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Module 4

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### 1. Title:

Defining and examining the implications of external locus of attention for singers: A rapid review

### 2. Rationale:

Most voice teachers aspire to make as efficient use of their student's lesson time as possible, and to teach in a way that helps the person in front of them understand and learn methodically. Of the many educational tools and frameworks that have arisen in the past few decades, contemporary research suggests that attentional locus, specifically adopting an external attentional locus, is among the most useful to singers (Treinkman, 2022). In the general motor learning research, external attentional locus is defined as a focus on the goal of the action instead the muscles used to achieve it, known as an internal locus (Wulf et al., 1998; Wulf & Lewthwaite, 2016; Wulf et al., 2015). This 'goal action coupling,' has been shown to trigger muscle systems (Wulf et al., 2001), thereby significantly reducing the cognitive load when compared to the internal locus, and the cognitive load reduction has been shown to result in deeper learning and increased confidence and self-efficacy (Wulf & Lewthwaite, 2016). For singers, who are physically unable to directly control many of the muscles used (Prescott & Liberles, 2022; Tracicaru et al. 2024) and who further can be easily overwhelmed (Helding, 2015) a goal-oriented attention may be an evolutionary requirement (Maas et. al., 2008), and the framework set up by this style of thinking therefore very attractive. However, a close look at the literature, in both studies and reviews, shows significant inconsistencies in the definition of external attentional locus for singers. Further, implications for resulting learning mechanisms follow confusion in

the cognitive psychology and neurology arenas and are even more inconsistent. Research based on conflicting definitions cannot draw consistent conclusions (Curry, 2022), and leaves voice teachers, researchers, and most importantly, voice students, without a clear sense of either how to structure their thinking, or of the learning implications of the thinking that comes most naturally to them. The below review was therefore undertaken to mine existing research for clear definitions of both external locus of attention for singers, and for resulting definitions of explicit and implicit learning in the hopes that future research on the subject will be easier to generalize.

### **3. Positionality and Insider Research**

“The term positionality,” according to Holmes (2020, p. 1) “both describes and individual’s world view and the position they adopt about a research task...” Holmes further states that a world view “concerns ontological assumptions, epistemological assumptions, and assumptions about human nature and agency.” A constructivist epistemology was assumed for this work: there is an external world that exists regardless of the extent to which it has been discovered. In the below research, the mechanics of the human body, including the brain and nervous system (Dew & Cabeza, 2011; Moss Erickson, 2022, 2023; Petersen & Posner, 2012) are referred to. However, the same mechanics that exist independently of human comprehension create unique understandings and learning preferences (Dew & Cabeza, 2011; Wulf & Lewthwaite, 2016). Because of this, it is crucial that the student be required to participate actively in their own learning (Holmes, 2019), and crucial further that the researcher be open to understanding the students’ and other researchers’ perspectives, introducing elements of phenomenology: research cannot study the learning implications of student perspectives without first learning what those perspectives are (Dewey et al., 2010). The implications of this are central to the very topic of this paper, which seeks definitional clarity to better understand learning mechanisms. The implications of this are further crucial to any educator or system more concerned with the amount students learn than with the information transmitted. This further necessitates that the researcher ‘identifies and acknowledges potential conflicts of interest’ (Goundar, 2025) from their

own perspective to be fully open both to the research and to the perspectives of students and study participants, and is reflective of Holmes' human nature and agency: bringing awareness to the researcher's perspective and potential bias increases choice in whether to include those in the work.

The topic of what to focus on when singing is very personal, which likely raises the potential for bias. This is not necessarily negative: Poirier et. al (2023) make a compelling argument for acknowledging positionality and bias as a positive source of inquiry. Being a singer is a major source of the researcher's professional identity, as is being a teacher. While not necessarily aspects that are culturally fixed (Holmes, 2019), experiences from these identities have clearly shaped the choice of topic. One of the researcher's major teachers, for example, exclusively taught with acoustic targets, which is an example of external locus of attention. He directed students' thoughts away from any physical feelings or feedback and only discussed registration and quality. As predicted by the literature, this transformed his students' singing very positively very quickly. However, when he stopped teaching, the researcher did not have enough independent understanding of her own physical sensations or feedback to maintain a high level of singing. She went to the other extreme with the following teacher and learned how to independently lower the larynx and front the tongue- both internal loci of attention. Also, as predicted by the literature, this was frustrating and difficult, but helpful in developing clear physical parameters for singing that will hopefully prove durable over time. All of this affects positionality as an insider researcher: finding ways of reducing student frustration and being empathetic to frustrations they do experience are powerful sources of motivation for teacher improvement; however, it will likely be necessary to remain vigilant about any tendency to project past experiences and feelings on to students. By remaining open to learning about students' unique experiences and perspectives, the researcher hopes to engage fully in participant contexts, and be deliberately positioned as an outsider this way (Goundar, 2025). In acknowledging the researcher's agency and freedom of choice, she is freed to recognize that students all have freedom of choice of whom to study with. The hope, therefore, is to use her life

experience to start the inquiry but stay open to where research and student perspectives lead.

#### **4. Goals:**

The goal of this work is to frame and word technical interventions based on what is known about learning generally and vocal learning specifically. This does not necessarily mean catering to a student's learning preferences, and it especially does mean presenting a prescriptive model of teaching. It means rather providing a framework to understand the likely consequences of instructions and learning preferences, which in turn empowers the teacher to make informed choices. It is additionally a goal to empower students to think about how they learn best so that they can communicate and collaborate with teachers. This is in line with the constructivist ideals that Holmes (2019) presents promoting student-centered learning in university settings, and further in line with the epistemology underlying this work: the understandings that humans create around physical events is the very topic of study. As Gibbs (1981) suggests, "Students need... to examine not just the subject matter... but also the process of their learning itself" (p.vii). Frameworks, or lenses through which a subject can be viewed, have been shown to improve learning at all levels (Song et al., 2022), and having a logical, definitionally consistent one on which to build a collaborative understanding of the students' learning process is proposed as an asset to the teacher's ability to learn about the student, student's ability to articulate their learning needs.

