Undergraduate and Graduate String Instrumentalists' Approaches to Learning New Solo Repertoire: Descriptive Case Studies of Deliberate Practice Using the Fitts and Posner Model of Skill Learning

by

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Abstract

Practice, defined as working at something repeatedly to achieve proficiency (Merriam-Webster, n.d.), is widely recognized as a necessary component of skill acquisition. Past research has recognized the need to develop systematic teaching of practice skills (Pitts et al., 2000; Prichard, 2017; Prichard, 2021). An effective method for teaching practice skills must be tailored to its target population, making it necessary to learn more about the practice habits of various student populations. In this collective descriptive case study, I examined how freshman, senior, and graduate level string performance majors ($N = 7$) learned solo repertoire from sightreading to performance by observing practice videos and interviewing participants about their learning process. I recruited participants from a diverse list of institutions that varied in size and setting, control, and admission stringency. My purpose was to examine how participants (a) learned a new solo at different phases of learning, (b) measured progress, (c) handled errors during practice, (d) used and justified practice strategies, and (e) determined if a change of practice approach was necessary. In addition, I investigated the extent to which students at different stages of university enrollment varied in their approach and their perceptions of applied music professors' approach to teaching. I used the skill acquisition approach advocated by Lehmann and Davidson (2002) and Scripps et al. (2013), the skill learning model by Fitts and Posner (1967), and the theory of deliberate practice by Ericsson et al. (1993) as my theoretical framework. The skill acquisition approach emphasizes that everyone can develop skills. The theory of deliberate practice specifies conditions that lead to expertise. The phases of skill learning encouraged more accurate recall of the learning process at different points in time.

.....*Keywords:* skill learning, skill acquisition, deliberate practice, Fitts and Posner

Artificial Intelligence (AI) Disclosure Statement

I used ChatGPT 4.5 in the preparation of this dissertation.

Ravitch and Carl (2016) encouraged the practice of multiple coding. In this process, multiple researchers examine the same data to arrive at a shared understanding and to jointly develop and refine codes. I used ChatGPT 4.5 as a virtual research assistant to fulfill this requirement for data reliability. ChatGPT 4.5 has a wider knowledge base and is better at more nuanced tasks, such as writing, compared to its predecessors. Additionally, its improved capability to follow user instructions, draw connections, and recognize patterns can be useful in tasks such as improving writing (OpenAI, n.d.).

ChatGPT is an intelligent chatting robot developed by OpenAI that uses Natural Language Processing capabilities. While ChatGPT was found to be unreliable in writing and synthesizing literature reviews, it showed potential as a tool for analyzing qualitative data when provided with appropriate prompts and commands (Lee et al., 2024; Li et al., 2024; Rahman et al., 2023). It can provide detailed responses to prompts and learns through a combination of reinforcement learning algorithms and human feedback (Dowling & Lucey, 2023; Wu et al., 2023). Davis (2023) cautioned that while it lacked the ability to find nuanced themes, it was successful at reproducing concrete, descriptive themes. These studies highlight that although AI is a powerful tool that can aid in research, it is only a tool and not a replacement for human involvement.

The use of Artificial Intelligence (AI) in scholarly research is relatively new and not yet widely accepted (Rahman et al., 2023), but recently, more academics have been advocating for its use to improve academic writing and productivity (Vassallo, 2024; Zhao, 2023). Additionally, AI has been used to enhance tasks specific to qualitative research, such as thematic analysis

(Katz et al., 2024; Lee et al., 2024; Morgan, 2023; Yan et al., 2023) and qualitative coding (Li et al., 2024). Bijker et al. (2024) found ChatGPT to be reliable in assisting with qualitative analysis, particularly when creating an inductive coding scheme from emerging data.

AI was generally considered a useful tool for editing (Da Veiga, 2025). I used ChatGPT, trained with FastTrack Mentor's PEER writing process for evidence-based academic writing as an editing tool. I uploaded individual chapters into ChatGPT with the prompt, "Read the uploaded text and provide suggestions for clarity and logical flow of each paragraph." While I did not copy ChatGPT's suggestions verbatim, I rewrote its suggestions in my own voice whenever appropriate.

While also a powerful research tool, generative AI, on the other hand, should be used with caution and with human oversight because of documented issues such as bias and the generation of inaccurate information known as *hallucinations* (Da Veiga, 2025). Additionally, AI cannot be listed as coauthors nor be held accountable for generating false information, making human authors still primarily responsible for fact- and reference-checking AI-generated information (Leung et al., 2023). For these reasons, I completed my own analysis of interview transcripts and video observation notes prior to running a separate analysis using ChatGPT 4.5.

I used a protocol developed by Kruikow (2024) to generate open and focused codes from interview transcripts and video observation notes. Li et al. (2024) used a similar process to test the reliability of ChatGPT 4.0 to generate open codes, subthemes, and themes from interview data. As I completed video observation and interview data collection from each participant, I uploaded deidentified interview transcripts and observation notes into ChatGPT 4.5. During the first phase of ChatGPT coding, referred to as the *naïve phase*, Li et al. (2024) recommended using generalized prompts that did not require ChatGPT to have specialized knowledge about the

research topic. I used the following prompt to perform the initial coding of each participant's interview transcript:

> I will upload an interview transcript with a music performance major where I asked questions about the participant's approach to preparing a piece for performance at three different phases of learning (cognitive or early, associative or intermediate, and autonomous or final). I also asked questions about how the participant's applied music teacher provided guidance on preparing a solo piece for performance. I want you to review this transcript and code it (a code is a unit of analysis in qualitative research) as if you were a qualitative researcher. I want you to use descriptive codes that are detailed, self-explanatory, and specific but not too wordy. The participant's name is _____, and the interviewer's name is Nile Wilson. I want you to code the participant's accounts, reported experiences, opinions, and comments. As the output, I want you to provide a list of codes you created, and under each code, I want you to provide a full segment of text (e.g., a sentence or part of a sentence) to which this code was applied.

I used the following prompt to perform the initial coding of observation notes from each participant's practice session video:

> I will upload observation notes of a music performance major's video practice sessions where the participant is practicing a new solo piece at three different phases of learning (cognitive or early, associative or intermediate, and autonomous or final). I want you to use descriptive codes that are detailed, self-explanatory, and specific but not too wordy. I want you to code the participant's accounts, reported experiences, opinions, and comments. As the output, I want you to provide a list of codes you created, and under each code, I want you to provide a full segment of text (e.g., a sentence or part of a

sentence) to which this code was applied. When you create the codes with their associated quotes, I want you to separate them into the three phases of learning mentioned earlier.

After completing the initial coding for each participant, I asked ChatGPT to organize the codes from the interview and observational data without their associated quotes to prepare for focused coding. I copied and pasted the output from all participants into a single Microsoft Word document for focused coding. Once the initial codes had been copied to this document, I uploaded it into ChatGPT and asked it to group similar codes into thematic clusters and determine overarching themes from these thematic clusters. After ChatGPT completed its analysis, I reflexively compared its output with mine, reviewing similarities and differences. Li et al. (2024) found moderate alignment between ChatGPT 4.0 and human researchers in identifying key themes in qualitative interview data. ChatGPT 4.0 has also demonstrated the ability to capture nuance and emotional content in qualitative data, making AI useful in augmenting human analysis. Researchers agree, however, that ChatGPT must be used to complement rather than replace human analysis (Lee et al., 2024; Li et al., 2024).

The author acknowledges full responsibility for the intellectual content of this work and has ensured that all AI-assisted sections have been reviewed and revised for accuracy and appropriate academic style. All AI-generated content was reviewed and validated for relevance, appropriateness, and accuracy before incorporation into the final document to maintain scholarly integrity of this research.

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I would like to thank all my teachers who believed I was intelligent and a competent musician who would achieve great things someday. I am a better teacher because of you.

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Thank you to all my orchestra students, orchestra parents, friends, and colleagues who cheered me on when I was at my lowest point, trying to write a dissertation while being diagnosed with a new chronic illness.

I don't know what to say to my family, except I know that my PhD has been hard on you, too. Thank you for your patience and love. I love all of you very dearly.

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Chapter 1: Introduction

Music performance is an activity that requires highly specialized movements. *Practice*, defined as working at something repeatedly to achieve proficiency (Merriam-Webster, n.d.), is widely recognized as a necessary component of skill acquisition. Musicians practice to achieve fluid performance free of conscious cognitive control over the execution of skilled movements (Barry & Hallam, 2002), a psychological state known as *flow* (Jackson & Csikszentmihalyi, 1999). Recognizing the importance of practice in skill development, practitioner journals for instrumental music educators have featured articles offering practice advice for students, teachers, and professional performers. The American String Teacher, for example, has published articles focusing on different aspects of practice: general "tips and tricks" for successful practicing (Deverich, 1991; Tatton, 1997; Unzicker, 2017), practice strategies and creative problem solving (Karr, 1999; Sariti, 2004; Tatton, 1997), self-regulation and structuring practice sessions (Berg, 2010; Kim, 2008; Rotjan & Nicholson, 2020), effective use of practice aids (Kalik & Giray, 2022), and encouraging individual home practice (Matesky, 1962).

Practice is a complicated activity that influences skill development, but practicing itself is a skill that musicians need to learn (Prichard, 2021). In the absence of clear instructions from teachers on how to practice, students are often left to navigate this complicated process on their own. This lack of direction is particularly detrimental to young children because it often causes frustration (Pitts et al., 2000). Consequently, the lack of tangible markers of progress that may result from ineffective practice can negatively affect the motivation to practice (Austin & Berg, 2006). Understandably, many young and inexperienced students were not able to verbalize and engage in practice strategies other than repetition (Pitts et al., 2000; Rohwer & Polk, 2006) and did not detect or correct errors during practice (Pitts et al., 2000).

Experience and years of study did not guarantee the ability to engage in effective practice. Even in studies documenting the practice behaviors of music majors, researchers have reported discrepancies between students' self-reported practice behaviors and those used during individual practice (Geringer & Kostka, 1984; Mikzsa & Tan, 2015). Other deficiencies in effective practice behaviors explored by past research included time management and self-regulation (Byo & Cassidy, 2008; Liu, 2024), error detection and correction (Duke et al., 2009), and the application of practice strategies learned during lessons to individual practice (Barry, 2007; Kostka, 2002; Mikzsa & Tan, 2015).

Gap in the Literature and the Need for the Current Study

Past research recognized the need to develop systematic ways of teaching practice skills (Pitts et al, 2000; Prichard, 2017; Prichard, 2021). An effective method for teaching practice skills must be tailored to its target population, making it necessary to learn more about the practice habits of various student groups. Researchers have explored how students of different ages, years of study, and achievement levels approached practicing and learned new skills (Barry, 2007; Geringer, et al. 2015; Hallam et al., 2012; Liu, 2022; Marin et al., 2014; Rohwer & Polk, 2006; Strietelmeier, 2020; Wilson, 2023). The body of knowledge on this topic, however, remains limited, particularly concerning the examination of how students learn the same piece at different points in time in real-world scenarios such as preparing for a recital.

While the series of studies by Chaffin and Imreh (1997, 2001, 2002, 2003) provided a longitudinal view of how a professional pianist learned a new solo, Hallam (1992) found evidence that students and professionals approached learning music differently. Additionally, skill development in both music and sports shares many common elements, making Fitts and Posner's (1967) phases of skill learning an appropriate theoretical framework for the study of

skill development in musicians. The Fitts and Posner (1967) skill learning model has been widely used in skill development studies in sports (Fernandes et al., 2022; Kee, 2018; Kim & Petrakis, 1998; Pennington et al., 2001) and has even seen limited application to medical and clinical practice skills (Bugdadi et al., 2018; Zwicker & Harris, 2009), but I have found no such applications in the domain of music learning and practice. The current study attempts to fill this research gap by using a well-known cognitivist skill learning theory to examine how a group of advanced string instrumentalists learn a new solo at different points in their preparation process.

Theoretical Framework

I used the skill acquisition approach (Lehmann & Davidson, 2002; Scripps et al., 2013), the three-phase skill learning model by Fitts and Posner (1967), and the theory of deliberate practice (Ericsson et al., 1993) as the theoretical framework for this study. All three theories are rooted in *cognitivism*, the analysis of human performance from an information processing standpoint. Cognitivist theories operated on the assumption that goal-directed behavior was a result of the interaction of complex components such as sensation, perception, memory, and response (Fitts & Posner, 1967). Additionally, the theories revolved around the idea that skill was a complex set of behaviors acquired through practice. Collectively, these theories will allow me to examine how participants use practice activities to progress through the different phases of learning a solo piece.

The skill acquisition approach assumes that since experts encounter similar physiological constraints as non-experts, everyone is capable of developing skills through effortful, goal-directed activities over a period of time (Lehmann & Davidson, 2002). Scripps et al. (2013) raised many of the same ideologies but went further by proposing changes in music education policy currently biased towards nurturing students who display musical aptitude early in their

training. Extending the idea that skill was a product of accumulated training rather than genes, the theory of deliberate practice (Ericsson et al., 1993) complemented the skill acquisition model by specifying the necessary components of practice that lead to expert performance.

The study of a particular piece of solo repertoire happens over an extended period, and naturally, a musician's recollection of the learning process may be blurred. Fitts and Posner (1967) observed that adult learners developed skills over three phases: (1) cognitive or early, (2) associative or intermediate, and (3) autonomous or final. I can encourage more accurate recall when interviewing participants about their practice behaviors by using these three phases as markers of specific points in time during the preparation of a solo (Bhandari & Wagner, 2006).

Assumptions

In pursuing this inquiry, I operated on the following assumptions: (a) as string performance majors, the participants have achieved an advanced level of skill on their respective instruments; (b) participants receive weekly applied music lessons on their major instrument; (c) participants are preparing a solo piece as a requirement for a juried performance or recital within the current school year; (c) participants are not familiar with the Fitts and Posner skill learning model, and (d) each participant will share truthful information in response to the interview questions.

Delimitations

I delimited the scope of the interview questions and practice session videos to the study of a solo piece for consistency and with consideration of the possibility that different types of repertoire may affect the approach to learning new music (Hallam, 1992). I recruited participants who satisfied the following criteria: (a) at least 18 years of age, (b) violin, viola, cello, and bass performance majors, (c) currently enrolled in a degree or certificate program in a music school in

the United States as a freshman, senior, or graduate student, and (d) currently in the sightreading or early phases of study of a solo work.

The difference in career goals between music performance majors and music education majors drives program requirements, particularly in the area of applied music. I chose to only include music performance majors in the sample because I wanted to investigate how students who were specifically training to become professional performers approached the study of solo repertoire, which may help inform how music educators teach musicians of all levels. Additionally, I delimited my sample to freshmen, seniors, and graduate students because Maynard (2006) found a disparity between the practice skills of beginning undergraduate music majors—freshmen and sophomores—and students with more seniority, findings that suggested practice proficiency improved as students progressed through levels of university-level study.

Positionality and Biases

I became enthusiastic about the study of skill acquisition primarily because it made proficiency an achievable goal even for an individual who has not been labeled "talented." The idea that the right kind of practice will eventually yield proficiency was appealing to me as an educator. I struggled during my formative years of music study, so I wanted to help students have better musical experiences than what I had as a child. I was one of the least skilled violinists in my orchestra, so I was called "untalented" by teachers and fellow students. After three years of slow progress, I was removed from the program. I eventually studied under a master teacher, became proficient, and majored in music, but professors deemed my achievements less impressive than other students who were "naturals." In American society, the term talent is often used to refer to natural ability. Although I know people mean well when they say, "You are so talented," I feel strongly that by attributing skills to talent—which many regard

as the result of innate traits—people do not consider the effort required to gain skills. I am generally skeptical of studies claiming genetic traits make certain individuals predisposed to the acquisition of expertise. I acknowledge that this bias will be present throughout my research, particularly when examining literature that favors skill as a result of innate traits.

