you just did?” (Crocco & Meyer, 2021 p.695) - this is important in order to help a student to establish their own reference-of-correctness
- KR for advanced students
- Consider using prescriptive KP for novices and descriptive KP for intermediate students - however, using external focus where possible is likely to be helpful
- Precision - express direction of an error, but only express magnitude to more advanced singers
- Talk less - clear, concise communication

Appendix 3 - Weekly personal practice review / goal review questions

EMILY JACKSON VOCAL COACH

Weekly personal practice review / goal review questions

(To discuss at the beginning of each lesson)

Tell me about your singing practice this past week.

What did you find **most useful?**

What did you find **most enjoyable?**

What did you find **most challenging?**

- During practice itself?
- Before practice? (e.g. motivating yourself to begin your practice session, finding a room to practice in, finding a convenient time to practice, juggling other commitments such as child care to allow you to practice

What are you **most proud** of this week?
(can be as simple as: “I practised every day and achieved all my goals”)

What progress have you made towards your **goals** this week?

- Did you meet your short term goals?
- Are you on track to meet your medium-term goals?
- Do you need to review any of your goals (e.g. make more challenging or more achievable)

What are your goals for today’s session?

Appendix 4 - Singing goals template (shared with student)

Name:			
EMILY JACKSON VOCAL COACH	My Singing Goals		
Long-term (Aspirational)			
Medium -term (6-12 months)	1.	2.	3.
Short-term (weekly)	• • •		

Appendix 5 - Random practice activity

EMILY JACKSON
VOCAL COACH

RANDOM PRACTICE ACTIVITY

Aim:
To enhance long-term retention of singing skills.

Intro

- Studies show that a ***random practice*** structure improves long-term retention of a skill.
- It is designed to feel challenging - this is a ***desirable difficulty,*** and it enhances long-term learning!
- Pausing to reflect after singing also enhances learning.

Activity

1. Choose your level of challenge.
    - Intermediate - sing each element **twice** before moving on
    - Advanced - sing each element only **once** before moving on

2. Choose three elements to practice.
   E.g.:
    - 3 contrasting song excerpts or full songs
    - 3 contrasting exercises from the options below (feel free to add your own)
    - A combination of the above

3. Set a timer (e.g. for 15 mins)

4. Choose one of these elements at random, e.g. by rolling a die (web-based or real)

5. Sing the exercise / song

6. Pause for a few moments, and reflect - what did you notice / feel / hear about what you just did?

7. Repeat (roll the die, sing the exercise/ song, pause and reflect) until the timer goes off.

Exercise choices

- Choose a scale pattern and sound for each exercise.
- Sing each exercise throughout your range.
- Feel free to add your own.

Scale patterns:

- ☐ 5-note major scale
- ☐ Major triad arpeggio
- ☐ Minor triad arpeggio
- ☐ Octave arpeggio
- ☐ Octave arpeggio with repeat of top note
- ☐ Octave arpeggio with sustain
- ☐ 1.5 octave arpeggio
- ☐ Minor pentatonic scale
- ☐ Blues scale

Sounds

- ☐ SOVT (e.g. straw phonation, lip trill, zzz, vvv)
- ☐ Na na na
- ☐ Mum mum mum
- ☐ Bo bo bo
- ☐ Twangy “nya nya nya”
- ☐ Goo goo goo
- ☐ Foo foo foo
- ☐ Nay nay nay
- ☐ Quaw quaw quaw
- ☐ Yeah_____
- ☐ Eee_____

Appendix 6 - Variable practice activity

EMILY JACKSON
VOCAL COACH

VARIABLE PRACTICE ACTIVITY

Aim:
To enhance the stability of a familiar song / singing skill, when performing under different circumstances.

Intro

- Studies show that a ***variable practice*** structure improves generalisability of a skill. This means that it can be performed more reliably under different circumstances.
- For example, you may perform in different venues, at volumes, with different instrumental accompaniment.
- The more ways you can vary your practice, the more stable your song performance will be!
- Pausing to reflect after singing also enhances learning.

Activity:

1. Select a song excerpt

2. Choose a parameter to vary (see below for ideas)

3. Sing the song as you usually would

4. Pause for a few moments, and reflect - what did you notice / feel / hear about what you just did?

5. Choose one parameter variation, and sing the song again

6. Pause and reflect

7. Choose a different parameter variation, and sing the song again

8. Pause and reflect

9. Keep exploring different ways to vary the way your performance.

Parameter	**Variations**
Emotion	Surprised, giggly, annoyed, vengeful, worried, joyous...
Tempo	Slightly faster or slower than usual / very slow / as fast as possible
Note articulation	Staccato / legato / alternate between lines
Volume	mf / mp / ff / ppp / vary between lines / use cresc. or dim. For each line
Key	Transpose to a variety of different keys, e.g. moving through the circle of fifths, or ascending a semitone at a time
Movement	Standing tall / step & click fingers / reach high then low / clap on the 2 & 4 / dance like an embarrassing relative at a wedding

N.B. Feel free to add your own.