#### **5. Learning Outcomes:**

The researcher hopes to deepen her understanding of Attentional Locus for singers and to understand how it affects learning. The immediate and practical outcome is becoming more targeted and empathetic in how students are cued; additionally, developing skills for writing a literature review is of interest. Working methodologically is not a particular strength of the researcher, and a Scoping Review/Rapid Review was chosen in part to

encourage this aspect of writing. Finally, it is hoped that the teaching done will be informed by an understanding of current literature on attentional locus.

## **6. Document Methodology and highlight limitations:**

The style of a scoping review was chosen to discuss “a gap in the existing literature (Arksey & O’Malley, 2005).” While vocal learning has been speculated about in the context of attentional locus (Maas et al., 2008; Helding, 2015; Helding, 2016; Treinkman, 2021; Treinkman, 2022a; Treinkman 2022b) studies on it have been limited and flawed (Atkins & Duke, 2013; Atkins, 2017; Treinkman, 2022a). A scoping review style allows me to incorporate different methodologies (Arksey & O’Malley, 2005) into my search because “relevant literature” overrides study design and even type of literature (Mak & Thomas, 2022). However, the parameters of the assignment did not leave time for a full 6-12 month scoping review (Mak & Thomas, 2022). A rapid review, or compressed review (King et al., 2022) in the style of a scoping review, was therefore chosen. As such, PRISMA- ScR and PICO (King et al., 2022) have been adapted for this review. An Important aspect of a rapid review is its “Transparent methodological choices” (King et al., 2022, p. 1), which make clear the positionality of the researcher. The researcher is fundamentally interested in learning how students learn best. Attentional locus presents a clear framework for understanding important aspects of this. The choice of rapid review comes from finding that the literature has left some major definitional gaps that diminish its ability to be relevant to the greater field. It is therefore imperative to discover what those gaps are, and present ways in which they could be filled in by future work.

## **7. Research Question**

Grant and Booth (2009) suggest carefully focusing the research question for rapid reviews. The research question was initially “What is known about Attentional Locus and the voice;” during the writing process, this has changed to “What do attentional locus studies reveal about vocal learning?” and then finally, “What does the existing

literature reveal about the definition of external locus of attention for the voice?” This more focused question allows both probing the existing literature deeply and discussing why the sought definitional clarity could affect learning. Evolution of the question arose out of the Hermeneutic Circle (Boell & Cecez-Kecmanovic, 2010): it was not until a large portion of the paper had been written that the final topic became clear.

## **8. Search Strategy and Inclusion/Exclusion Criteria:**

The limited amount of time available for a rapid review, and the broadness in literature type available for scoping reviews presents ample opportunity for bias (Grant & Booth, 2009). To mitigate this, article search choices and supporting literature choices are being made transparent. The keywords searched were voice, singing, motor skills, and attentional locus. They were searched in Google Scholar and the time limitation was articles that were published between 2000 and 2025. These dates were chosen due to advances in technology, which have led to improvements in understanding of the effects of attention on learning (Dew & Cabeza, 2011; Petersen & Posner, 2012; Moss Erickson, 2022). When searching review articles including article content, the keywords returned 1280 results; when the search was limited to the titles, it returned 0 results. Additions of ‘and’ to the keywords, intended to reduce the number of articles, increased them. The initial keywords were therefore used and titles searched manually for relevance. Only articles that were specifically regarding attentional loci and the voice, or that had significant portions devoted to this, were included. Research focused on non-human animals was excluded. Additionally, research that used the terms loci or locus to describe a specific body part, as opposed to attention, was excluded. Extensive manual searching of bibliographies was also carried out. This reduced the number of articles forming the basis of this review to 10.

| Title                                                                                                                                   | Author(s)                                                                  | Year<br>Publi<br>shed | Type of<br>Research | Aspects Discussed                                                        |
|-----------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------|-----------------------|---------------------|--------------------------------------------------------------------------|
| Effects of focus of Attention on Tone Production in Trained Singers                                                                     | Atkins, R                                                                  | 2017                  | Quantitative Study  | Singers evaluated based on attentional locus conditions                  |
| Changes in Tone Production as a Function of Focus of Attention in Untrained Singers                                                     | Atkins, R; Duke, R                                                         | 2013                  | Quantitative Study  | Same as above but untrained singers                                      |
| Attentional Focus Effects and Singing: Enhancing Vocal Performance through Body Movements and Gestures as External Focuses of Attention | Brand, S                                                                   | 2021                  | Narrative Review    | Body movement and gestures as a source of external locus of attention    |
| Focus of Attention Research: A Review and Update for Teachers of Singing                                                                | Treinkman, M                                                               | 2021                  | Narrative Review    | Discusses benefits of adopting an external locus of attention            |
| Focus of Attention in Voice Training and Performance: Applications to Voice Studio                                                      | Treinkman, M                                                               | 2022                  | Narrative Review    | Ways of teaching aspects of singing using an external locus of attention |
| Focus of Attention in Voice Training                                                                                                    | Treinkman, M                                                               | 2022                  | Quantitative Study  | Codes instructions from voice teachers based on attentional loci         |
| Principles of Motor Learning in Treatment of Motor Speech Disorders                                                                     | Maas, E<br>Robin, Donald A<br>Austermann Hula, S<br>Freedman, S<br>Wulf, G | 2008                  | Critical Review     | Relative efficacies of motor learning strategies incl. attentional loci  |

|                                                                                                            |                          |      |                    |                                                                                                     |
|------------------------------------------------------------------------------------------------------------|--------------------------|------|--------------------|-----------------------------------------------------------------------------------------------------|
|                                                                                                            | Ballard, K<br>Schmidt, R |      |                    |                                                                                                     |
| Motor Learning and Voice Training: Locus of Attention                                                      | Helding, L               | 2015 | Narrative Review   | Avoiding mention of the body in cuing                                                               |
| Motor Learning and Voice Training, Part II: Locus of Attention: Internal or External? That is the Question | Helding, L               | 2016 | Narrative Review   | When in the learning process are various attentional loci most appropriate                          |
| Adopting an External Locus of Attention Enhances Musical Performance                                       | Mornell, A<br>Wulf, G    | 2019 | Quantitative Study | Musical performance of instrumentalists including singers under varying attentional loci conditions |