Qualitative research is never truly objective, but according to Ravitch and Carl (2016), a researcher must use reflexivity to address subjectivities and examine biases. Collaboration is one way to ensure that reflexivity occurs throughout the research process. To reduce the possibility of this bias negatively affecting the data collection and analysis process, I enlisted the help of fellow music educators and non-music professionals with formal musical training to serve as my peer reviewers. I also enlisted the help of an expert researcher as my faculty advisor.

Purpose Statement

The purpose of this study is to examine how string performance majors learn a solo piece from sightreading to performance at different points in the preparation timeline that correspond to the three phases of learning by Fitts and Posner (1967): cognitive or early, associative or intermediate, and autonomous or final. I examined how freshman, senior, and graduate level string performance majors ($N = 7$) learned solo repertoire from sightreading to performance. I recruited participants from a diverse list of institutions that varied in size and setting, control (public or private), and admission stringency. My goal was to find answers to the following questions through descriptive collective case study research:

1. How do freshman, senior, and graduate string performance majors practice solo repertoire during the early, intermediate, and final phases of preparation?
2. How do students measure progress?
3. How do students handle errors during practice?

4. What practice strategies do students use and why?
5. If students change their practice approach and strategies at different phases of preparation, what are the factors that drive this change?
6. How do students perceive their applied professor's approach to teaching practice skills?
7. To what extent do students in different stages of university enrollment vary in their approach to learning a new solo?

Chapter 2: Review of the Literature

The purpose of this study is to examine how string performance majors learn a solo piece from sightreading to performance at different points in their preparation timeline using the skill acquisition approach (Lehmann & Davidson, 2002; Scripps et al., 2013), the theory of deliberate practice (Ericsson et al., 1993), and the Fitts and Posner (1967) phases of skill learning as its theoretical framework. This chapter includes a brief history of cognitivist information processing theories. The review of related literature also includes independent discussions of each component of the theoretical framework and relevant applications in domains within and outside of music performance.

The Study of Human Movement and Performance

Research on skill acquisition and human performance has been conducted since the late 1800s, beginning with studies by Ebbinghaus. Ebbinghaus (1885, as cited in Proctor & Dutta, 1995) established that mental processes can be objectively observed and quantified in experimental settings. This effectively changed society's view of the study of human psychology, setting the precedent for future investigations into human learning and cognition. Following Ebbinghaus' revolutionary studies, Bryan and Harter's (1897, 1899, as cited in Proctor & Dutta, 1995) observations on the development of telegraphy transmission and reception skills are recognized as a breakthrough in the study of practical skill acquisition in the work environment. While their initial research focused on the amount of experience needed to acquire skill for accurate transmission and reception of telegraph messages, they later discovered that continuous improvement in telegraphic skills relied on developing a hierarchy of habits that allowed telegraphers to overcome performance plateaus.

Early researchers on skill acquisition also tried to explain the mechanisms behind voluntary movement. Among the notable observations by Woodworth (1899, as cited in Proctor & Dutta, 1995) was that even simple movements required timing and coordination to execute and that accuracy of movement varied when executed under different conditions of speed, stress, practice, fatigue, and sensory control. Additionally, Woodworth theorized that movement is executed in two distinct phases, namely, the initial impulse and the current control. This theory of movement implies that voluntary movement is a result of an underlying plan or motor program that adjusts based on visual feedback from the environment.

While much of the subsequent research studied movement control with limited scope and duration, Craik (1943, as cited in Proctor & Dutta, 1995) investigated movement in the context of dynamic environments. Craik viewed humans as operators of a mechanism, an information processor that actively monitors information from the environment to produce an observable response. When Bartlett (1958, as cited in Proctor & Dutta, 1995) demonstrated that high level cognitive skills such as thinking and problem solving can also be observed and studied experimentally, more formal methods of describing problem solving processes followed. These developments included a comprehensive theory of problem solving by Newell and Simon (1972, as cited in Proctor & Dutta, 1995), modeled after information processing systems used by artificial intelligence.

By the 1950s, the exponential growth in informational sciences influenced the further development of interest in human performance theory from an informational processing standpoint, a school of psychology that would later be known as cognitivism (Fitts & Posner, 1967). *Cognitivism* gained popularity between 1950 and 1970 in response to behaviorist theories that limited research to observable human behaviors such as conditioned responses to previous

associations (Codington-Lacerte, 2023). Cognitivist theories explain human learning in terms of the complex language that computers use to achieve a desired outcome within the confines of their logical framework (Fitts & Posner, 1967). In this view of voluntary movement, humans receive a stimulus from the environment, process the information with short sequences of operations or *subroutines*, and respond with an output governed by an executive program (Moe, 2005). Proctor and Dutta (1995) added that although this model also assumes that information processing occurs in three stages, different processing models will vary in the properties of each stage or the order in which each stage occurs. The terms cognitivism and information processing will be used interchangeably in this study. Fitts and Posner's (1967) phases of skill learning belong to the information processing theories of human movement.

Phases of Skill Learning

Fitts and Posner (1967) defined skilled behavior as an organized sequence of purposeful activities influenced by practice. Similar to Bryan and Harter's (1897, 1899, as cited in Proctor & Dutta, 1995) findings that suggested skill is acquired in distinct phases, Fitts and Posner (1967) observed that typical adult learners progressed through three phases as they learned new skills: (1) cognitive or early, (2) associative or intermediate, and (3) autonomous or final. In the *cognitive* or *early phase,* an individual develops an understanding of the task and the sequence of steps involved in task completion. It involves the *intellectualization* of a skill, which includes raising awareness of perceptual cues and the correct sequence of actions needed to produce appropriate responses. In the *associative phase* or *intermediate phase,* an individual is now able to draw on a patchwork of old habits and prior knowledge to create new patterns of responses to the demands of the task. As skills grow, errors are also gradually eliminated. Since the time an individual spends in this phase can vary depending on the complexity of the skill, effective

practice routines and training methods are especially crucial in advancing to the next phase of learning. An individual reaches the *autonomous* or *final phase* when he or she is able to perform a task without much cognitive control and is less likely to be disrupted by distractions. While an individual can continue to increase speed and efficiency during the final phase, the rate at which they improve progressively decreases. While learning occurs in three phases, the transition between phases is not always obvious (Fitts & Posner, 1967).

Fitts and Posner's research on skill learning was based primarily on the observable behavior of laboratory subjects and interviews with teachers. Without the technology to track brain activity as an individual transitioned from one phase to the next, the distinction between phases became somewhat arbitrary, and each phase gradually merged into the next (Fitts & Posner, 1967). Advances in medical imaging technology have created new possibilities for studying brain activity during learning activities. Several studies used neuroimaging technology to show brain activity at various phases of skill learning (Doyon et al., 2002; Doyon, Penhune, & Ungerleider, 2003; Hikosaka et al., 2002; Lehéricy et al., 2005; Pascual-Leone et al., 1993; Pascual-Leone et al., 1993; Pearce et al., 2000; Svensson et al., 2003 as cited in Lindquist & Guadagnoli, 2008), providing evidence for the association of observable behavior with concurrent brain activity. When an individual in the cognitive stage performed a skill while thinking in a step-by-step manner, brain activity was focused in the cerebellum, the area of the brain associated with motor learning and sensorimotor coordination. This activity diminished to nearly undetectable levels as practice continued, indicating that as the skill grew, less cognitive control was required. Activity shifted to the corticostriatal loop in the basal ganglia, the section of the brain responsible for associating sensory input and motor output, as an individual learned to perform the skill with more fluidity. The shift in activation patterns may support the gradual

elimination of errors, a characteristic of the associative phase. Less rapid changes in activation patterns occurred during the transition from the associative to the autonomous phase. Neuroimaging studies also indicated that individuals in the autonomous phase showed evidence of a consolidation effect of training called motor map reorganization.

Many new theories of skill learning have been developed since the inception of Fitts and Posner's skill learning model, but the durability of this study is evidenced by its use as the theoretical framework of multiple studies spanning several years and a wide variety of domains. Each researcher used the three-phase model in different ways. Kim and Petrakis (1998) divided Karate practitioners into three groups by skill level that corresponded to Fitts and Posner's phases to determine differences in visual and perceptual speed. Beginners with the rank of white belt were in the cognitive phase, intermediate students who achieved the rank of blue belt were in the associative phase, and advanced students who earned the rank of black belt were in the autonomous phase. Similarly, Bugdadi et al. (2018) tested the automaticity of force application during simulated brain tumor resection. They grouped junior residents, senior residents, and expert surgeons in each of Fitts and Posner's phases based on their level of expertise.

Researchers also used Fitts and Posner's (1967) three phases to create a plan to facilitate skill development through appropriate pedagogical practices and learner support during the different phases of learning. Zwicker and Harris (2009) created a three-phase intervention plan for a 10-year-old with an acquired brain injury. The plan provided appropriate levels of support as the patient learned to regain the motor control needed to bowl with his friends. Similarly, Kee (2019) conceptualized a variety of strategies to teach athletes who were at different phases of mindfulness training. Pennington et al. (2001) noted the importance of awareness of the phases of learning to create appropriate training activities for athletes. As a more complex application of

the phases of learning, Spalva (2016) developed a curriculum for the Dance Composition component of a bachelor's degree program by creating three levels of training that corresponded to each of Fitts and Posner's phases of skill learning. These studies highlight the importance of supporting individuals at different phases of learning with appropriate learning activities.

The practice of dividing learning into several phases is not new. Researchers have studied how musicians learn a new piece of music in phases. A longitudinal study by Chaffin and Imreh (1997, 2001, 2002, 2003) explored a concert pianist's preparation of a movement from J. S. Bach's Italian Concerto for performance. The authors explored practice in terms of musical memory and problem solving at various stages of preparation using a combination of self-reporting and practice observation. Marin et al. (2014) asked woodwind students at different levels of achievement to give a hypothetical classmate practice advice on how to study a Baroque or Classical solo piece at the beginning, middle, and end stages of performance preparation. Williamon and Valentine (2000) observed recorded practice sessions of 22 pianists at three stages of practice as they prepared a solo piece for performance. While the authors of these studies did not use Fitts and Posner's three-phase model, they provided a way to examine the learning process in terms of observable behavior at different points in time.

Skill Acquisition Through Deliberate Practice

Early studies on skill acquisition involved the performance of a task in a controlled laboratory setting over a short period of time, but the area of expert performance study was relatively unexplored until the work of Ericsson et al. (1993) examined how expert violinists gained highly specialized skills (Proctor & Dutta, 1995). From this study of violinists in West Berlin grouped into three levels of achievement, Ericsson et al. (1993) coined the term *deliberate practice*, an activity specifically intended to improve skill in a domain with an already

established method of effective training techniques. For practice to be considered deliberate, all activities must fit the following criteria: (a) be performed under the guidance of an expert coach, (b) test the limits of one's ability, (c) center on specific, well-defined goals, (d) require focus and conscious thought, (e) require feedback and modification of efforts based on feedback, (f) requires one to develop effective mental models for continued improvement, and (g) build and modify previously acquired skills (Ericsson & Porter, 2016). Ericsson et al. (1993) theorized that expert skill was the result of accumulated amounts of deliberate practice over an extended period of time—a principle known as the *monotonic benefit*—and how well an individual navigated effort, motivational, and resource constraints. While the theory of deliberate practice was developed to examine expert performance, it has since been applied to the study and improvement of intermediate-level skills such as typing proficiency (Keith & Ericsson, 2007) and reshaping coursework to help students score higher on the final exam (Miller et al., 2021).

Ericsson et al. (1993) found that the most elite violinists, those who were training for a career as international soloists, had developed deliberate practice habits during adolescence and reached stable levels of deliberate practice that they were able to sustain without exhaustion. This allowed them to practice longer than the typical violinist. By the time they reached adulthood, they had accumulated more hours of deliberate practice than the group of violinists who were members of international-level symphony orchestras and another group of violinists who were studying to become teachers. Ericsson et al. (1993) acknowledged the possibility that innate abilities might have a direct influence on skill, allowing individuals to gain a performance advantage by engaging in the same activities for longer times with the same amount of effort. Although they did not directly discount the role of individual differences in the shaping of expertise, they argued that an individual's circumstances may have allowed them more

opportunities for deliberate practice. Individuals who began training early in childhood, for example, may exhibit a higher level of skill than their peers because they have accumulated more hours of deliberate practice, and because they exhibit higher levels of skill, they are also more likely to be offered opportunities and support for further study.

Although the theory of deliberate practice may have provided a more optimistic view of skill as something attainable by anyone, it had its share of critics. Williamon and Valentine (2000) criticized the basic assumption that the amount of deliberate practice over a period of time was directly related to an individual's acquired skill. They were unable to find evidence that the quantity of deliberate practice applied to the preparation of a particular composition was associated with the quality of its performance. Sloboda et al. (1996) questioned the reliability of the study by Ericsson et al. (1993) because participants used retrospective estimates of practice amounts over a 10-year time frame. Additionally, critics of the deliberate practice model disapproved of the dismissal of the role genetic attributes (such as muscle composition) play in the development of experts. Ruthsatz et al. (2008) examined the original data from the Ericsson et al. (1993) study of violinists and noted that each group already showed differences in musical aptitude long before they had accumulated 10 years of deliberate practice, evidence pointing to the influence of innate traits.

More recently, Hambrick et al. (2020) cast doubts on deliberate practice as a scientific theory, pointing to shifts and inconsistencies in the definition of the term. Additionally, the authors presented evidence that individual differences in expertise cannot be explained by deliberate practice alone. They proposed that future research on expertise must consider the interaction of several elements, such as domain-relevant experience, developmental factors, and background factors. Kulesagaram et al. (2013) echoed the conclusions of Hambrick et al (2020).

Despite objections to the skill acquisition approach and the low likelihood of encountering prodigies and geniuses in the typical music classroom, why should educators study expert performance? Lehmann and Davidson (2002) cited several reasons to study expert performers, but maintained that the most important reason was to demonstrate that teaching can have an impact on performance. In addition to the amount of time spent on deliberate practice activities for at least 10 years, extensive engagement in relevant practice activities supervised by teachers and coaches produced expert performance (Ericsson et al., 1993). Even a study that found genetic effects on music accomplishment acknowledged that genetic potential for music accomplishments is only fully realized through practice (Hambrick & Tucker-Drob, 2014). Additionally, Harwell and Southwick (2021) argued that many of the objections to the theory of deliberate practice were primarily based on misconceptions.

Matthew Syed, Olympic table tennis champion turned award-winning journalist, documented his journey into the world of elite sports in the book *Bounce* (Syed, 2010). He acknowledged the role his coach played in shaping him into an elite athlete. In addition to training with an expert coach, Syed (2010) also listed the circumstances that allowed him to achieve expertise in table tennis. While he initially thought of his success as a "triumph of individuality" without any advantages over others, he later described his expertise as an intersection of events that worked in his favor. Syed's parents, who have never played table tennis, purchased a competition-level table tennis table and set it up in their large garage. He had an older brother who learned to play table tennis at the same time, and together, they amassed hours of practice time before they even began formal training.

The Syed brothers also happened to attend a primary school where one of the teachers was an expert table tennis coach who trained many of Britain's champions. The coach routinely

conducted table tennis trials with the children at the primary school and discovered the Syed brothers, who, at this point, were already proficient players because of accumulated hours of playing table tennis. It was the coach's invitation to join the Omega club, a spartan facility where members could train for free and practice 24 hours a day; however, that developed their expertise. To further emphasize the claim that expertise was a product of deliberate practice and not genetic advantages, Syed named multiple table tennis champions who lived on his street and, like him, attended his primary school and trained at the Omega club. The author acknowledged that had he lived just a few blocks outside the attendance zone of the primary school where his coach worked, Syed would have taken a different path.

Effective Practicing is a Skill

Understandably, school-age students who are early in the process of musical skill development have not yet learned effective practice skills (Hallam et al., 2012; Pitts & Davidson, 2000). While there was evidence that students learned more effective practice skills as they gained experience (Maynard, 2006) and that the development of musical skills enhanced the precision of performance goals (Hamilton & Duke, 2020), the idea that progression in musical skill corresponded to an improvement in practice skill has also been negated by studies that showed deficiencies in practice skills and self-regulation strategies in music majors (Duke et al., 2009; Maynard, 2006; Mornell et al., 2020; Suzuki & Mitchell, 2021). Who, then, is responsible for teaching students how to practice? The teacher should be the expert in this area, but instruction on effective practice is a skill that is not systematically addressed in music instruction. Kostka (2002) reported that very few college music majors and their applied lesson teachers discussed practice strategies and the formulation of an effective practice plan during applied music lessons. Adult piano students had a broad knowledge of practice strategies but did

not implement many of these strategies during practice (Bugos & High, 2009). Similarly, Barry (2007) found that although applied music teachers had a broad knowledge of effective practice strategies, teachers demonstrated very few strategies during applied music lessons. The lack of coaching on how to practice puts the burden of deciphering this complicated process on the student.

Several studies have highlighted the problem that when students were left on their own, they often did not know how to practice effectively. Pitts and Davidson (2000) studied the practice behaviors of three instrumentalists in the beginning stages of study by systematically analyzing practice sessions filmed during the students' first six months of study. The authors observed that the children were only aware of difficulties in the piece when they struggled or stopped, but did not isolate small-scale errors or attempt to fix global errors such as tuning or poor tone. The children either persevered through the errors or were discouraged by their lack of progress. Based on these observations, the researchers concluded that the participants did not have the ability to detect and fix errors.

Pitts and Davidson's (2000) study highlighted the frustration children experience during individual practice when they have no clear direction on what or how to learn. In contrast, Hallam et al. (2012) reported that many young instrumentalists eventually stopped using ineffective practice strategies—such as returning to the beginning of a piece if they made a mistake—as they progressed in skill. Despite this, the authors still found evidence that some students were still unable or unwilling to change practice strategies that may have worked during the beginning stages of study when pieces were shorter and less complex. This resulted in negative attitudes towards practice, particularly in the middle grades. Surprisingly, even elite musicians needed coaching on effective practice behaviors. Mornell et al. (2020) reported that

even advanced musicians lacked appropriate strategies in three domains of self-regulating behavior: forethought, performance, and self-reflection. Additionally, most participants used practice to work on technical aspects of performance and did not prioritize tone quality and musical interpretation.

Teachers are highly influential in developing practice skills in students. Maynard (2006) investigated the use of repetition during practice among artist teachers and their advanced students and found that while participants used repetition extensively, the more experienced instrumentalists played more target passages and performed twice as many repetitions. This led to the conclusion that students refined practice skills during the first two years as music majors. Barry (2007) found that students were more likely to incorporate practice strategies when applied music teachers provided vivid demonstrations, reflective feedback, and opportunities for the student to repeatedly experience practice techniques during the lesson. Similarly, students in a study by Weidner (2021) experienced an improvement in the quality of individual practice after their band teachers explicitly taught practice skills during ensemble rehearsals. These studies highlight the importance of deliberate instruction of practice techniques in both private instruction and classroom settings, reinforcing the influence of teachers on the development of independent musicianship.

Deliberate teaching of practice and self-regulation strategies can develop both instrumental skills and self-confidence. Miksza (2015) found that students who learned both practice and self-regulation made significant gains in performance achievement compared to students who only learned practice strategies. These students also devoted time to rehearsing musical and interpretive elements rather than focusing only on surface elements such as notes and rhythms. Similarly, Mieder and Bugos (2017) concluded that even when practice instruction

was focused solely on practice strategies, students felt empowerment that positively affected musical self-efficacy, even when performance achievement did not improve. Together, these studies highlight the importance of deliberate instruction in music practice in developing both musical skills and a sense of self-efficacy.

Non-musical applications of self-regulation strategies can easily be applied to music practice. Park et al. (2017) found that a backward planning model of goal setting led to greater motivation and better goal-relevant performance because it encouraged participants to think more clearly about task-related goals. Similarly, Wiese et al. (2016) found that although the backwards planning model increased completion time, participants who used the backwards planning model influenced higher-order thinking processes.

Teaching Evidence-Based Strategies to Improve Performance

The applicability of the principles of deliberate practice to the non-expert population can be used to improve teaching practices. Even if elite-level musical performance was not the ultimate goal of music education, improved teaching practices will allow proficiency to become an achievable goal for the average student (Lehmann & Davidson, 2002). Teachers can have a significant influence on a student's success. For this reason alone, teachers must incorporate evidence-based practices that promote durable learning instead of subscribing to and propagating *neuromyths*: misconceptions in scientific research about learning and cognition (Firth, 2021).

Learning Versus Performance

If the goal of adopting evidence-based practices in education was to improve student learning, how do educators know if students were actually learning? First, educators need to differentiate between behaviors characteristic of performance from behaviors that demonstrate learning. Schmidt and Bjork (1992) differentiate between performance and learning.

Performance is a temporary behavior change that happens during the acquisition or practice phase of a new skill. *Learning* is a permanent behavior change characterized by an individual's ability to demonstrate that the skill has been retained after a delay or period of disuse and generalize, transfer, or apply the skill in different contexts.

Schmidt and Bjork (1992) warned that misinterpreting improved performance during training as learning created a weak foundation for designing real-world learning environments and instructional practices. The authors pointed to how a flawed research design may have contributed to this faulty concept of learning. When researchers conducted studies that measured the acquisition of skills, participants were typically asked to practice a task while researchers manipulated independent variables such as instructions, feedback, or scheduling of practice. The goal was to test if certain variables caused an improvement in performance, and if they did, the expected conclusion was that this variable somehow enhanced the learning process. This view of learning was problematic for two reasons: (a) performance during acquisition was an inaccurate indicator of learning, and (b) acquisition and retention phenomena are not separable. Effective learning should instead be measured by demonstrating a level of retention. It was crucial, therefore, that when measuring the extent to which true learning has occurred, various retention or transfer tests must be included.

Many performers have experienced the frustration of practicing diligently for hours on end only to perform poorly under pressure. While the amount of time spent practicing is important, the strategies used in practicing were better predictors of successful performance (Duke et al., 2009). Despite this seemingly common-sense conclusion, many students continued to use ineffective practice methods with the belief that if they practiced more, their performance would improve (Hallam et al., 2012). Two practice strategies favored by musicians are blocked

practice and massed repetition. *Blocked practice* involves spending a considerable amount of time working on one skill or concept before moving on to the next. *Massed repetition* involves practicing the same skill or concept multiple times without any delay between repetitions. Unfortunately, massed repetition and blocked practice strengthened performance during the training phase but did not promote one tell-tale sign of learning: long-term retention (Bjork & Bjork, 2019b; Roedinger & Pyc, 2012; Carter & Grahn, 2016). Practicing in conditions that only improve performance during acquisition can even produce a false sense of success. Participants in a study by Simon and Bjork (2001) who practiced keystrokes under blocked conditions were overconfident about their true level of learning because they based their assessment on their superior performance during training. One remarkable finding was that the participants remained overconfident about their learning even after they performed poorly in a recall test before the final retention test.

Traditional practice advice from well-meaning teachers and instrument pedagogical methods still espoused massed repetition and blocked practice despite research that pointed to more effective strategies (Carter & Grahn, 2016). The real culprit for the continued promotion and use of strategies that only resulted in temporary performance gains was the inability to distinguish between performance and true learning (Bjork & Bjork, 2019b; Yan & Sana, 2021). Erroneously assuming that performance reflected actual learning may encourage individuals to adapt training conditions to maximize learning during training instead of creating conditions that maximize retention and transfer of skill (Schmidt & Bjork, 1992). Performance gains achieved through massed repetition of material did not result in long-term learning because the learner did not consider the role of forgetting in the learning process. In their New Theory of Disuse, Bjork and Bjork (1992) theorized that human memory was characterized by storage strength and

retrieval strength. *Storage strength* measures how well an item is learned. *Retrieval strength* determines how well stored items can be accessed from memory. Although related, storage and retrieval strength are independent of each other. Items that have high storage strength might have low retrieval strength—such as a concerto learned several years ago but not practiced since it was last performed—and vice versa. Storage strength has no capacity limitation and can be increased through further study or recall. Retrieval capacity, on the other hand, is limited by the processing capacity of working memory and the reduction of retrieval strength by competing memories.

A related concept in the acquisition of motor skills—the forgetting and reconstruction hypothesis—explained why forgetting benefited long-term learning:

> …learners profit from "reloading" the motor program corresponding to a given skill. Thus, for example, a golfer who practices hitting a particular shot on a driving range over and over again with the same club, perhaps with only a few seconds between shots, will tend to repeat what was done on the prior swing without actually reloading the motor program corresponding to that club and the target on the range. Switching clubs or targets from swing to swing does, by contrast, require reloading the appropriate motor program, which then enhances learning and transfer to shots on an actual golf course. (Lee & Magill, 1983 as cited in Bjork & Bjork, 2019a, p.166)

Since retrieval strength was limited, memories that were not accessed were not lost; rather, as a way of adapting to our changing lives, these memories become nonretrievable, so they do not compete with current memories. Memories then become *nonretrievable*—or simply put, forgotten—can be relearned at an accelerated rate once they become pertinent again. Using the New Theory of Disuse framework, the authors theorized that manipulating conditions that

encouraged successful retrieval of memories increased both storage and retrieval strength. More challenging conditions for retrieval encouraged stronger memories (Bjork & Bjork, 1992).

Desirable Difficulties

Schmidt and Bjork (1992) observed that training and practice conditions that encouraged long-term retention, generalizability, and resistance to degradation under altered contexts were not necessarily the same conditions that maximized performance during training. On the contrary, conditions that increased the effectiveness of the training regimen produced relatively poor performance during the acquisition and practice phase. Practice conditions that slowed the rate of improvement or degraded performance during training but potentiated actual learning are called desirable difficulties. *Desirable difficulties* are variations in training conditions that keep learning from being bound to a particular context, allowing for more flexible learning (Bjork & Bjork, 2011). These variations in training conditions create a *contextual interference effect*, defined by Magill and Hall (1990) as a learning phenomenon where interference during practice is beneficial to learning. Higher levels of contextual interference caused poor performance during practice while yielding superior retention and transfer of skill.

It is important to mention that for a difficulty to be "desirable," it must generate optimal cognitive challenges that trigger the encoding and retrieval processes that result in learning. If, however, the individual did not have the background knowledge or skills to respond to these challenges successfully, the difficulties become "undesirable" and learners may disengage (Bjork & Bjork, 2019a; Bjork & Bjork, 2020; Zepeda et al., 2020). Desirable difficulties can be classified into four broad categories: (a) variations in the sequencing and timing of tasks during practice, (b) variations in the nature and scheduling of feedback during acquisition, (c) inducing

variations of the task (Schmidt & Bjork, 1992), and (d) generation effects and test-induced learning (Bjork & Bjork, 2011).

Examples of desirable difficulties that vary the sequencing and timing of tasks are interleaving and spaced or distributed practice. *Interleaving* is a cognitive strategy that involves mixing different types of learning material so that each item is preceded and followed by a different item type (Firth, 2021). The practice of interleaving was first introduced in a sports study on teaching three different badminton serves to students (Goode & Magill, 1986). More than a decade later, a study by Hatala et al. (2003) was one of the first to apply interleaving to a domain outside of sports. The benefits of interleaving have been evident in studies across many different disciplines such as math (Foster et al, 2019), grammar for Japanese students studying English (Nakata & Suzuki, 2019; Suzuki, 2021), motor tasks (Schorn and Knowlton, 2021), and music performance (Carter & Grahn, 2016; Stambaugh, 2011). Interleaving can be applied to music practice by rotating between different musical passages or technical exercises during a session. During each new attempt at playing musical material, the brain must reconstruct the cognitive processes needed to perform successfully. This creates a more realistic context for performance where musicians have only one chance to start a piece (Carter & Grahn, 2016).

The robustness of the interleaving effect has been studied in different populations and has been shown to be effective on different types of learners. Yan and Sana (2021) found that interleaving was effective for students with different working memory capacities when learning how to discriminate between the painting styles of multiple artists. This is a significant finding since students with specific learning disabilities (SLD) were known to have memory deficits that affected academic and cognitive performance (Toffalini et al, 2017). Researchers also observed

that retrieval strength was also a benefit of interleaving (Foster et al, 2019; Carter & Grahn, 2016).

The timing and scheduling of practice tasks had a significant effect on long-term retention. Spaced or distributed practice involved repeated encounters with learning material that were spaced out in time rather than in succession (Kang, 2016). Carpenter et al. (2012) differentiated spaced from massed repetition as follows:

> When the spacing gap between two or more presentations of the same item is zero (e.g., the same biology term and definition are presented back-to-back with no interruptions in between), the presentations are said to be *massed* together. When the gap between presentations is greater than zero…the presentations are said to be *spaced* or *distributed* because they are separated by a nonzero time interval. The gap separating spaced presentations can range anywhere from a few seconds to several weeks, whereas the gap separating massed presentations is zero. (p. 370)

Scheduling subsequent review sessions so that they were spaced out over time from the initial study generally led to better retention than when the sessions were scheduled close together. The increased retention from this time gap between practice sessions is known as the *spacing effect*, a phenomenon that has been observed over 133 years of research on human cognition (Bjork & Bjork, 2019a). Research by Gerbier and Toppino (2015) revealed that the benefits of spacing can be effective over longer time intervals, from one to 28 days, rather than minutes or hours. One likely explanation for this increased benefit involved the *deficient processing hypothesis*: "The second occurrence of an immediately repeated item received less processing compared to spaced repetition, resulting in less efficient encoding and poorer memory." When a larger time interval between presentations was introduced, the increased

cognitive processing led to improved memory. Another likely explanation for improved retention after larger time intervals between repetitions was that sleep was likely to happen in between, increasing the likelihood of memory consolidation, a process in which newly learned information is integrated with previous knowledge. Researchers are still unsure of the optimal spacing of study sessions for achieving optimum learning, so the body of research into this phenomenon is ongoing (Carpenter et al., 2012).

The category of desirable difficulties most familiar to musicians is the intentional application of variations of the task. Strietelmeier (2020) composed a series of short etudes that featured technical passages idiosyncratic to the violin to determine whether practice behaviors changed in response to the technical demands of a piece. The researcher observed several practice strategies that involved intentional use of task variations: using *pizzicato* (plucking with the right hand) to play passages typically played with the bow, tempo and rhythm variations, playing backward, octave displacement, the addition of double stops, and various strategies that involved repetition of specific notes in each section.