The main articles were selected because they concerned attentional locus and the voice. These were supported by articles on attention and learning in sports, neuroscience, and cognitive psychology that provided research context. For example, two of the studies mentioned are very openly based on papers by Gabrielle Wulf, and the researchers attempted to adapt these studies for singers. Understanding those original studies is crucial to understanding the context in which the singer-based studies were situated. It should be noted that only one of the supporting pieces studied was from pre-2000: this was one of the original works by Wulf and colleagues showing her findings on attentional locus, and it was used for its clarity. The Hermeneutic Circle (Boell & Cecez-Kecmanovic, 2010) was further to find supporting literature deepening my understanding and context of the topic. This in turn helped to both broaden and narrow the supporting literature search. An example is the discussion of the difference between feedforward and feedback, something that seems to have been explored insufficiently in attentional locus literature on the voice. It was necessary to understand it separately to comprehend the hole its absence in the literature left in general understanding of attentional locus and motor learning.

### **Use of Grey literature:**

Because this was conducted as a Rapid Review, use of grey literature was very limited (Grant & Booth, 2009). Only Tier 1 Grey literature, with peer review and high levels of retrievability (Adams et al., 2016) was used. Strong preference was given to Grey Literature published or updated after 2000 for the same reasons as with main articles; brief mention was made to Edwin Gordon's 1983 seminal work to support mention and discussion of audiation, though the specific edition cited was updated in 2012. Brief mention was made of both Graham Gibbs (1981; 2013) and Donald Schön's 1983 work in the Component 1 reflection and justification and Albert Bandura's 1997 work because these authors' works were the original philosophical sources for some of the thinking. It should be noted, however, that none of the grey literature, particularly that published before 2000, was used to support scientific claims.

### **9. Reflection:**

Gibb's Reflective Cycle (Gibbs, 2013) was chosen because it allows for a section on emotional reactions, a significant part of this process for me. Elements of Schön's work (1983) were also used in the reflection and throughout the research process.

### **Description:**

I undertook a study examining existing literature on attentional locus for the voice. I found that several concepts, particularly external locus of attention and its effects on learning, were inconsistently defined in the existing literature, and set out to clarify these items with a large body of relevant supporting literature. Through this process, I made major changes in my view of attentional locus and its value. I experienced a constant interaction between knowledge I gained from researching this subject and my real life singing and teaching, which affected both my openness to the evidence in the literature I was reading, and my willingness to continue to apply it in my studio. This phenomenon

is well documented in literature on insider research and positionality. While I document here a reflection on indirect research rather than direct research, I resonate with Yip's (2024) assertion that positionality greatly affects the topic chosen and how the researcher interacts with it. For example, as I detail below, I struggled greatly even accepting the efficiency elicited by an external locus of attention. However, the overwhelming body of evidence I was reading about led me to try various cues, including ones whose use I question below, with my students. The immediate increase I witnessed in their abilities formed a powerful example of 'reflection-in-action' (Schön, 1983) and led me to reevaluate the biases with which I walked into my reading. Working from the other direction, Stanley and Krakauer's redefinition of an explicit fact, combined with Brand's (2021) review on gestures as external locus targets, further made me realize that if I asked a student what they felt they were doing and they responded with a gesture, that there was no need to ask beyond this- the gesture itself was both an external locus of attention and an explicit fact, and that asking beyond this would likely increase their cognitive load, potentially harming learning. Before undertaking this research, I likely would have done exactly this, thinking that it would strengthen the memory.

### **Feelings:**

I experienced some feelings of isolation and worry considering my research findings, as my vocal learning path has not been in line with these findings. This is an example of my own subjectivity, which, through reflection, I hope to "move beyond" (Yip, 2023, p. 224). In my own singing, I have studied with voice teachers who worked entirely with internal locus and others who were dogmatically external locus. The external locus worked more quickly but the internal locus led to more robust learning, and the idea of internal locus leading to more robust learning was not something I found in the literature, hence the isolation. This is likely why, in my Module 3 project (Shoup, 2025), I set out to see if students could use internal locus cues to build self-efficacy: while I do feel that I studied something important, I was also resisting the large body of literature

that correlates external locus with improved self-efficacy (Wulf & Lewthwaite, 2016). While I was unaware of it at the time, I can in retrospect examine how this “played out in the research process” (Yip, 2023, p.225): my positionality affected the entire topic that I chose to study, what questions I asked, and therefore what my findings were. There may, however, have been some “uninformed skepticism” (Silva, 2025, p. 9), in which my anecdotal experience led me to doubt the objectivity of the information I was reading. Moving forward into Module 4, the experience of acknowledging the bias I had in Module 3 and slowly working through it, has made me much more aware of when and why I resist certain pieces of research evidence. In many cases, particularly when studying topics that are personal, it is absolutely my own bias informing my skepticism (Silva, 2025) This does not negate my experiences; is rather a reminder that the information from research, particularly if it is scientific research, is intended to be objective (Stamenkovic, 2022). In line with my constructivist epistemology, any meaning I build on this on this is my own (Holmes, 2019).

This was also the first time I picked apart logical inconsistencies in the published work of others. While I admire Atkins (2013; 2017), Treinkman (Treinkman, 2021; Treinkman, 2022a; Treinkman, 2022b), and Holding (Holding, 2015; Holding, 2016) for many of their examples and for the intent of their work, I was disappointed that they had not grappled more deeply with definitional differences in external locus of attention. I felt this particularly in the direct research, as the lack of clarity undermines nearly all its conclusions. I was also disappointed in the seemingly careless use of learning vocabulary, implicit and explicit, which again undermined the otherwise important points they were trying to make.