Experiments on task variability introduced practice conditions that forced subjects to adjust their behavior to meet the goal (Memmert, 2006; Vakil & Heled, 2016). Memmert (2006) investigated the long-term effects of two training conditions on a complex motor skill: the basketball free throw. The control group took 160 shots from the free-throw line. The experimental group took 160 shots from different positions around the restricted area. The subjects took the Basketball-Shooting Test before and after training, and on a retention test one year later. Both groups improved their performance during acquisition, with the control group showing better performance than the experimental group. In the retention test given one year later, the experimental group demonstrated better skill retention.

Using a mathematical puzzle known as the Tower of Hanoi, Vakil and Heled (2016) tested the effect of constant versus variable training conditions on the acquisition and transfer of cognitive skills of 84 young adults. The constant training group practiced the task for 10 consecutive trials with identical configurations, followed by an additional trial with a new configuration of the task. The varied training group practiced 10 consecutive trials with different configurations, followed by a new configuration. During the acquisition phase, the constant training group performed better than the varied training group when time per move was measured, showing an advantage in terms of performance speed but not in terms of accuracy or planning time. When measuring the degree of transfer in terms of total time for solution, time per move, and time of the first move, the constant training group yielded a higher cost. Experiments in variable practice suggested that changes in context forced a change in behavior during each performance attempt and encouraged information processing about the relationships among the original task and its variants. Even when these activities resulted in poor performance during acquisition, they contributed to retention and generalizability (Schmidt & Bjork, 1992).

Generation and test-induced learning are examples of desirable difficulties that are underutilized as a learning tool. Tests have been used to assess learning, but have typically not been used to affect learning. A growing body of evidence suggested that using testing as a form of retrieval practice improved retrieval strength and increased the likelihood of successful retrieval (Roediger & Karpicke, 2006, as cited in Desy et al., 2018). Retrieval involves the deliberate recall of information from long-term memory without prompts or repeated studying of learning material. Roediger and Butler (2011) found that cognitive strategies, such as interleaving, that promoted retrieval strength also boosted long-term retention and transfer of learning. In a study involving students with math learning disabilities (MLD), Iuculano et al.

(2015) observed that after eight weeks of one-on-one tutoring using a combination of strategies such as speeded retrieval of math facts, participants with MLD showed brain activation patterns indistinguishable from their typically developing (TD) peers. Leonard et al (2020) observed that the benefits of retrieval-based cognitive strategies resulted in long-term retention in both typically developing children and children with developmental language disorder (DLD). Cognitive strategies that promoted retrieval strength also boosted long-term retention and transfer of learning (Roediger & Butler, 2011).

If cognitive strategies that introduced desirable difficulties were shown to be effective in promoting learning, why are these strategies not widely used in the educational setting? Desirable difficulties are difficulties after all, and many learners were not able to get past slow and mistake-ridden attempts at learning that were characteristic of strategies that incorporated them. Learning gains were also not immediately evident, which made teachers and students prematurely conclude the strategies were not effective (Bjork & Bjork, 2019b; Firth, 2021). Additionally, students who engaged in mistake avoidance rather than mistake correction during practice may find these strategies frustrating. Certainly, in my attempts to teach systematic use of desirable difficulties in my classroom, I encountered students who were vocal about their frustration over dealing with mistakes during practice sessions.

In revisiting their groundbreaking research on desirable difficulties and their effects on learning, Bjork and Bjork (2020) admitted they naively assumed sharing their research findings with learners and teachers was enough to convince individuals about the efficacy of new learning strategies. In response, researchers offered realistic solutions to implementation problems, particularly in the school setting (Hodges & Lohse, 2020; Zepeda et al., 2021). Hodges and Lohse (2020) presented considerations for future research in the application of desirable

difficulties. The authors hypothesized when planning activities that included desirable difficulties, the following criteria must be considered: (a) the difficulty must be specific and relevant to the task that is being tested, (b) the challenge induced by the difficulty must consider the individual's current experience, and (c) the difficulty must result in steady improvements during practice so that success is always achievable even when it is not guaranteed, and (d) the performance meets or exceeds the learner's expectations within the constraints of the third condition.

Research by Zepeda et al. (2020) discovered that knowledge about learning strategies that incorporated desirable difficulties was insufficient to motivate learners to change their behaviors. The authors reviewed five areas of psychological research in search of strategies that may increase engagement and persistence to increase the likelihood that learners implement desirable difficulties in their study. The authors suggested the following solutions: (a) increasing the perceived value of the activity or task; (b) reducing the perceived cost—the negative aspects of engaging with a task in terms of task effort, outside effort, loss of valued alternatives, and emotional—of the learner's engagement; (c) reframing the appraisals and attributions that learners make about their experience; (d) creating appropriate challenges that can be adjusted as learning progresses to encourage learner engagement; (e) providing learners with choices to engage with tasks that introduce desirable difficulties to increase feelings of autonomy and to create a learner-centered environment.

Use of Practice Aids to Enhance Learning

The availability of technology has provided a way for musicians to access practice tools that were not easily accessible before smartphone ownership and internet access became widespread. Even school-aged children now have easy access to technology. Many have their

own phones, and for those who do not, schools are now adopting 1:1 access to devices like the Apple iPad. Middle school band students in a study by Gibbs (2022) believed that using technological practice tools helped them improve their instrumental skills. Additionally, students believed that while technology did not increase their enjoyment of practice, it increased their task efficiency during practice. The students identified focus during practice as one of the most important benefits of using technological practice tools and aids.

Listening to professional recordings can be done at the click of a button through streaming services such as Spotify and YouTube, so the viability of listening to professional recordings as a practice aid warrants investigation. High school students in a study by Wilson (2023) reported that listening to professional recordings was their preferred method of acquiring an overview of solo repertoire assigned by their teacher. Cash et al. (2014) found that participants who listened to an auditory model before learning a new melody improved faster than the participants who did not. Additionally, Violotti and Williamon (2017) found that students were more likely to listen to recordings than professionals as they learned to develop their interpretation of music. Listening to recordings had a positive influence on the students' practicing and performing habits and contributed to their growing musical awareness.

Video feedback was utilized before smartphone technology made video recording accessible to virtually anyone. Herbert et al. (1998) reported that a group of female tennis players who used videotape feedback to self-evaluate showed a shift in thinking processes that resulted in marked improvement in the performance of an attack stroke. Recording technology has rapidly evolved since then, and the widespread ownership of smartphones has made video and audio recording an accessible tool, particularly because these apps come preinstalled on any smartphone. The technology to record practicing and performances is now compact and less

cumbersome to operate, so the potential for self-recording as a practice tool is also worth exploring. Boucher et al. (2020) reported that high performing college guitar majors with developed self-regulatory skills found video self-feedback helpful in evaluating their choice of practice strategy finding or finding errors in their performance.

High school string musicians in a study by Wilson (2023) reported using a combination metronome and tuner app while learning solo literature. Combination tuner and metronome apps are now easily accessible on smartphones and are especially attractive tools because they cost significantly less and have more features than a dedicated tuner and metronome device. One feature easily accessible on a sophisticated tuner and metronome app is tone generation, a function that can be used to generate drone accompaniment. Zabanal (2020) found that college instrumental music majors used drone accompaniment to improve their *intonation*, defined as the ability to play with accurate pitches. Although there is little empirical evidence that playing with drone accompaniment actually improved intonation, participants perceived it as an effective tool.

Middle school band students in a study by Gibbs (2022) identified the metronome as their most frequently used practice tool. Students felt the metronome provided them a means to develop a solid sense of rhythm, which in turn, helped them play better during ensemble rehearsals. Empirical evidence on the effectiveness of the metronome during practice is scarce, but a study by Arthur et al. (2016) found that metronome use can be detrimental to sightreading in less skilled musicians when set to excessively fast tempos.

The Skill Acquisition Approach and Its Impact on Music Education

Skill acquisition researchers acknowledged that individual differences may contribute to differences in performance (Ericsson et al., 1993; Lehmann & Davidson, 2002). Rather than pointing to inherited traits as the source of this advantage, however, skill acquisition researchers

found that enhanced physiological, cognitive, and psychomotor traits in top performers were acquired through many hours of practice. Lehmann and Davidson (2002) cited a 1988 study by Wagner that reported a difference in the angle of arm rotation between pianists and violinists to further illustrate how the habitual movement patterns demanded by tasks can alter physiology. Syed (2010) debunked a claim by Entine (2001, as cited in Syed, 2010) that Blacks are naturally superior runners by looking at one particular region in Africa that produced champion distance runners. Syed noted that top Kenyan athletes were predominantly from areas of high altitude, a training condition many elite marathon runners use to force the body to adapt to thin air by producing more oxygen-carrying red blood cells. In addition to the environment, Kenyan children also run long distances as a necessity. They run to attend school because of the absence of public transportation, resulting in more than six thousand hours of cumulative running by the time they turn 16 years old. Similarly, a healthy human brain also adapts to the demands of the environment. Brain scans of licensed London cab drivers revealed a correlation between an increase in gray matter in the posterior hippocampus, a feature associated with spatial representation of the environment, and the number of years of experience (Maguire et al., 2000).

In contrast, some studies point to genetic traits that predispose an individual to advantages in performance. Ilardo et al. (2018) studied the extraordinary ability of the Bajau, a nomadic sea people from Southeast Asia, to hold their breath underwater when diving for food deep in the ocean. The authors discovered that the Bajau's enlarged spleen, an organ that functioned as a reservoir of oxygenated red blood cells, was present in both divers and non-divers. This led researchers to conclude the enlarged spleen was a genetic adaptation that evolved over thousands of years. Some researchers even argued that the propensity to practice was genetically influenced. Although Hambrick and Tucker-Drob (2015) acknowledged

deliberate practice contributed to skill acquisition, they presented evidence from a study of over 800 pairs of twins that children who possessed genetic propensities for music were more likely to engage in dedicated music practice. Similarly, Mikzsa (2006) found a significant interaction between impulsiveness and performance achievement. In a study that investigated the relationship between practice effectiveness and individual differences, students in the low impulsiveness group significantly outperformed students in the high impulsiveness group, suggesting that less impulsive students used their practice time wisely and produced better results.

Despite conflicting results on whether skill was a product of genetic traits or training, what justifies adopting a skill acquisition approach to teaching? Yuen (2021) reported that five percent of college violin professors attributed failure as a potential violin performance major to a lack of talent, while 26 percent of respondents thought that potential violin performance majors can be taught to develop the abilities to meet collegiate standards. Additionally, participants recognized the need for potential violin majors to develop a solid technical foundation by studying with private teachers who were also professional violinists. Lehmann and Davidson (2002) advocated the skill acquisition approach to teaching primarily because it allowed music educators to design instruction based on factors they can influence, such as practice habits and strategies. Although several researchers argued that some factors that influence skill acquisition are hidden and beyond control (Hambrick et al., 2020; Hambrick & Tucker-Drob, 2015; Kulasegaram et al., 2013; Miksza, 2006), researchers have also provided evidence that teaching students how to practice can make a positive impact on proficiency (Meidner & Bugos, 2017; Miksza, 2015; Prichard, 2021). Scripps et al. (2013) went further by asserting the concept of talent as an innate ability rather than an ability that can grow may be the chief obstacle in an

equitable form of music education. They advocate the reexamination of music education policy that redefines the idea of skill as something acquired:

> Without a critical examination of where expertise comes from, "talent" could become a self-fulfilling prophecy that can be used too easily to demonstrate to children that it is not worth trying to learn something difficult, something that does not come naturally, something that requires a commitment to countless hours of practice from which only the "talented few" will profit. (55)

Summary

Research on skill acquisition and human performance has been conducted since the late 1800s. Studies by Ebbinghaus (1885, as cited in Proctor & Dutta, 1995) established that mental processes can be objectively observed and quantified in experimental settings. Following Ebbinghaus' groundbreaking studies, more research emerged to explain human skill acquisition through the information processing approach. One such theory is Fitts and Posner's (1967) phases of skill learning. The theory suggests that skill is acquired in distinct phases, namely, cognitive or early, associative or intermediate, and autonomous or final.

Fitts and Posner's research on skill learning was based primarily on the observable behavior of laboratory subjects and interviews with teachers. Recent advances in medical imaging technology have created new possibilities for studying the association between observable behavior and concurrent brain activity. But even before brain imaging studies provided evidence of the viability of Fitts and Posner's theories, the three-phase skill learning model had already been successfully applied to different domains, including sports science. Despite similarities between sports and music, Fitts and Posner's phases have not been applied to studies in skill acquisition in music, even when the practice of dividing the learning process into

several phases is not new. Researchers have studied how musicians learn a new piece of music in phases to examine practice behaviors at different points in time. The current study will use Fitts and Posner's three phases of skill learning as a memory aid when interviewing string performance majors about their process of learning a piece from sightreading to performance.

The area of expert performance study was relatively unexplored until the work of Ericsson et al. (1993) coined the term *deliberate practice*, an effortful, goal-directed activity specifically intended to improve skill in a domain with an already established method of effective training techniques. While deliberate practice offered an optimistic view of skill as achievable by anyone, many have criticized the validity of deliberate practice as a scientific theory for explaining expert performance. The main argument against deliberate practice was its failure to address the influence of innate traits on the development of skill. Harwell and Southwick (2021) argued that many of the objections to the theory of deliberate practice were based on misconceptions about the research of Ericsson et al. (1993).

Despite the ongoing debate on what truly predicts expert performance, proponents of the skill acquisition approach argued that teachers can best influence students' skill development by systematically teaching practice skills rooted in research. Scripp et al. (2023) went further by saying that music education policy must redefine talent as developed proficiency rather than a hereditary aptitude. Otherwise, it becomes a self-fulfilling prophecy that discourages students from pushing past the difficulties of music study because they were not naturals.

Chapter 3: Methods of Procedures

Research Design

The purpose of this study is to examine how freshman, senior, and graduate string performance majors learn a solo piece at different points in their preparation timeline, from sightreading to performance. According to Yin (2017), case study research is most appropriate when investigating a contemporary phenomenon within a real-life context that may yield more variables of interest than mere data points. Merriam (1998) asserts that case study is a particularly appropriate design when the researcher is interested in a process. Since the process of preparing for a musical performance is a highly individualized activity, investigation into this phenomenon may yield a wide variety of responses best presented through a descriptive collective case study. Following Merriam's (1998) procedure, each case will be presented individually using rich, "thick" descriptions of the phenomenon, a process called *within-case* analysis. The second level of analysis involves *cross-case synthesis,* where findings across all cases are examined. Yin (2017) cautioned researchers from using the data reduction approach typical of quantitative data analysis during cross-case synthesis. Rather, he advocated that researchers retain a holistic view of the entire case when comparing or synthesizing across cases.

Case studies require multiple sources of evidence to establish construct validity (Yin, 2017). To satisfy this condition, each participant submitted a total of three 20- to 30-minute practice videos of the same solo recorded during the early, intermediate, and final phases of preparation and completed a 30-minute interview after submitting the final practice video. I requested a scanned copy of each participant's solo to examine annotations. Additionally, if a participant kept a practice journal, I requested an electronic copy or image of journal entries on the dates practice videos were recorded.

Interview Protocol Development

I created a semi-structured interview protocol for an unpublished study (Wilson, 2023) using the Interview Protocol Refinement (IPR) framework by Castillo-Montoya (2016) and adapted it for the current study. This framework approached the formulation of interview questions in two phases: (a) ensuring that interview questions align with research questions and (b) constructing an inquiry-based conversation. I used a matrix to map interview questions that have a possibility of eliciting answers to my research questions to satisfy the first phase, and formulated open-ended questions that have a better probability of encouraging a rich narrative for the second phase. I included a menu of prompts to encourage more conversation.