### **Evaluation:**

I had a clear sense of my topic immediately after the Module 3 paper, which helped me to start early and think deeply about the topic. I was able to delve both into the main articles and the supporting literature at some depth. However, two things delayed my

writing: I read many articles that I did not end up using, and in retrospect, I may have been better off scanning them and using the time to focus on work that was clearly within my exclusion/inclusion criteria. For example, if I had used the CRAAP evaluation model (Blakeslee, 2004) before engaging in deep reading, I likely would have ruled out several articles early on for not passing the second step, Relevance. There is a part of me that does not regret this, as I feel that it added richness to my general understanding of the topic, and I genuinely enjoy going down 'rabbit holes' with my research, but from a time management perspective it was not ideal. I also didn't make a GAANT chart, which I found helpful in the previous module. This was likely because I felt confident from having gotten an early start. In the future, however, I plan to be stricter with the GAANT chart and the timelines. All, I feel that I have managed my time better with this module than with the previous ones, though I did have similar issues.

I struggled with writing the implicit/explicit portion of the paper in a way that was connected enough to the literature. I am happy that included it, as I feel that it added an important layer to the paper both for its practical conclusions about what conscious learning is, and for its highlighting more definitional inconsistencies in the studied work, but I found it difficult to write it in a way that coalesced with the rest of the paper.

### **Analysis:**

I am mildly ADHD, which has both positive and negative consequences for my work. While I don't struggle to focus on topics that I am genuinely interested in, I tend to wander intellectually and go on tangents, reading things that interest me, but which may or may not be relevant. There are positive results from this when I make unique connections between subjects, as indicated by the Hermeneutic Circle (Boell & Cecez-Kecmanovic, 2010) but it is terrible for time management. Related to this is that I tend to be a perfectionist in my work and will often over focus on certain aspects of it and leave other aspects to the last minute. The relationship between perfectionism and procrastination is well documented in psychological literature, with certain types of perfectionism being negatively correlated with productivity and positively correlated with procrastination (Çapan, 2010; Steinert et al., 2021). This again has positive and

negative consequences, with positive ones being high standards for the sections I focused on (Gil et al., 2023) and negative ones being sections that I rushed because I left them to the last minute.

## **Conclusion**

Continuing my topic from Module 3 was an excellent choice because I was already familiar with the general material and this allowed me to deepen my understanding rather than being overwhelmed with a new field. While I managed my time better than in Modules 2 and 3, I still have room for improvement. I additionally managed to touch on all the areas and implications of external locus that I wanted to partially by refining my research question. I have now done enough work in this master's to observe patterns in my own work that have shifted slightly from the last time I was in school: while some of the procrastination patterns are the same, I have matured enough to observe them without feeling threatened.

Researching and writing about attentional locus and cognitive load has absolutely been a help to my teaching: it has helped me frame how my students learn, direct their learning for the future, and understand ways in which this is similar and different from my process.

## **Action Plan**

For future work, will absolutely make a GAANT chart early in the process. I want to use it to encourage myself to meet intermediate deadlines and further reduce procrastination. With this, however, I want to still allow for some intellectual wandering, as I feel that this is important to my process, I just want to have planned for it in my timeline, possibly interleaving it, as this seems to be a necessary part of the hermeneutic circle. I plan on continuing to allow my research to affect my teaching and vice versa; I was stunned and inspired working with a nonverbal student immediately after reading Stanley and Krakauer's (2013) paper: this student's explicit facts are sounds and movements and his understanding is independent of his ability to verbalize. This helped me to feel that that was an important section of the paper, even though I

was struggling with it. I hope to continue to be open to experiences like this. I finally plan to continue to pursue this area, as it has connections to many of my interests. In the past, I had been debating whether to pursue tongue and jaw work or music learning theory and audiation, but attentional locus gives me a context for how to study both of those things in a way that is connected to the practicality of understanding how to teach them.

Component 2:

### **10. Critical Appraisal and Synthesis:**

As a voice teacher, this researcher is constantly addressing ways in which students can economize their learning. Whether proving to themselves that they can succeed at singing generally or proving to themselves that they can solve a particular technical or musical problem, experiencing oneself making progress is a major component of self-efficacy, which in turn is a major indicator of whether the student will continue to study (Bandura, 1997; Lewis et al., 2015). In this spirit, it is necessary to have a framework through which to view instructional implications, as these are powerful predictors for how a student learns a task (Wulf et al., 1998). What kinds of instructions are most effective for most learners? Why? Attentional locus, particularly the beneficial effects of an external, goal based attentional locus, seems to provide such a framework with which voice teachers can structure both theirs and their students' thinking (Treinkman, 2021). However, the literature reveals that exactly how an external locus of attention is defined is murky for the singer. Further, learning vocabulary, particularly implicit learning, explicit learning, and cognitive load, is used inconsistently in literature directed at singers. Since the entire goal of this study is to understand the learning implications of attentional locus, it will be necessary to additionally delve into these definitions. This paper, therefore, has three main sections: external locus definition for singers, the impact of feedback on attentional locus for singers, the impact of attentional locus on learning mechanisms for singers. Existing vocal research will be situated within current neurological and cognitive science research. It will be shown that in a few circumstances, definitional consistency has been maintained across disciplines, and in

others, confusion in vocal research terminology reflects debates within other fields. This work seeks clarity so that teachers can make informed choices about their instructions and feedback based on current understandings of learning principles.