I shared the original interview protocol with several professional music educators to evaluate its face validity and conducted a pilot study with a participant from the target population. I made modifications to the original interview protocol, primarily to questions designated as "warm-up" and musical background, to better suit the target population of the current study. I included questions about participants' perceptions of learning how to practice from their applied music professors. In addition, I included prompts that allowed me to ask questions about the practice behaviors of interest in their video recordings. All research methods and procedures were approved by the Auburn University Institutional Review Board (IRB).

Participants

All participants are undergraduate and graduate string performance majors who were at least 18 years of age and enrolled in a performance degree or certificate program in the United States (see Table 1). Participants were in the sightreading or early phases of preparation of a solo piece when the study began. I recruited a total of 7 participants—two freshmen, one senior, and four graduate students—from a diverse list of colleges and universities that varied in size and

setting, control (public or private), and admission selectivity. The instruments represented in the sample were violin (*n*=3), viola (*n*=1), cello (*n*=2), and bass (*n*=1). Four participants were female and three participants were male.

Table 1

Participant information

Participant (pseudonym)	Sex	Instrument	Level	Ethnicity	University control	University size	Admission pre-screening
Michelle	F	Cello	Freshman	White	Private	25,000+	Yes
Sandra	F	Cello	Freshman	White	Public	45,000+	Yes
Edward	M	Violin	Senior	Asian	Private	700+	Yes
Samantha	F	Viola	Graduate	White	Public	35,000+	No
Henry	M	Violin	Graduate	Mixed	Private	7500+	Yes
Sonia	F	Violin	Graduate	Hispanic	Public	15,000+	No
James	M	Bass	Graduate	White	Private	100+	Yes

Note: $N = 7$. Information about music schools from the National Association of Schools of Music [NASM]. (n.d.), Carnegie Classification of Institutions of Higher Education (2021), and individual school websites.

Sandra, Undergraduate Freshman

Sandra, an 18-year-old White female, is a cello performance major in her first year of undergraduate study at a large public university in the Midwest. She began private lessons on the cello when she was five years old. She participated in the public school orchestra program while supplementing her instrumental music education with private lessons and orchestra membership through a conservatory preparation program. Sandra hopes to be employed as a professional

symphony musician upon graduation, though she recognizes that professional performers must be prepared to fulfill other roles, such as teaching, throughout their careers.

Michelle, Undergraduate Freshman

Michelle is a 19-year-old White female who is majoring in both cello performance and music education. She studies at a private, not-for-profit music institution in the Mid-Atlantic where prospective undergraduate performance majors are required to audition with selections from the school's prescribed repertoire list. Cello performance is one of the handful of majors that requires a recorded pre-screening audition. She began playing the cello when she was in the 5th grade by studying with a private teacher. She shared that while her career goals change periodically, she hoped to have a career as a chamber musician and music teacher.

Edward, Undergraduate Senior

Edward is a violinist in his fourth year of study at a small not-for-profit conservatory in the Northeast. He is a 22-year-old male of Asian descent who has been studying the violin privately since he was four years old. He attended the public school system and participated in his school orchestra program beginning in the 5th grade. Even as an undergraduate senior, Edward already showed great promise as an orchestral musician and soloist. He has performed with several elite youth orchestras that have embarked on concert tours outside the United States. He was recently awarded a chamber music fellowship to perform at a prestigious and highly selective summer music festival. Edward plans to continue violin study at the graduate level and hopes to pursue a career as a symphony orchestra concertmaster and soloist.

Henry, First Year Graduate Student

Henry is a 23-year-old master's degree student majoring in violin performance at a private, not-for-profit university in the South Central United States. Admission to this university

as a performance major is highly selective and requires a pre-screening audition. He completed an undergraduate degree in violin performance at a private, not-for-profit university in the Northeast that also requires a pre-screening audition of prospective performance majors. He is male and identifies as both White and Hispanic. Henry grew up in a musical household with parents who are professional musicians and began playing violin under their tutelage when he was only four years old. Henry's primary reasons for attending graduate school were his desire to learn a different perspective of violin playing from a different teacher and to gain a deeper understanding of the repertoire he needed to learn for orchestral auditions. He shared during the interview that he was preparing for an audition for a symphony orchestra in the Southern United States.

Stephanie, First Year Graduate Student

Stephanie is a 36-year-old master's degree student majoring in viola performance. She began private study on the violin at age six and transitioned to viola in the 10th grade. She is a White female in her first year of study at a state-supported public university in the Northeast. She returned to graduate study after a 13-year gap, previously earning an undergraduate degree in viola performance from a private not-for-profit institution in the Northeast. An unsuccessful audition for a local orchestra left her feeling she was stagnating as a performer and prompted her to go back to school. "It was the first time I really felt like I was really prepared…I was sounding at a professional level…and I didn't get it…the adjudicators said that my playing was really good…except it lacked finesse." Stephanie's career goals include winning a position in one of the local orchestras and teaching applied music lessons at the university level.

Sonia, Second Year Graduate Student

Sonia is a female master's degree student majoring in violin performance at a state-run university in the Northeast. She is a 29-year-old international student who earned her bachelor's degree in violin performance from a state university in Mexico. She came to the United States to study after she met her current university's string faculty members during a concert tour in Mexico. Her primary motivation for pursuing a graduate degree was her desire to earn an orchestral position in her home county. "When I finished my undergrad degree, I tried… auditioning for orchestras, for jobs, and I kept finding myself not passing the first round, like, constantly. So I just realized I'm not at the level I need to be yet. Like, I need to keep working. I need to be learning more." When asked about future plans, Sonia was undecided about going back to Mexico to begin auditioning for orchestral positions or pursuing a Doctor of Musical Arts degree in violin performance, either in the United States or in Mexico.

James, Second Year Graduate Student

James is a 24-year-old White male in his second year of graduate study in double bass performance. While still a student at a highly selective not-for-profit institution on the West Coast, James is already an accomplished musician, having been invited to perform as a chamber music fellowship recipient at a prestigious summer music festival. He also performs as a substitute musician for one of the major symphony orchestras in the United States. He recently won a titled position in one of the major symphony orchestras in the United States, a few months before his graduation. He earned his bachelor's degree in double bass performance from one of the most prestigious music schools on the East Coast. He began double bass study through the public school system when he was ten years old and immediately began private lessons the following summer.

Sampling and Recruitment

I used purposeful sampling to select participants. I sent recruitment materials to faculty contacts at each of the selected institutions for distribution to potential participants who meet the general eligibility requirements. Each recruitment packet included an information letter, interview protocol, and instructions on recording and uploading practice videos. I offered financial incentives to increase the likelihood of recruiting participants (Dillman et al., 2014). Participants received $100 as an Amazon gift card sent through email or direct payment into their Venmo cash app account. Participants also received one set of Kaplan Solutions professional strings for their respective instruments through a generous donation from D'Addario Strings. The voluntary nature of this study allowed participants to opt out at any time, but only participants who completed all component activities of the study received compensation. Interested students contacted me directly through email, text message, or phone to confirm their participation and receive instructions on how to record and upload practice videos. The Auburn IRB approved a Waiver of Documentation of Consent since participants were all legal adults who did not belong to a vulnerable population. Participants scheduled a Zoom interview with me after submitting the final practice video.

Practice Video Procedures

Participant practice videos were my primary source of data. (Morgan et al., 2017; Yin, 2017). Participants selected one solo piece in the sightreading or early phases of study to use in the recorded practice sessions. Each participant submitted a 20- to 30-minute practice video recorded during each of Fitts and Posner's phases of learning: cognitive or early, associative or intermediate, and autonomous or final. According to Fitts and Posner (1967), learners move through the phases of learning at different rates, with the speed of progress largely dependent on

the complexity of the task and the skill of the learner. Some researchers who observed or interviewed musicians about practice behavior over time assigned specific numbers of practice sessions to a particular phase of learning or stage of practice (Chaffin & Imreh, 1997; Marin et al., 2014; William and Valentine, 2000). Recognizing that participants will move through the study of a solo at different rates, I did not designate a particular number of sessions for each phase of learning for the current study. I allowed participants to determine when they progressed through each phase by providing descriptions of typical behaviors in each of Fitts and Posner's (1967) phases of learning (see Table 2).

Table 2

Guide for participants to determine phases of learning for video recordings of solo repertoire practice sessions

Phase of Learning	Descriptions of Typical Behaviors
Early	Movements are slower and less fluid
	Step-by-step thinking when playing passages
	Many mistakes
Intermediate	Movements are faster and more fluid
	Movements executed without thinking too much
	Fewer mistakes
	Using current skills to problem-solve
Final	Play fluidly without much thought
	Less likely to be disrupted by distractions

Note: From the phases of skill learning by Fitts and Posner (1967)

I required participants to record their first video during the initial reading of the piece or any practice session thereafter, where participants were still familiarizing themselves with the solo. Participants recorded their second video when they determined they had progressed beyond

the familiarization phase (Wilson, 2023). Because the majority of practice time is spent in the intermediate phase (Fitts & Posner, 1967), this phase likely had the most variability in the number of practice sessions. Participants submitted their final video when they began polishing the piece for performance. I instructed participants to practice as they would normally. I emphasized to the participants that they were welcome to provide commentary while recording, if it would not distract them from practicing as usual. I instructed participants to shoot videos in standard definition to keep the file sizes small, but I did not ask them to convert any video files, as this additional step may have affected their willingness to participate.

Interview Procedures

I emailed each participant a Zoom meeting invitation when we agreed on a date and time for the debriefing interview. I used the following security features on Zoom to prevent unauthorized users from joining the meeting: (a) each participant received a unique Zoom meeting ID, (b) all Zoom users were required to log in, (c) participants stayed in the virtual waiting room until I admitted them into the meeting room, and (d) after admitting the participant, I locked the meeting to keep out unauthorized users. After confirming I had permission to proceed and record the interview, I asked questions from the available prompts in the approved interview protocol. I also formulated additional questions based on observations from practice videos. When I found interesting data in the participant's practice videos, particularly if the participant did not provide commentary during the practice video, I played these video clips during the Zoom interview to allow the participant an opportunity to offer more context (Liu, 2024; Miksza & Brenner, 2023).

Participant Confidentiality and Data Security

In studies where the researcher engages in detailed conversation with the participant about their lived experience, there is always a risk of breach of confidentiality (Ravitch & Carl, 2016). To minimize the risk, I did not address the participants by their real names whenever the interview was being recorded. I removed identifying information in the written transcript and final report and referred to students with pseudonyms. Upon completion of the interview transcription, I uploaded the audio recordings of the interviews to AU Box, a secure cloud service approved for the storage of data with identifying information, and deleted these files from my computer. Digital copies of interview transcripts stored on my computer and printed copies filed in my research binder did not have identifying data.

Students uploaded practice videos to AU Box using a unique file upload link to their individual folders. Although this link allowed participants to upload videos, the link did not allow them access to the folder that stored their videos. As an added privacy measure, I accessed practice videos through AU Box only and did not download copies to my laptop. In certain instances when I had to download practice videos to my laptop to convert them into a different format, I deleted the video from my laptop as soon as I uploaded the converted video to AU Box. I mailed professional string sets donated by D'addario Strings directly to the participants using the mailing address they provided during the interview. D'addario did not have any contact with participants or access to participants' contact information.

Some participants had difficulty uploading their videos through the AU Box file upload link. At the suggestion of the Auburn data librarian, I filed a modification request to allow participants alternative methods of submitting videos if AU Box uploads failed. I presented the following alternatives to participants: a) upload videos to a Cloud storage service of their choice

and allow access to download their videos through an emailed link; b) upload to YouTube as an unlisted video and email a link to the video; and c) mail a USB thumb drive that plugged directly into their phone in a padded envelope with prepaid postage and tracking to send back materials when all videos have been recorded.

Data Analysis Procedures

According to Ravitch and Carl (2016), qualitative data can be analyzed both deductively and inductively. The *deductive* approach involves looking into previous research to inform the analysis of new data. When taking the *inductive* approach, on the other hand, the researcher relies on the data itself to create codes. It is not unusual in qualitative research to use a strategic combination of both deductive and inductive approaches to coding during multiple readings of the data (Ravitch & Carl, 2016). I created open codes based on the theory of deliberate practice (Ericsson et al., 1993), the phases of skill learning (Fitts & Posner, 1967), and the skill acquisition approach (Lehmann & Davidson, 2002; Scripps et al., 2013) and entered these codes in my qualitative analysis software of choice ATLAS.ti. In addition, I created open codes using the sequential and global dimensions of the Felder-Silverman (1988) learning styles and Chaffin and Imreh's (1997, 2001, 2002, 2023) dimensions of musical focus, and data collected during practice video observation and interviews.

Based on my findings in an unpublished pilot study, I used the sequential and global dimensions of the Felder-Silverman (1988) learning style model to determine each student's general approach to learning a new piece. First conceptualized to improve engineering education, it categorized students into four dimensions that corresponded to how they received and processed information. *Sequential learners* follow linear thinking processes and learn in small incremental steps. They learn best when the material is presented with increasing complexity,

and their approach to problem solving involves logical and stepwise paths. *Global learners*, on the other hand, approach learning holistically and sometimes perform better when they can jump directly to working on difficult and complex material. For a global learner, seeing the "big picture" is necessary for success.

Musicians are confronted with many details that compete for their attention when learning a new piece of music. Using video recordings of multiple practice sessions of an expert pianist to document the process of learning a new solo for performance, Chaffin and Imreh (1997, 2001, 2002, 2003) determined a musical work had four dimensions that required attention during practice and performance: (a) basic, (b) interpretive, (c) performance, and (d) formal structure (see Table 2). The *basic dimensions*—familiar patterns, fingerings, and technical difficulties—require attention for a musician to be able to play the notational elements of a composition. The *interpretive dimensions* included elements such as dynamics and phrasing that shape the musical

character of the piece. The *performance dimension* included basic, interpretive, and expressive cues that enabled successful and effortless retrieval of highly practiced movements from long-term memory while also allowing a level of automaticity to reduce the cognitive load as the performance was underway. The *formal structure* was the division of the piece into smaller sections based on similar or dissimilar thematic content or musical character.

I used Chaffin and Imreh's (1997, 2001, 2002, 2003) dimensions of musical focus to analyze and interpret each participant's learning process at each phase of learning (see Table 3). The authors analyzed the practice process using a combination of practice behavior observation and listening to the performer's commentary during practice sessions. While it was difficult to differentiate between practice behaviors focused on basic and interpretive dimensions from those

Table 3

Dimensions that require attention while learning a new piece of music for performance

Basic			
	Fingering (non-standard choices on which fingers to use to play notes)	Technical difficulties (places requiring attention to motor skills)	Familiar patterns of notes (e.g., scales, arpeggios, chords, rhythms)
Interpretive			
	Phrasing (grouping of notes to form musical units)	Dynamics (changes in loudness or emphasis of a series of notes to form a phrase	Tone color (the interaction of principles of sound production—bow pressure, speed, sounding point—and the type of vibrato to produce the desired sound
Performance			
	Basic cues (familiar patterns, fingering, and technical difficulties)	Interpretive cues (phrasing, dynamics, tempo, and tone color)	Expressive cues (emotion to be conveyed during performance)
Musical/formal structure			
	Section boundaries (beginnings and ends of musical themes, dividing the piece into sections and sub-sections)	Switches (places where two or more repetitions of the same theme begin to diverge)	

Note. Adapted from "Practicing Perfection: Piano Performance as Expert Memory," by R. Chaffin and G. Imreh, 2002, *Psychological Science, 13*(4), p. 344. Copyright 2002 by the American Psychological Association

focused on performance dimensions, practice activities that strengthened the ability to retrieve practiced movements from long-term memory were an important feature of practicing with a focus on performance (Chaffin & Imreh, 2001). Chaffin and Imreh (1997) also noted that a

performer can use the formal dimensions of a piece as a retrieval scheme when playing music from memory. For this study, I did not differentiate between various retrieval schemes when determining if participants were practicing with a focus on performance dimensions; rather, I counted every attempt at simulating a performance scenario as a focus on performance dimensions.