#### 10.a. **External Locus of Attention**

Gabriel Wulf has brought the effects of attentional loci to the forefront of motor learning research over the past 20 years (Wulf et al., 1998; Wulf, 2002; Wulf & McNevin, 2003; Wulf & Mornell, 2008; Wulf & Lewthwaite, 2016; Mornell & Wulf, 2018). It is clear from her work that humans have evolved to focus on the goals of their physical tasks rather than on the process of executing them (Wulf & Lewthwaite, 2016). This goal-oriented approach, an external locus of attention, consistently results in faster, more accurate learning across a broad range of tasks and performer experience levels. An EMG study documents more efficient muscle triggering with an external locus than with an internal one (Vance et al., 2010), and further work, much of it led by Wulf, has demonstrated both superior performance under pressure (Wulf & Lewthwaite, 2016) and retention when attention is focused away from the body than when it is focused towards it (McNevin et al., 2003). An external locus arguably reduces the cognitive load of an activity and helps the body find an appropriate amount of challenge for learning complex skills (Wulf, 2002; Wulf & Lewthwaite, 2016). Wulf and colleagues have coined the term ‘constrained action hypothesis’ to describe the downsides of an internal locus of attention: when attention is concentrated internally, the natural coordination of the body is inhibited and made inefficient (Wulf et al., 1998; Wulf & Lewthwaite, 2016). While differences exist between motor signaling of the body and of the voice (Moss Erickson, 2022; Moss Erickson, 2023), preliminary research indicates that in this area, they are similar, with the few studies that have been performed on attentional loci and the voice showing clear advantages in muscle coordination of articulators as assessed by a pressure transducer (Freedman et al., 2007) and tone quality of singing as evaluated by expert listeners (Atkins & Duke, 2013; Atkins, 2017; Mornell & Wulf, 2018). Systemic Reviews by Treinkman (2021, 2022), a Critical Review by Maas et al (2008), a Systemic Reviews by

Brand (2021), and Holding (2015, 2016) come to similar conclusions. However, a close look at these studies and reviews shows a variety in definitions for the singer that undermines any overarching application of results.

A major definition of external locus, based on several of Wulf's papers, (Wulf et al., 1998; Guss-West & Wulf, 2016; Mornell & Wulf, 2018) is simply an instruction that doesn't mention the body specifically. It relies on images to either create or cue physical sensory experiences and use these as the external locus, or goal, for the action. This would elicit coordination that will create specific breath, postural, or resonance conditions. Treinkman's 2021 study of 278 mostly classical singers examines and codes what is being said in voice lessons, using similar methods and the same coding criteria that Guss-West and Wulf used in their 2016 survey of professional ballet dancers. In this study, Guss-West and Wulf coded the dancers' self-instructions as internal locus if they made direct reference to the body and muscle movements; combination when an image was used in combination with an instruction to the body; and external if the body was not referred to directly at all. For example, if a dancer noted that they were "balancing bones and wrapping muscles" (Guss-West & Wulf, 2016, p. 26), this was coded as an internal locus, but if they imagined 'elevating themselves like a balloon' (Guss-West & Wulf, 2016, p. 26), it was coded as external locus. Treinkman likewise states that if a cue is given to feel a "reverse ice cream cone," (Treinkman, 2022a) it is external, but if the cue is given to feel a "reverse ice cream cone... in the palate," (Treinkman, 2022a) it is mixed or internal. It is curious that Treinkman chose to use the same coding criteria as the Guss-West and Wulf study, as the goal of a dancer's craft is the position and movement of the body, while the goal of the singer, which she states herself in her 2022 review, for a singer is the sound. With these criteria, she found that 50.83% of the instructions were external locus, 39.42% were internal, and 6.48% were combination. Holding takes a similar point of view in her 2015 and 2016 reviews, describing teaching instructions that avoid direct control of the muscles of the body. She advocates for use of imagery to minimize the cognitive burden of needing to coordinate all the muscles needed for the singing task, and in doing so, reducing the self-

consciousness of the student. She invites the student to react spontaneously to being offered a free trip to Hawaii and then observing how their body reacts instead of deliberately releasing their abdomen. Further, rather than instructing the student to ‘drop the jaw,’ for example, she advocates self-massage of the jaw, or having the student recall an instance where the jaw was filled with Novocain so that the student is recalling a sensory experience rather than executing a specific muscle action. Readers will note, however, that while the sensory experience is in line with Treinkman’s coding, this instruction would have been coded as internal or mixed in Treinkman’s study because the jaw was mentioned. Even within this category, therefore, there is disagreement about which wording would elicit an Internal locus and which an external locus for the voice.

Some important questions are raised by these hypotheses: is there a significant difference between learning through imagery that references the body, even if it does not mention it specifically, versus learning through acoustics? While physical imagery is clearly a form of external locus, it may function differently from a neurological perspective than an external locus that is acoustically induced. “When we vocalize,” according to Moss Erickson (2023, p.667), “the tongue is not signaled from a singular ‘tongue’ location in the motor cortex, but rather in association with other articulators to generate a specific sound target,” implying that at least one neural pathway for a structure that is crucial for both resonance and articulation (Nair, 2021) is ideally acoustic and external. Clearly this is not the only way to signal the tongue, as it has crucial roles in swallowing and eating: Freedman et al (2007) were able to demonstrate superior tongue strength using an external locus of attention over an internal one. This research leads us to speculate that there are multiple neurological pathways that influence the resonators and articulators, and therefore multiple ways to trigger them into coordination using an external locus of attention. Still, the addition of the acoustic pathway that signals the resonators and articulators of the voice that may not exist for the limbs must be considered when categorizing and tracking these instructions, as it is reasonable to speculate that the different pathways will affect the ability of the singer to

synthesize the information. Further, it must be acknowledged that leading with any physical cue, even if the cue itself is an external locus of attention triggering a position, is not goal oriented for the singer in the same way that an acoustic cue would be. Thus, whether the body is specifically mentioned or not, any image based positional cue could be considered to have aspects of both an external and internal locus for the singer.