Morgan et al. (2017) advocated for case study research where observational data is the focus, even when multiple sources of data are used, because it allows for research to center around activities in their naturally occurring contexts. This framework requires observational data to be collected and analyzed before collecting interview data. Even when collecting multiple types of evidence, I used videos of practice sessions as my primary source of data. I uploaded observation notes from these practice videos into ATLAS.ti and developed additional codes from them. Additionally, I used these notes to create a descriptive account of participants' practice room behaviors.

Høstgaard and Bertelsen (2012) found the use of video observation methods to be superior to other ethnographic research techniques in disclosing the complexity of clinical work practice. Additionally, Morgan et al. (2017) reported that the use of self-recorded videos allows the researcher to observe in a non-participant role, increasing the likelihood that participants will behave normally. While participants in a study by Høstgaard and Bertelsen (2012) initially performed work tasks "by the book" when being filmed, their behavior became less affected by the presence of observers when the participants were informed about the study's objective beforehand. Following this recommendation, I created documents that clearly explained the objectives and participant expectations for the current study and sent them to potential participants before they committed. I also shared a copy of the interview protocol with potential

participants to become familiar with the study objectives and see the questions in advance in an effort to create a sense of ease and trust.

Høstgaard and Bertelsen (2012) asserted that video observations have an advantage compared to personal observation and field notes in that videos can be reviewed multiple times. Potentially, each time a video is reviewed, an observer may notice something new, but it is the nature of video observation that may create problems. Høstgaard and Bertelsen (2012) also warned that because video observations can provide incredibly rich data, it is possible to spend too much time and resources on data analysis by setting a range of objectives that are unclear or too broad in scope. Researchers must set clear objectives and delimitations on which settings and behaviors to observe to avoid wasted time and effort.

I used previous studies (Chaffin & Imreh, 1997, 2001, 2002, 2003; Liu, 2023; Miksza & Brenner, 2023) as models of instrumental music practice analysis for setting clear expectations and delimitations on behavior observation (Høstgaard and Bertelsen, 2012). The common elements shared by the aforementioned studies were the use of specific terminology and clear descriptions of practice behaviors. For example, in determining how a professional pianist prepared a solo work for professional performance, Chaffin and Imreh (1997, 2001, 2002, 2003) made a distinction between a *run*—a practice segment or sequence of segments that covered more than two sections of a piece—and *work*, practice segments with an interruption and three or more repetitions of the same passage. Miksza and Brenner (2023), on the other hand, listed specific practice activities and behaviors that constituted a particular strategy. The studies by Chaffin and Imreh (1997, 2001, 2002, 2003) and Miksza and Brenner (2023) focused on quantifying the frequency of behaviors. While Liu's (2023) study had some quantitative elements, it focused on describing participant behaviors observed on video recordings. Following

Liu's (2023) method, I documented the frequency of relevant behaviors to inform my findings while emphasizing descriptive information. I obtained an unmarked copy of each participant's chosen solo work, which I used to follow along while watching practice videos.

Audio-visual documentation of practice behavior has become easier and more cost-effective with the invention and widespread ownership of smartphones with high-quality audio and video capabilities. As an added benefit, participants used personal devices, eliminating the need to train them on how to use specialized recording devices. When using video to document participant video, a researcher must mitigate the impact of a phenomenon called the camera or observer effects that may alter participant behavior when they are aware that their behavior is being recorded or observed (Barron, 2007; Becker & Martinique, 2014). While the impact of the camera or observer is impossible to eliminate, von Lehm and Heath (2007) suggested that researchers consider placing equipment to minimize its obtrusiveness while also positioning and focusing the camera so that it captures activity without requiring the researcher to operate the camera.

As I completed each interview transcription and verified its accuracy with the participant, I uploaded each transcript without identifiable data to ATLAS.ti, applied previously established codes to the transcript, and created more open codes as needed. I highlighted quotations, keywords, and phrases of interest in the interview transcripts and coded them appropriately to find trends and recurring themes. I combined the preliminary codes from the observational and interview data, determined which codes were closely related, and grouped these codes into thematic clusters based on shared characteristics. From these thematic clusters, I narrowed the data down to overarching themes.

Trustworthiness and Reliability of Data

I used strategies suggested by Ravitch and Carl (2016) and Yin (2017) to ensure the trustworthiness of the data. I used multiple sources of evidence—observations, interviews, and artifacts—as a means to triangulate information. Additionally, I used findings from multiple studies that both support and challenge my findings as a means of theoretical triangulation. I employed dialogic engagement to establish the trustworthiness of data collected from the interview. I developed my interview protocol by working with peer reviewers and an expert advisor. I employed participant validation strategies and conducted them through e-mail. During the participant validation process, I provided the participants with an electronic copy of the interview transcript without identifying data, invited them to contact me if they needed to add or clarify details after reading the interview transcript, asked follow-up questions when I needed more information or need clarification about certain responses, and confirmed the transcript accurately reflected the details of our conversation.

Creswell and Poth (2018) described memo writing as documentation of ideas and thoughts that occur to the researcher. Memo writing can be used to document changes in thought processes as the researcher learns more about the topic. I used the memo function of ATLAS.ti to keep a running account of how my understanding evolved. In addition to using ATLAS.ti to formulate codes and highlight interview data that fit existing codes, I printed and bound a copy of the interview transcripts without identifiable data. I used the printed transcripts to write memos and notes about important themes. I eventually transferred these notes as a memo entry in ATLAS.ti. I read through each interview several times and added new insights as a memo on ATLAS.ti.

Ravitch and Carl (2016) encouraged the practice of multiple coding. In this process, multiple researchers examine the same data to arrive at a shared understanding and to jointly develop and refine codes. I used ChatGPT 4.5 as a virtual research assistant to fulfill this requirement for data reliability. ChatGPT 4.5 has a wider knowledge base and is better at more nuanced tasks, such as writing, compared to its predecessors. Additionally, its improved capability to follow user instructions, draw connections, and recognize patterns can be useful in tasks such as improving writing (OpenAI, n.d.).

ChatGPT is an intelligent chatting robot developed by OpenAI that uses Natural Language Processing capabilities. While ChatGPT was found to be unreliable in writing and synthesizing literature reviews, it showed potential as a tool for analyzing qualitative data when provided with appropriate prompts and commands (Lee et al., 2024; Li et al., 2024; Rahman et al., 2023). It can provide detailed responses to prompts and learns through a combination of reinforcement learning algorithms and human feedback (Dowling & Lucey, 2023; Wu et al., 2023). Davis (2023) cautioned that while it lacked the ability to find nuanced themes, it was successful at reproducing concrete, descriptive themes. These studies highlight that although AI is a powerful tool that can aid in research, it is only a tool and not a replacement for human involvement.

The use of Artificial Intelligence (AI) in scholarly research is relatively new and not yet widely accepted (Rahman et al., 2023), but recently, more academics have been advocating for its use to improve academic writing and productivity (Vassallo, 2024; Zhao, 2023). Additionally, AI has been used to enhance tasks specific to qualitative research, such as thematic analysis (Katz et al., 2024; Lee et al., 2024; Morgan, 2023; Yan et al., 2023) and qualitative coding (Li et

al., 2024). Bijker et al. (2024) found ChatGPT to be reliable in assisting with qualitative analysis, particularly when creating an inductive coding scheme from emerging data.

AI was generally considered a useful tool for editing (Da Veiga, 2025). I used ChatGPT, trained with FastTrack Mentor's PEER writing process for evidence-based academic writing as an editing tool. I uploaded individual chapters into ChatGPT with the prompt, "Read the uploaded text and provide suggestions for clarity and logical flow of each paragraph." While I did not copy ChatGPT's suggestions verbatim, I rewrote its suggestions in my own voice whenever appropriate.

While also a powerful research tool, generative AI, on the other hand, should be used with caution and with human oversight because of documented issues such as bias and the generation of inaccurate information known as *hallucinations* (Da Veiga, 2025). Additionally, AI cannot be listed as coauthors nor be held accountable for generating false information, making human authors still primarily responsible for fact- and reference-checking AI-generated information (Leung et al., 2023). For these reasons, I completed my own analysis of interview transcripts and video observation notes prior to running a separate analysis using ChatGPT 4.5.

I used a protocol developed by Kruikow (2024) to generate open and focused codes from interview transcripts and video observation notes. Li et al. (2024) used a similar process to test the reliability of ChatGPT 4.0 to generate open codes, subthemes, and themes from interview data. As I completed video observation and interview data collection from each participant, I uploaded deidentified interview transcripts and observation notes into ChatGPT 4.5. During the first phase of ChatGPT coding, referred to as the *naïve phase*, Li et al. (2024) recommended using generalized prompts that did not require ChatGPT to have specialized knowledge about the

research topic. I used the following prompt to perform the initial coding of each participant's interview transcript:

> I will upload an interview transcript with a music performance major where I asked questions about the participant's approach to preparing a piece for performance at three different phases of learning (cognitive or early, associative or intermediate, and autonomous or final). I also asked questions about how the participant's applied music teacher provided guidance on preparing a solo piece for performance. I want you to review this transcript and code it (a code is a unit of analysis in qualitative research) as if you were a qualitative researcher. I want you to use descriptive codes that are detailed, self-explanatory, and specific but not too wordy. The participant's name is _____, and the interviewer's name is Nile Wilson. I want you to code the participant's accounts, reported experiences, opinions, and comments. As the output, I want you to provide a list of codes you created, and under each code, I want you to provide a full segment of text (e.g., a sentence or part of a sentence) to which this code was applied.

I used the following prompt to perform the initial coding of observation notes from each participant's practice session video:

> I will upload observation notes of a music performance major's video practice sessions where the participant is practicing a new solo piece at three different phases of learning (cognitive or early, associative or intermediate, and autonomous or final). I want you to use descriptive codes that are detailed, self-explanatory, and specific but not too wordy. I want you to code the participant's accounts, reported experiences, opinions, and comments. As the output, I want you to provide a list of codes you created, and under each code, I want you to provide a full segment of text (e.g., a sentence or part of a

sentence) to which this code was applied. When you create the codes with their associated quotes, I want you to separate them into the three phases of learning mentioned earlier.

After completing the initial coding for each participant, I asked ChatGPT to organize the codes from the interview and observational data without their associated quotes to prepare for focused coding. I copied and pasted the output from all participants into a single Microsoft Word document for focused coding. Once the initial codes had been copied to this document, I uploaded it into ChatGPT and asked it to group similar codes into thematic clusters and determine overarching themes from these thematic clusters. After ChatGPT completed its analysis, I reflexively compared its output with mine, reviewing similarities and differences. Li et al. (2024) found moderate alignment between ChatGPT 4.0 and human researchers in identifying key themes in qualitative interview data. ChatGPT 4.0 has also demonstrated the ability to capture nuance and emotional content in qualitative data, making AI useful in augmenting human analysis. Researchers agree, however, that ChatGPT must be used to complement rather than replace human analysis (Lee et al., 2024; Li et al., 2024).

Since I asked participants to answer questions about past events, recall bias was a threat to the trustworthiness of the data. Bhandari and Wagner (2006) recommended that recall periods should not stretch further than 12 months in the past to reduce recall bias. Participants chose solo repertoire that was in the very early phases of preparation at the beginning of the current study, and a target performance date within the Spring 2025 semester. This timeline ensures that at most, participants will be answering questions about a piece they have prepared during six months, well below the 12-month threshold. Bhandari and Wagner (2006) also recommended the use of memory aids such as landmark events to encourage more accurate recall. During the

interview, I used the three phases of learning by Fitts and Posner (1967) as a memory aid because it set specific landmarks during the preparation of a solo for performance. The specific timelines I set were the cognitive, associative, and autonomous phases of learning. I operated on the assumption that participants would not be familiar with Fitts and Posner's phases of learning, so I substituted the terminology with vocabulary more familiar to the participants. I used the terms *beginning* or *early* for the cognitive phase, *intermediate*, *building*, or *working* for the associative phase, and *late, final, polishing,* or *performance-ready* for the autonomous phase. While memory aids have not been widely tested, the results are promising (Bhandari & Wagner, 2006).

Conclusion

The purpose of this study is to examine how string performance majors learn a solo piece from sightreading to performance using the skill acquisition approach (Lehmann & Davidson, 1997; Scripps et al., 2013), the theory of deliberate practice (Ericsson et al., 1993), and the Fitts and Posner's (1967) phases of skill learning as its theoretical framework. The review of related literature included a brief history of cognitivist information processing theories. Additionally, I discussed each component of the theoretical framework in detail and provided studies that both supported my points and provided contrary arguments. The current study will fill the gap in the literature by providing insight into skill acquisition activities of string performance majors using Fitts and Posner's (1967) phases of learning, a theory that has demonstrated validity and reliability across multiple domains over many decades of research.

Chapter 4: Findings

Past research recognized the need to develop systematic ways of teaching practice skills tailored to its target population, making it necessary to learn more about the practice habits of various groups of students. The current study attempts to fill this research gap by using a well-known cognitivist skill learning theory to examine how a group of advanced string instrumentalists learn a new solo at different points in their preparation process. Skill development in both music and sports share many common elements, making Fitts and Posner's (1967) phases of skill learning an appropriate theoretical framework for the study of skill development in musicians.

The purpose of this study is to examine how string performance majors learn a solo piece from sightreading to performance at different points in the preparation timeline that correspond to the three phases of learning by Fitts and Posner (1967): cognitive or early, associative or intermediate, and autonomous or final. I examined how freshman, senior, and graduate level string performance majors ($N = 7$) learned solo repertoire from sightreading to performance. I recruited participants from a diverse list of institutions that varied in size and setting, control (public or private), and admission stringency. This chapter presents findings from observational and interview data of each participant's process of learning a new solo for performance during the Fall 2024 or Spring 2025 terms. My goal was to find answers to the following questions through descriptive collective case study research:

1. How do freshman, senior, and graduate string performance majors practice solo repertoire during the early, intermediate, and final phases of preparation?
2. How do students measure progress?
3. How do students handle errors during practice?
4. What practice strategies do students use and why?

5. If students change their practice approach and strategies at different phases of preparation, what are the factors that drive this change?
6. What are students' perceptions of how their applied music professor teaches practice skills?
7. To what extent do students in different years of university enrollment vary in their approach to learning a new solo piece?

Within-Case Analysis

Sandra, Freshman Undergraduate

Sandra chose the second variation of Adrien-François Servais' *Caprice sur des motifs de l'opéra Le Comte Ory, Op. 3,* a virtuoso piece based on themes from Giacchino Rossini's opera *Le Comte Ory.* Servais was an early 19th century Belgian cellist and composer. He was probably the finest cello virtuoso of his day, captivating European audiences with his powerful sound and acrobatic technique (Piere, 2001). The second variation of the caprice is a virtually non-stop showcase of virtuoso technique, such as fast double stops and arpeggios executed with rapid-fire off-the-string strokes called *sautillé.* Changes in clef, and consequently, register occur very frequently in this variation.

Cognitive or Early Phase.. Sandra recorded her sightreading session on January 29, 2025 with an anticipated performance date in April 2025. Before playing the piece on her instrument, she listened to several professional recordings while following along with the score. In addition to listening to recordings of different artists playing her solo, Sandra's teacher directed her to listen to opera arias by Rossini and Mozart to understand the style better as she developed her interpretation.

Sandra played through the first nine measures of the piece slowly, but it was immediately apparent that she had the technical skill to configure her fingers in the correct shapes. The next

16 measures are peppered with triple stops on the left hand and rapid string crossings on the right. Sandra tuned each triple stop as blocked chords and later returned to this section to add the string crossings with the bow arm. Before she looked at the section more deeply, she said, “I think I’m going to go through and find patterns in the music so I can do slow practice without being overwhelmed by all the notes.” She also mentioned that since this section had her playing in thumb position, the cello’s highest range, it was important for her to stay relaxed.

Sandra worked backward, moving measure by measure in reverse from the end of her practice target. She practiced moving from one chord block to another by shifting with audible slides, presumably to feel the distance between changes. She shook her left hand out now and then to relax it. She set the metronome at a slow tempo while she practiced sliding triple stops to different positions, playing each chord for two beats. She created variations in playing the blocked chords to target specific execution issues.

As she wrote markings to indicate open or closed hand shapes in her music, she said, “In passages like these…you have to really pay attention to the hand shapes. I always want to notate my hand shapes so I can keep them organized in my head.” She displayed an advanced awareness of tuning that emphasized the intervallic relationships of the notes in the chord. “I’m going to write arrows in my music to tell myself which notes I need to play flatter and which notes I need to play sharper.”

Sandra confirmed during the interview that familiarization was her goal during the early phase of learning. “I try to play through it…just to get a feel for what it’s like, what the tricky passages are going to be like.” The highly virtuosic nature of this piece was challenging even for an advanced cellist like Sandra. Her practice focused primarily on basic dimensions because the notational elements were particularly difficult, but she did not appear to be concerned about making too many mistakes at this point. Occasionally, however, she stopped to take a breath as if

she were frustrated. “This is hard. I’m gonna move on to a different section to allow that practice to sink in so my hands don’t get tired and I don’t get frustrated.”

As she familiarized herself with the piece, she was already formulating practice strategies to use in tricky passages. Formulating a practice plan was important for Sandra because her teacher expected her to be able to play through the piece when she plays it at her lesson for the first time. She emphasized that even when her teacher expected her to work independently during the early phase of learning, she did not feel that she was on her own. “One thing (my teacher) can do at this stage is… give me fingerings…I’m also able to bring spots to him that I need help technically.”

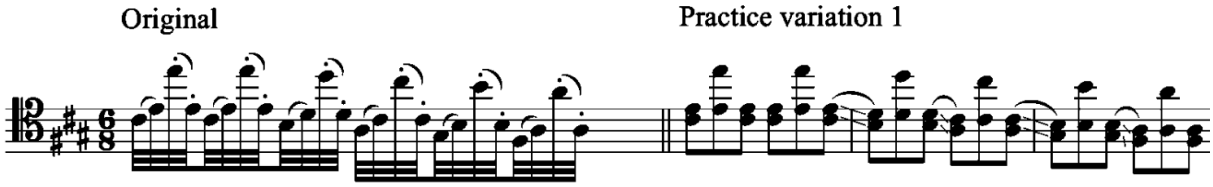
Despite Sandra’s obvious focus on navigating the basic dimensions of the music, she emphasized that paying attention to musical details was important during the early phase of learning. “I don’t think it’s good to just learn the notes and then just pour the musical stuff on top because it doesn’t feel as natural.” She added that while learning the notes and rhythms, she was also thinking about interpretive dimensions such as dynamics and tone colors, even when her initial attempt at those elements was not nuanced.

Associative or Intermediate Phase. Sandra recorded her second video on March 23, 2025, seven weeks after her first recording. The intermediate phase was marked by her ability to play passages continuously even when she was not performing them at the prescribed tempo. Because she was able to play the basic dimensions, she felt confident about being able to focus on details and musical nuance. She did not begin thinking about bow management and distribution until the intermediate phase of learning because she was heavily focused on the motions of the left hand. She added that she was actively trying to change this habit because learning bow distribution early in the process was important.

Sandra's goals during the intermediate phase were to build fluency in playing the basic dimensions of the piece while also beginning to internalize her musical interpretation, a finding confirmed by her practice activities and interview responses. She practiced this section much like she did in the early phase, by applying variations that allowed her to isolate motions and correct specific problems in execution (see Figure 1, Figure 2, Figure 3, and Figure 4).

Figure 1

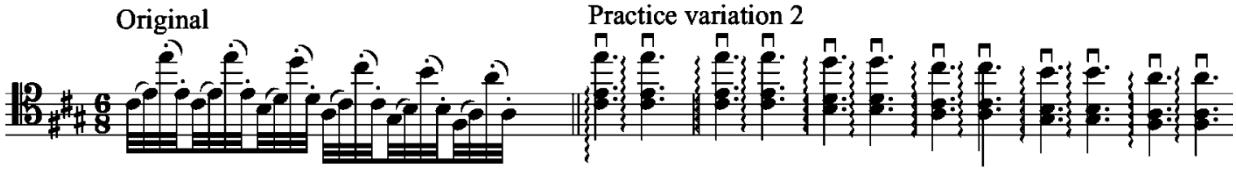
Practice variation 1 for solving issues in technical passages



Note: An excerpt from the second variation of Adrien-François Servais' *Caprice sur des motifs de l'opéra Le Comte Ory, Op. 3* (Servais, *n.d.)*

Figure 2

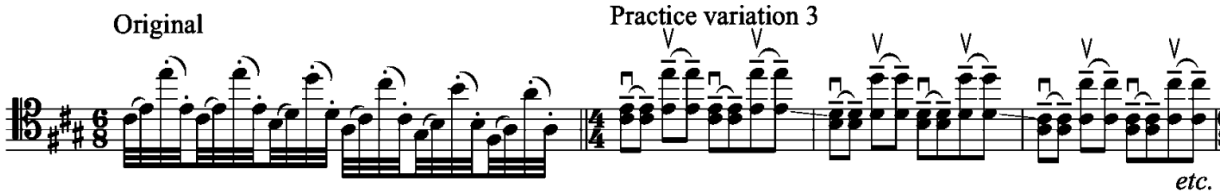
Practice variation 2 for solving issues in technical passages



Note: An excerpt from the second variation of Adrien-François Servais' *Caprice sur des motifs de l'opéra Le Comte Ory, Op. 3* (Servais, *n.d.)*

Figure 3

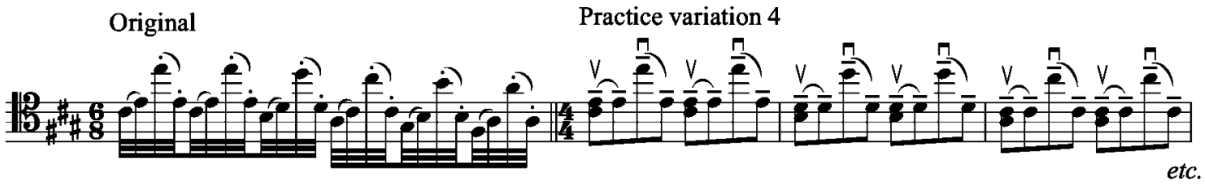
Practice variation 3 for solving issues in technical passages



Note: An excerpt from the second variation of Adrien-François Servais' *Caprice sur des motifs de l'opéra Le Comte Ory, Op. 3* (Servais, *n.d.)*

Figure 4

Practice variation 4 for solving issues in technical passages



Note: An excerpt from the second variation of Adrien-François Servais' *Caprice sur des motifs de l'opéra Le Comte Ory, Op. 3* (Servais, *n.d.)*

Sandra listened to professional recordings less frequently, primarily because her teacher was more involved in guiding her through learning the piece. "Once I'm able to really play, he gives a lot of input…so I think I listen to less recordings, but they can be really helpful to answering my questions about specific spots." Sandra's teacher addressed technique-related issues that involved playing the notes and rhythms, but also tried different approaches to make it easier for her to invoke the character of the piece. "We did a lot of work on my right hand…trying to get better sound production. We worked a lot on getting a really playful character, so in my lessons, (my teacher) would try to make me laugh while I was playing."

Catching errors and correcting them during the early and intermediate phases of learning was important to Sandra, and she used self-recording as a tool to accomplish this. When using self-recording to improve performance, Sandra emphasized the importance of setting a specific listening target. When practicing shorter segments of music, her goals become more specific in scope. When playing longer sections of music, she used self-recording to gain a listener's perspective so she could more effectively correct herself.

Sandra also performed run-throughs of longer sections during the early and intermediate phases, even when her performance was not yet up to par. She began memorizing the piece once she could play longer sections, but instead of allowing memorization to happen as a natural consequence of repetition, Sandra took a more intentional approach to be more comfortable and secure with her memory. "I would play with the music really far away so I can see the outline of the notes, but I'm not just staring at the page." She also set the metronome faster than her performance tempo to force her to focus on the flow of the piece rather than each note, a practice activity I had observed in her video.

Throughout the video, Sandra never spent too much time practicing the same passage or practice variation. As she shook her hand out, she said, "This section always makes my hand really tired, so I like to…play another section, then come back to this section, play another section…" *Interleaving*, the practice of alternating material, is used primarily as a strategy to strengthen learning, but in this case, Sandra used it to combat hand fatigue and overuse injuries. She credited her high school orchestra teacher for introducing interleaving and other types of cognitive strategies to improve learning. She also stopped frequently to shake out her hand, showing an awareness of her body's signals of fatigue.

Sandra ended her practice session by running through the piece. "I'm gonna run through the piece, not expecting it to be good but just for the purpose of practice performing." She played

through a significant section of the piece but appeared to have a memory slip and went back to a section and restarted the run-through from there. She recorded the run-through of the piece. "Now I'll listen to the recording and address all the intonation issues and the memory slip I had, but I think it's good to have run-throughs where you refuse to stop even when you're not quite ready to perform it."

Autonomous Phase. Sandra recorded her final practice video on April 26, 2025, one day before her jury. Sandra stopped listening to professional recordings of her solo during the final phase; she did not want to incorporate any new interpretive ideas. One of her goals during the final phase practice session was to engage in slow practice. Additionally, she wanted to be able to play her piece with a good flow. To achieve this, she practiced a passage faster than her intended performance tempo and used the metronome. Although Sandra's movements were confident and precise, she sometimes fell behind the metronome. Similar to her previous videos, Sandra practiced difficult passages by applying different variations.

She emphasized that while it was tempting to run-through the piece multiple times closer to the performance, slow practice was an integral part of her final phase preparation. "If you're doing lots of slow practice focusing on your sound and intonation, it just makes the performance feel…and sound better." Sandra still corrected errors, but because mistakes were more difficult to correct later in the process, she sometimes resorted to *drilling*, the process of repetitively playing a small section of music. While she thought it was necessary to use it to correct well-ingrained she advised against using it as a primary practice strategy.

After approximately six minutes of working on one passage, Sandra continued to a different passage, one that was characterized by wide jumps from the bottom range of the cello to a harmonic note at the end of the string. She alternated between playing the passage in tempo, slow practice, and application of practice variations she had also used in her intermediate phase

videos. Even when she practiced small segments of each passage, she always ended by playing the whole passage in tempo. She ended her short practice session by running through the entire piece. “I’m going to now run through the whole thing, and then afterwards I’ll take notes on what I want to review for my jury.”

Sandra determined performance readiness by soliciting feedback from others and thought it was important to perform in front of others multiple times before the actual performance date. She advocated doing this process as early as the intermediate phase. Sandra often performed run-throughs for her teacher during lessons. At this point, her teacher focused on giving performance and interpretive advice rather than going through a laundry list of technical issues. When Sandra and her teacher were both comfortable with her performance during lessons, she simulated performance stress by performing in front of other cellists in studio class. Additionally, self-recording run-throughs provided a means to determine readiness and simulate performance pressure.

Skill Development as a Performance Major. The highlight of Sandra’s practice videos was the creative approach she devised to solve technical problems. She shared that learning effective practice was a regular activity during her pre-conservatory lessons, and she credited her former teacher for influencing her creative problem solving approaches. She added that she enjoyed this type of work because creative practice engaged her brain and helped her improve faster. Sandra’s current teacher encouraged the same creativity in the practice room. “My teacher likes to use the analogy of a science lab…the practice room is your lab where you’re doing all the experimentation and trying different things.”

While Sandra’s responses pointed to a fulfilling pre-conservatory learning experience, she continues to uncover gaps in her approach to learning. “My current teacher…has been showing me that I am really left-hand centered. The two of us have been working on…putting

more focus and emphasis on my right hand since I got to college." She added that her current teacher emphasized playing the instrument in coordination with her breath. She reported that this approach to playing has helped her improve her technique because she has learned to relax more while playing.

When asked to assess her skill development from high school to her first year of undergraduate study, Sandra felt that although she had improved as a cellist, her former and current teachers did not differ in their message. She thought that her teachers agreed on many different principles of playing, even when they approached teaching differently. She realized that the biggest change during her journey from an advanced high school student to an undergraduate freshman was in her way of thinking. "(My cello teachers) don't disagree with each other. I'm realizing that I need to…change the way I practice."

Summary. Sandra focused on familiarizing herself with her new solo during the early phase of learning. She achieved this by listening to recordings of different performers playing the solo. Additionally, she listened to Mozart and Rossini arias to familiarize herself with the musical style because her solo was based on themes from a Rossini opera. Sandra was expected to prepare her solo independently before playing it at her lesson, but her teacher was willing to help her if she encountered a problem that she was unable to solve on her own. While going through the piece at a slower tempo, Sandra annotated fingerings and hand shapes on her music to help her navigate challenging passages. At this point in her study, she was not concerned about mistakes, nor did she expect to sound good.

Sandra focused on developing fluency in playing her solo during the intermediate phase of learning. She achieved this by creating practice variations that addressed specific technical problems in different passages. While she also used self-recording during the early phase of learning, she relied more heavily on self-recording during the intermediate phase to allow her to

diagnose and correct errors. Sandra had already formed a fundamental interpretive vision of the piece during the early phase of learning, but the intermediate phase is when her motor skills were fluent enough to allow her to play with more nuance. She advised against mindless drilling of sections because it instilled bad habits and also had the potential for causing injury. Her teacher was more involved during the intermediate phase, providing her guidance with technical and interpretive elements. Sandra began the intentional process of memorization during the intermediate phase. She also emphasized that it was important to run through sections of the piece even when it was not fully developed and still under tempo.

While Sandra performed multiple run-throughs of her entire solo during the final phase, she also included mindful slow practice. She still addressed errors and technical challenges during this phase, but she focused more heavily on pressure-proofing her performance by playing her solo for others. She added that it was important to do this even earlier in the process, even if it meant asking a random person in the practice room wing to listen to shorter sections of the piece. Since her interpretation of the piece was already fully formed, she stopped listening to professional recordings to keep them from influencing her performance. Sandra's teacher's guidance was limited at this point, offering only advice on how to bring out the musical character of the piece rather than addressing a laundry list of technical issues.