Mornell and Wulf (2018), Maas et al (2008), on which Wulf was included in the 'et al,' and Treinkman in her reviews (2021 and 2022) all state that the clearest example of an external locus of attention for singers is an acoustic target: a pitch, a vowel, or a quality. Maas et al. (2008) further speculate that external locus for the voice may be best defined as an "acoustic output," and that this 'parallels actions unrelated to the voice' (Maas et al., 2008, p. 287). Wulf and Mornell (2018) test this theory on singers and other musicians in the first of two attentional locus experiments on classical musicians. This experiment consisted of twenty-three classical musicians, four of whom were singers. They listed two focus conditions: the internal locus condition was precision of fingers and notes for instrumentalists, and lip movements for singers. The external condition for both groups was the "expressive sound of the music" (p. 379). They found, across all the musicians, that the external locus improved musical expression without detracting from technical precision. There was unfortunately no breakdown between instruments and therefore no way of knowing if the effects were differently pronounced from one instrument to the other. Singers were not included in the second experiment, which came to similar conclusions. However, while it is frustratingly general, the overall results of the study support the idea that focusing on sound goals is optimal for performance. That this conclusion arose from a study mostly based on instrumentalists suggests that acoustic targets can affect instruments played with the hands. Brand's review suggests this from the opposite angle, as he argues for the use of physical gesture as a form of external targets. He cites examples of choral directors and voice teachers instructing students to move their arms, squeeze balls, and stomp feet as examples of gestures that can help a student achieve both musical and technical goals and argues that they 'improve vocal motor targets.' Embodying the musical and technical intention in the

limbs of the body, he suggests, avoids the constrained action hypothesis by making the target intention distal from the vocal tract but still within the body. While his perspective is, as he admits, psychological, both his conclusions, and those of the effects of an external, acoustic target that helps both singers and instrumentalists: supported by neuroscience: the hands directly aide the audiation due to their proximity in the brain to the dorsal laryngeal motor cortex, which itself may have evolved due to the common, communicative functions of the hands and the voice (Moss Erickson, 2023).

#### 10.b. **Feedback**

A distinction that has not been explored sufficiently in attentional research on the voice is that between feed forward instructions, and feedback. There is evidence of separate neurological pathways in the brain for feedforward instructions and feedback monitoring (Semedo et al., 2022) for motor learning, and that a version of this exists for voice use (Moss Erickson, 2022). “Feedback,” according to Moinuddin et al (Moinuddin et al., 2021) “is movement-related information that is ‘fed back’ to the learner before before, during (concurrent), and after (terminal) an attempt to perform a task to enable modifications for the next action.” All these things could come from sensations inside the body, intrinsic feedback (Mcilwaine et al., 2010), or from outside the body, augmented feedback (Mcilwaine et al., 2010; Moinuddin et al., 2021). Augmented feedback is further divided into Knowledge of Performance (KP) (Mcilwaine et al., 2010; Moinuddin et al., 2021) which refers to the quality of a movement and is associated with an internal locus, and Knowledge of Results (KR), which refers to how close a performer was to a certain target and is definitionally associated with an external locus. Feedback, in whatever form it takes, can greatly affect attentional locus, either enhancing the feedforward instruction or shifting the attention inwards (Wulf et al., 2010).

Application of these concepts to the voice requires examination. The vocabulary presented above is clearly applicable to a golfer, who is using their body to control a

club that hits a ball at a target. A golfer concerned with the motion of their left foot will instruct themselves internally and be attentive to proprioceptive feedback, or augmented feedback in the form of KP, either of which could be concurrent or terminal. The same golfer focusing on a distant target for the ball has a focus that is clearly outside of their body, and the feedback of how far the ball lands from the target will be terminal and KR. A singer trying to lower the larynx, drop the jaw, or front the tongue is using an internal locus and, as with the golfer, the feedback may be based on some combination of KP from proprioception or biofeedback, though any resulting sound would provide a form of KR. However, external locus again presents us with difficulties. As discussed above, the clearest external target for the voice user is an acoustic target. If a singer uses an acoustic target, and this results in the singer hearing a certain sound or frequency intensely in their head while they sing, which they then consciously follow as they sing, has the attention shifted inward? Perhaps yes from a purely directional standpoint, however, from a goal-oriented standpoint, the acoustic target has been achieved, and the singer is using concurrent feedback and KR as they continue singing. What if a singer feels a vibration in the body as they sing? This, arguably, could also be considered a form of both concurrent feedback and KR, the result being the felt vibration. This hypothesis is supported by neurological evidence that suggests connection between hearing and feeling (Ro et al., 2012). Further, it is speculated that there is a significant difference between feedback sensations from vibrations and proprioceptive sensations from movement of a particular part of the vocal tract, as these would be the result of different neurological signaling (Moss Erikson, 2023). The former should be considered KR, more in line functionally with an external locus of attention, and the latter KP.

In her research on both amateur (2013) and trained (2017) singers, Atkins, like Treinkman, seeks to apply findings from a study, on which Wulf was a co-author (McNevin et al., 2003) to singers. This study showed that participants learning a balance task improved retention relative to increased distance of their attentional loci conditions. Atkins and Duke (2013) chose 5 attentional conditions: using hands to feel the vibrations at the throat; using hands to feel vibrations on both sides of the nose;

sending sound to a microphone placed 18 inches away; sending the sound to a point on the wall that was 18 feet away; without instruction. The first two conditions were categorized as internal, the second two as external, and the fifth as a baseline. The videos were evaluated by expert listeners and acoustic software. The baseline conditions were consistently ranked the worst of the 5, suggesting that these amateur participants performed better with any attentional locus than without one. The conditions that produced the best results were the point on the wall and the hands on the face, respectively. No overall correlations were found between the conditions and acoustic measurements. In 2017, working with trained singers, Atkins used the following focus conditions: baseline, or no attentional locus; the soft palate; vibrato; directing sound to a tripod 18 inches in front of them; directing sound to a point 24 feet away; directing sound to a point 40 feet away; filling the room with sound. The final condition was rated the best by both Atkins and an outside expert listener, though as Atkins admits, this may have been due to conditioning, as many of the singers' reported having used this cue in lessons.

Since it seems that Atkins' goal in both experiments (2013) was an attempt to recreate Wulf's experiment with singers, it is understandable why certain conditions were chosen. Wulf's experiment tested performers' abilities to maintain alignment of markers on a balance board that were varying amounts of distal from their bodies. The instruction was to attend to the alignment of the markers, and the result was that participants retained their learned skills more robustly when the markers were distal from the body. Feedforward instructions and concurrent feedback were therefore embedded into the same task: the performer would use the alignment of the markers as feedback to make the next adjustment. It seems that is this an important aspect that Atkins was seeking to replicate in her experiments. Having ones' fingers on the face or throat, feeling for vibrations, would give immediate, concurrent feedback to the performer and allow them to adjust as they sang. The condition to attend to vibrato would accomplish the same thing, as would the condition to 'fill the room with sound,' especially in the admittedly live room of the 2017 study, would give the singer concurrent acoustic feedback from the sound waves bouncing from the walls and back

to their ears. The results clearly suggest some phenomenon about how singers react to concurrent feedback and perhaps even how distal this feedback is from the sound source which, as discussed previously, would affect attentional locus. The problem lies in the coding of the conditions: feeling vibrations on the throat and face (2013) and vibrato (2017) are coded as internal locus, but these conditions are goal oriented and therefore fundamentally different from the instruction to raise the soft palate, which is also coded as internal. Even though they are varying amounts of distal from the body, these conditions are all results and therefore have more in common with external locus than with internal locus, which calls into question the internal validity of both experiments: they did not study what they set out to study. This may partially explain why there were no consistently measurable acoustic differences between the conditions in the 2013 study. It would be interesting to repeat this study with better defined locus targets to see if any of the patterns became more robust.

### **10.c. Learning Implications**

It will be recalled that the goal of this research is to understand the affects these attentional loci have on learning mechanisms. Both Holding and Treinkman use the words, 'implicit' and 'explicit' learning in ways that will benefit from further exploration. Treinkman, for example, states repeatedly that an external locus of attention triggers implicit learning because the resulting action is coordinated and it is difficult to describe the parts verbally. Holding (Holding, 2015) similarly delineates implicit knowledge from explicit knowledge, defining the later as "knowledge that," and the former as "knowledge how." Holding takes this farther when she equates non-attention with external locus in her 2016 review, juxtaposing quotes from Gabrielle Wulf and Adina Mornell with discussions of "just do it" and 'The Maxim,' a concept of performing a skill in the moment without thinking consciously about it, implying that this is what Wulf and Mornell are promoting, though quotes included in Holding's paper contain no mention of non-attention: they both praise external attention and justify their reasons for a goal-oriented pedagogy. Holding further describes the following hypothetical example of a student in a lesson:

“Let us imagine a teacher who knows his physiology well. First, he might explain to the student that the reason she feels ‘out of breath’ is because her rigid rectus is impeding the descent of her diaphragm, which in turn does not allow her viscera to be displaced, which explains her lack of oxygen. At this point, our confused singer may unknowingly tighten her abs further at the alarming realization that she has no idea what viscera are, why she would want them displaced, nor where on earth they might go. Now the teacher has effectively removed our singer from her sensory awareness (her implicit knowledge system) and, using technical verbiage, placed her squarely in her explicit learning mode (Helding, 2015, p. 90).”

Helding has effectively described a scenario in which the student, overwhelmed with “explicit” information, finds themselves unable to act. The use of anatomical descriptions has indeed disconnected her from the natural coordination of her body, and in this scenario, the psychological discomfort that this causes the student triggers tension that will likely exacerbate the technical issue of being ‘out of breath.’ The researcher wholeheartedly agrees with the problematic aspects of the scenario but finds the use of the words “implicit” and “explicit” to be unclear.

To be fair to Helding and Treinkman, these statements are reflective of debate in the larger world of motor learning, which indicated the supposed superiority of implicit learning over explicit learning. Shea et al. (2001), for example, found that “the learning of complex motor skills might actually benefit if information about regularities and environmental stimuli is withheld” (p. 859), and even more recently, Garnaas and Tilaar (2024a; 2024b) found that gymnasts learning a novel skill improved retention when it was not explained explicitly. The concept of an external locus triggering implicit learning is likely taken from work led by Wulf (Wulf et al., 1998; Wulf & Lewthwaite, 2016), though it should be noted that Wulf and colleagues seem to have become more mindful of these terms over time. Implicit learning implies learning that has happened unconsciously and un-deliberately, and it is used to in this circumstance because of the

automaticity that external locus cues trigger in the body (Wulf et al., 1998). Sweller (2024) using the words “biologically primary knowledge” instead of “implicit,” defines this type of learning perfectly by stating that it “consists of information that we have evolved to acquire easily and automatically. It is acquired unconsciously without instruction from others.” (Sweller, 2024, p. 2) He further contrasts this with “biologically secondary knowledge,” which he states is any knowledge that must be learned explicitly, or deliberately. Much research importantly equates explicit learning with the ability to verbalize exactly what one has done (Stanley and Krakauer, 2013). The voice’s preference for coordinative automaticity is well documented, (Titze, 2021; Moss Erickson, 2022); however, the very fact that we are studying how best to cue voice students should render the idea of teaching voice definitionally incompatible with any kind of learning that is “acquired unconsciously.” How, then, should we understand the type of conscious, but automated, learning, that we are attempting to cue? The external locus targets discussed above are ideally descriptions of sounds or sensations, and the internal locus targets are verbal descriptions of movements. Holding provides a pithy explanation with her statement, “Muscles don’t ‘do’ words (Holding 2015, p.40);” and indeed the external locus literature has provided overwhelming evidence that acoustic and sensational goals provide ideal coordinative cuing. How, then, are we meant to reconcile this with the likelihood of learning being conscious? Stanley and Krakauer (2013) provide a philosophical architecture. “Skilled action,” they state, “is action guided by ongoing accrual and improving application of knowledge of facts about an activity” (p. 2). They follow this, however, by stating that “there is simply no reason to conclude that concept possession generally requires the capacity to linguistically articulate.” Their knowledge of facts is equivalent to conscious knowledge, but this conscious knowledge can take many forms. A visual or acoustic target, therefore, can qualify as forms of explicit learning, even if they are not verbal. That the body has evolved to take these targets and use them to coordinate itself is evidence not of implicit learning but rather of efficient, explicit learning. Neuroscience appears to support this: Dew and Cabeza, reviewing neuroimaging studies in 2013, were unable to find expected patterns delineating implicit and explicit memory retrieval. Muscles appear, indeed, to ‘not do words;’ however, there is clearly something deeper at play than simple implicit vs.

explicit learning. Rather, we are expanding our definition of what an explicit fact is, and by these definitions, it includes sensations, acoustic targets and Brand's (2021) gestures. Wulf and McNevin support this conclusion in a 2003 study: in response to research promoting distraction techniques for implicit motor learning, they tested distraction against both external and internal locus and found that the distraction group performed on par with the internal locus and the external locus outperformed them both (Wulf & McNevin, 2003). In the 2016 review summarizing new learning observations, Wulf and Lewthwaite are very clearly in line with Stanley and Krakauer when she states that "It is unlikely that knowledge per se is detrimental to performance. Rather it appears critical that an appropriate external focus be adopted in preparation for or during performance. Thus, it is not that the entire process must be implicit or explicit, but that timely goal-action coupling is facilitated. If that coupling is affected by an overt instruction, or by the nonconscious recognition of a primed goal, both explicit and implicit conditions can facilitate goal-action binding (Wulf & Lewthwaite, 2016, p.1400)." While they do not rule out implicit learning, they find the dichotomy between implicit and explicit learning to be less important than the focus of attention, and it is unimportant whether that focus, or goal, be verbal or sensational, conscious or not.

The results of this study demonstrate an effective widening of the definition of conscious, explicit learning, we have not addressed all the issues correctly raised by Treinkman and Holding in the introduction to this section. In Holding's hypothetical above, the singer is bombarded with anatomy. While Holding attributes this to the information being explicit, an understanding of cognitive load sheds deeper light on why the description provided by the hypothetical teacher renders any subsequent intervention useless. Sweller (2024) provides context with his discussion of Working Memory, or short term, limited memory that processes new information. The brain can hold approximately 3 to 4 novel items in working memory for about 20 seconds when those items are being processed; elements that must be processed simultaneously because they interact and affect each other add to the cognitive load. The example given in Sweller's work is foreign language grammar, though it is easy to see how quickly a new singer could surpass the 3-4 interacting items. On the surface, a singer

could be completely overwhelmed when asked to attend to their breath and multiple articulators, as could happen with an internal locus of attention, but this could happen even when the teacher, such as Holding's hypothetical one, focuses on one element, such as the breath. If "Muscles don't do words," holds true, then it is reasonable to speculate that the process of translating a verbal description into a physical sensation and back could itself exhaust working memory. A singer, for example, singing for the first time in head voice, could be processing, concurrent, intrinsic feedback which may be difficult to ignore due to its intensity, which would itself add to the amount of novel information that she is processing. Further, an attempt to ignore this feedback may add to the cognitive burden (Lind et al., 2009), and we risk causing muscle tension and anxiety with cognitive overload (Cezar et al., 2023). It seems therefore judicious to economize the number of items we are asking our students to attend to, with the full knowledge that the translation from words to sounds or sensations, and feedback from their bodies may easily sap their working memories, and that this could happen from one cue, whether it be internal or external locus. Thus, it is likely not explicit learning per se that overwhelmed Holding's singer, but rather the cognitive overload of processing more novel information than her brain would be capable of handling. That the body can use external locus of attention to deliberately trigger coordination of muscle systems without the cognitive overload of attending to each individual muscle speaks to a unique aspect of the human physical and vocal systems.

## **11. Findings and Conclusion:**

Maas et al (2008) state that external locus of attention is "poorly defined for the voice." Throughout this paper, the existing literature on external locus of attention and the voice has been examined and contextualized, and an attempt has been made to clarify this definition. It seems that the clearest locus of attention for singers is an acoustic target and this is supported by current neurological literature on the voice. While Treinkman states that these instructions exist "on a spectrum," they seem rather to exist in different categories. For example, the researcher speculates that an external locus of attention on an acoustic target might differ from an external locus of attention on a physical

position, such as imagining a backwards ice cream cone, whether the throat was mentioned specifically. Feedforward and feedback conditions affecting attentional locus, were discussed, and it was discovered that an understanding of feedforward and feedback conditions impacted the internal validity of Atkins' studies. Finally, two of the articles leaned heavily on the words implicit and explicit learning, and the researcher examined this use of vocabulary, finding that the use of those terms was not entirely in line with current thought. Deliberate learning, it was found, has more in common with explicit learning than with implicit learning, even if the performer is unable to articulate verbally what they are doing. Thus, an external locus of attention for singers is ideally acoustic and explicit, and the body can use the deliberately chosen acoustic targets to coordinate itself and significantly reduce the cognitive overload that would surely occur if muscles were controlled individually. These conclusions reflect and enhance similar ones reached by pedagogues Edwin Gordon (2012) and Kenneth Bozeman (2013), who wrote extensively on the benefits of acoustic targets in training musicality and vocal technique.

Based on all of this, the researcher echoes Holding (2015, 2016) in her calls for more studies on singers. Future direct research testing the conclusions above should base its definitions on ones that are consistent and in line with current neurological research. Studies like Treinkman's and Atkins' could be repeated but with the clearer definitions delineated above. Adjusting Treinkman's coding, for example, to differentiate acoustic from physical external locus cues would shed more light on how most voice teachers are thinking, rather than simply whether the body was mentioned. Further, both neuroimaging and EMG studies on neurological signaling would be invaluable for seeing if any measurable difference emerged between physical external locus cues and acoustic external locus cues.

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