Sandra expressed fulfillment with the skill she achieved during her training with her pre-conservatory cello teacher. This teacher was responsible for instilling creative practice habits that she still used as a freshman undergraduate. She also expressed satisfaction with her current teacher, who has helped her develop her technical skills further. She added that both teachers agreed on many different aspects of playing the cello, but she did not realize this until she matured as a musician and changed her perception about playing.

Michelle, Freshman Undergraduate

Michelle studied the second movement of the *Cello Concerto No. 1.* by Dmitri Shostakovich for performance at a recital in February 2025 and began working on it in December 2024 after completing her first semester as a freshman. Glass (n.d.) described this formidable work dedicated to renowned Russian cellist Mstislav Rostropovich as "marked by wit alternating with abject gloom." Cellist Alisa Weilerstein (n.d.) characterized the slow second movement as a work that conveyed veiled suffering, a sorrow one was not allowed to express publicly. In addition to its expressive challenges, the cellist must also conquer technical challenges such as the extended harmonics section at the end of the movement (Shostakovich, 1959).

Cognitive or Early Phase. Michelle's primary goal during the early phase of learning was familiarization with different elements of her solo. She achieved this by listening to recordings of the piece performed by different cellists to expose herself to a variety of interpretations. Michelle actively listened to recordings while reading the score to gain a better sense of the musical style, phrasing, tempo, and, to a lesser extent, how the solo part fits in with the accompaniment. She shared that while listening to the piece, she liked to move her bow hand along with the music to feel the rhythms and tempo.

Michelle recorded the first video to document the early phase of learning on December 2, 2024, approximately one week after sightreading the piece for a prospective performance in February 2025. She described this practice session as her first deep dive into the music. She provided commentary throughout the video about her problem-solving process. Except for the last staff of the first page, the majority of the opening section is written in either tenor or treble clef, requiring the cellist to play past the neck of the instrument. She appeared to easily navigate

the pitches at the upper register of the cello, even with the small pitch issues she encountered at this phase of learning.

Michelle played through the first 34 measures of the piece, ignoring minor inaccuracies in pitch, presumably because she wanted to finish the section before doing any detail work. Since studying with her new cello teacher, she has been more deliberate about thinking of musical phrases and playing expressively rather than only working on technical elements of a piece. Michelle's teacher believed that focusing solely on technical details early in your practice was like "leaving out key pieces of a puzzle and trying to shove them in later." Michelle's goal was to think about how she wanted to move from one note to the next to shape the phrase and convent dynamics

Expressive playing on a bowed string instrument can be achieved primarily by manipulating bow speed, weight, and sounding point with the right hand. While the left hand is primarily responsible for pitch and rhythm, it is also responsible for vibrato, another ingredient in the recipe for expressive performance. String instrumentalists can vary tone color by using an infinite number of combinations of left and right hand elements. Michelle's teacher encouraged experimentation with these elements during lessons in the early phase of learning. "We played around with using less bow and kind of being at the tip to have a lighter, airier sound. But then we ended up finding that it was more of a soloistic sound." This comfort in experimentation was apparent in her practice activities.

Michelle spent the majority of her practice time on forming an idea of sound that could convey the musical character of the piece. Michelle talked about how her teacher often emphasized the importance of thinking about bow distribution when practicing. She admitted forgetting about that detail until halfway through the video recording, and the mere mention of this made her put more effort into practicing passages with bow distribution in mind. Michelle

also spoke about how she needed to be more intentional about her vibrato during practice. *Vibrato* is a left hand technique that involves moving the hand back and forth to create a regular pulsation of a pitch. She followed through with this reminder by experimenting with two different types of vibrato on the same passage. She began with a more basic type of vibrato that was even throughout the passage, then moved to one that she described as "shimmery," which was narrower in amplitude but increased in width as she progressed through the *crescendo*.

Michelle did not completely ignore technical challenges, despite her obvious attention to interpretive elements, though she did not dwell on mistakes. In dealing with one particular shift that was consistently inaccurate, Michelle practiced the shift repeatedly, sometimes devoid of musical expression or shaping. Understandably, Michelle was experiencing coordination issues in performing wide shifts while also attempting to play with musical expression. One notable detail about Michelle's practice session was that even when working on technical problems within a piece, she attempted to play passages expressively.

After being satisfied with what she accomplished in the first 32 measures, she decided to continue to the *tenuto* section. She commented about keeping her tempo stable rather than manipulating tempo as she played the passage. She recognized that she did not use a metronome as much as she should, especially when studying slow pieces. She continued to work on technical issues such as the accuracy of the shifts, but they were never devoid of interpretive elements. She was intentional about playing interpretive elements when practicing technical details.

In the final minutes of the video, Michelle performed a run-through of the sections she practiced while attempting to incorporate many of the basic and interpretive elements she worked on throughout the video. Michelle seemed slightly embarrassed when she talked how about performing run-throughs too early in the learning process. "I would say I don't recommend

doing run-throughs as early as I do. They never go well. I think I make myself feel more confident from doing that than I should, because I'll play the piece pretty badly, and think to myself, I got through it, and think it's like a big accomplishment."

Associative or Intermediate Phase. Michelle had played her solo for her teacher before she recorded her intermediate phase video on December 20, 2024. During that lesson, her teacher commented on how she focused too much on her left hand when she needed to pay more attention to bow placement and tone production. Her new goal since that lesson was to improve her tone by being more aware of what her right hand was doing. She added that her practicing has improved since focusing more on keeping the bow close to the bridge and worrying less about her vibrato.

Michelle characterized intermediate phase performance as one marked by the ability to play technical elements more adeptly, even when interpretive nuances were not yet polished. The first noticeable change from the first video was that Michelle was now making fewer mistakes and was therefore able to play a longer stretch of music without stopping. Her changes in position were more fluid and accurate. She spent a few minutes at a time working on sections that were not completely secure, and her tone was more confident. Because she was able to play without stopping too much, she was able to play a larger chunk of the four-page movement.

She practiced the piece in sections marked by changes in musical character, evidence that she understood the formal elements of the piece. Practice activities and commentary later in the video provided more evidence of Michelle's awareness of where changes in musical character occurred in the music. "This is kind of like a transitional period into the next part, and it's very loud and gradually getting louder." Michelle's tone was more confident as she appeared to make a conscious effort to keep her sounding point consistently closer to the bridge when the music

required a more intense tone.. She was very deliberate about manipulating the sounding point as she played sustained notes marked with a *crescendo* and *decrescendo* within the same measure.

When practicing technically challenging passages, Michelle broke the section down into smaller, more manageable chunks. She frequently detected and corrected errors, except when she intentionally performed a run-through of a section. Michelle talked about self-recording as a tool to diagnose errors in the intermediate and final phases of learning, but not during the early phase. "I feel like in the earlier phase, it's a lot easier for me to identify just while listening to myself what the problems are…later on, I specifically use recording when I'm struggling to identify issues."

Michelle identified several strategies to practice challenging passages, but identified tempo manipulation as one she uses the most. "I'm pretty big on playing things going back and forth between playing things half tempo and full tempo. That's something (my high school cello teacher) really likes and I found helpful." She also isolated specific aspects of the problem passage. "This time I'm going to play it through and just focus on intonation, then the next time I'm going to focus on intonation and tone…stacking things. I find it's usually something I have to do just because there are so many things to think of at once."

Michelle conducted small experiments during her practice session. "Let's try with a little bit more hair and a straighter bow." While it was apparent that she was attempting to play with musical intent, her focus was clearly on the basic elements of the piece, primarily tuning wide intervals and double stops written in thumb position. She also implied that she needed to build endurance to be able to play the piece with sustained intensity. Michelle ended her practice session in the same manner she ended her first video, by playing through the sections she spent the most time practicing.

Autonomous or Final Phase. Michelle shared that she had done a good amount of practicing on the piece since she recorded her previous video. She recorded the final video on January 19, 2025. She took one week off from practicing the piece, which seemed to hurt her fluidity. Michelle seemed to have made more errors during this final phase video compared to her intermediate phase video. One mistake was enough to throw her off focus and trigger more errors. During the interview, Michelle shared that she prepared this piece as one of her options for the mid-term cello studio recital, but decided to perform a different movement from the same concerto instead.

After she refreshed her memory of the piece, she played the passage with the amount of intensity it needed from both hands and repeated it several times for good measure. Michelle continued to show evidence of experimentation with interpretive elements even during this final phase of study. She spent the majority of her practice time on a passage that required her to draw an intense sound from her instrument while executing wide shifts and playing in the highest register. The section seemed to be physically demanding, as evidenced by the short but frequent stretch breaks she took while working on this sequence. Michelle built endurance to play for longer periods by ensuring that the number of hours she played her instrument every day was relatively similar, spreading her practice time into smaller sessions throughout the day. Michelle ended her session by performing a run-through of the sections she practiced.

Michelle's first criterion for a performance-ready piece was the length of time she had been working on it, but she also added that her institution required a high level of polish for performances. "They verify with your teacher every single time you want to perform something." She determined performance readiness primarily from feedback from her cello teacher. Performing a piece during studio class and receiving feedback from others in her studio also helped her make this determination.

Michelle reported listening to professional recordings during the final phase, but with a different focus than in the early and intermediate phases. “I’m focusing really carefully hearing how I fit in with the piano (accompaniment).” When using self-recording during the final phase of learning, Michelle focused on finer details of the piece. She also recognized that because some details are challenging to hear in a recording, she must also use these recordings to listen to herself more globally. “Sometimes it has to be more bigger picture because it’s hard to hear things like tone. I find recording especially useful for things like intonation and coordination with the piano (accompaniment).”

Skill Development as a Performance Major. Michelle added that one aspect of her playing that he has worked on consistently was her tone production. She mentioned that her teacher’s primary focus was to develop a big, clear tone, accomplished by playing close to the bridge. I observed this particular detail during Michelle’s intermediate phase video, where she consistently and intentionally positioned the sounding point close to the bridge. I also observed in all three videos that she was comfortable with experimenting with tone colors and other expressive elements.

Working on tone and expressive elements of a musical selection, even during the early phase of learning, was a key feature of her lessons with her new teacher. Naturally, finding the right musical nuance requires experimentation with different sounds to create a tonal palette. Michelle used the word intention frequently in all three videos. *Intention*, based on Michelle’s description of her practice activities, was used to describe an action done with purpose to produce an expected outcome. She shared that her teacher consistently emphasized playing with intention.

The performance demands of an undergraduate performance major were more intense than what she experienced as an advanced high school cellist. The increase in the amount of

music practice and performances allowed her to realize that she had to consider her physical limitations when during practice. She also learned how to advocate for herself to avoid injury whenever her teacher forgot about her limitations and instructed her to perform a technique that was difficult for her to execute:

> My arms are not that long because I'm pretty short. So I always got to a point with (my former teacher) like this too, where they're like, you're still not reaching it…and then I get to a point where I'm…using my shoulder, and…it's actually kind of hurting me. And then we're at a point now that I sometimes have to remind (my current teacher).

When asked to compare the way she practiced as an advanced level player in high school and how she practices now as a performance major, she shared that she was too busy with other activities to truly devote her time to practicing. Since becoming a performance major, Michelle has been learning to be more organized about setting practice goals. She was still learning how to be methodical at correcting mistakes because she still relied heavily on repetition as an error correction tool. She reported that she was showing improvement in diagnosing specific problems faster and finding appropriate solutions.

Michelle recognized that within the same practice session, improvement could be difficult to see. "(Improvement) might not be like entirely meeting that goal because a lot of things take a lot of time, but getting somewhat closer to meeting that thing we worked on." Improvement for Michelle from one lesson to the next was dependent upon how well she followed her teacher's advice. "So if at my lesson I worked on tone production, and we only worked on that, and I come again and play the same piece, and he says…your tone is really scratchy, then I'm going to feel like I didn't do my job."

Summary. Michelle observed interpretive elements of the music even during the early phase of studying a piece. This approach, espoused by her new cello teacher, was evident when

she consistently attempted to shape phrases and observe dynamic markings even as she worked through the notational and technical elements of the music. She expressed a desire to be more deliberate about left and right hand techniques that have direct influence on expressive elements and showed a willingness to experiment to find the right kind of sound. She showed the awareness to detect errors and the ability to correct them without obsessing over perfection.

Technical fluency during the intermediate phase allowed Michelle to devote more focus on the interpretive dimensions of her solo. She explored different interpretive options by experimenting with tone color. She demonstrated an awareness of the formal boundaries of the music, particularly during changes of musical character. She used these formal elements of music to organize her practice session, starting and stopping at sections where it made "musical sense." While Michelle did a significant amount of problem solving during her practice session, she recognized that her teacher was a valuable source of practice and performance advice.

Michelle focused on refining her performance during the final phase, but an extended break from playing her cello likely contributed to increased errors. She addressed these errors by using practice variations to address coordination issues while also recognizing that she needed to learn to be more methodical about correcting mistakes. She ran through longer sections of the piece to build performance stamina and added that she ran through pieces in all phases of learning because it boosts her confidence.

The most significant change in her practice habits from high school to her first year in college was that her focus on music performance allowed her the time and opportunity to be more methodical about practicing. Through her teacher's guidance, she learned to become more thoughtful about how to use technique to convey musical intention and to incorporate interpretive elements even in the early phase of studying a piece.

Edward, Senior Undergraduate

Edward will be performing Ysaÿe's *Sonata No. 6* for an upcoming recital in May 2025. Eugene Ysaÿe was a 19th century violinist, conductor, and composer who studied with violin virtuosos Henryk Wieniawski and Henry Vieuxtemps. Four years of study in Paris allowed Ysaÿe's opportunities to network with influential musicians and establish his career as a soloist.. Ysaÿe was regarded as pivotal in developing the new style of violin playing (Stockhem, 2001).

Sonata No. 6 was dedicated to Spanish violinist and composer Manuel Quiroga, whose brilliant career was cut short when he died at age 46 (Nimbus Records, n.d.). This composition is characterized by fast passages and slurred double stop runs in a variety of intervals. This virtuosic piece, marked *Allegro giusto non troppo,* has six pages of non-stop movement with a prescribed tempo of eighth note equals 100 beats per minute (Ysaÿe, 1924).

Cognitive or Early Phase. Edward recorded his early phase video on March 13, 2025, for a recital in May 2025. Before playing any new piece on his instrument, he often looked at the full score to gain a more global understanding of the music. He also notated bowings and fingerings on the solo part before even picking up his violin because it provided a framework for study and accelerated his ability to learn the piece. Edward attributed the ability to visualize the mechanics of playing passages without his instrument to his strong violin technique. He added that having the acute ability to discern pitch, known as *perfect pitch*, has helped him in this process.

Edward engaged in extensive familiarization activities before playing a new solo on his instrument. He listened to the piece many times before playing it on his instrument to allow him to manage its many complex details. He listened to a variety of professional recordings by violinists he admired as he examined the score. He emphasized that listening to different artists perform the same piece was important when formulating an original musical vision. "It's great to

open your ear to new possibilities. We get bogged down by our favorite recordings, and then we end up copying it…and I think it takes away from our own individual artistry, creativity."

In addition to listening to multiple recordings of the same piece by different artists, he listened to recordings of other compositions by the same composer, a process espoused by his violin teacher, collaborative pianist, and other mentors. "I have to understand the language of the composer…for instance, Mozart. Best thing if you're studying Mozart…is listen to the arias…everything is so operatic even if it's instrumental." Additionally, Edward thought it was important for musicians to be familiar with the formal structure of the piece. "How does the introduction and the first theme relate to the second theme? What is the accompaniment doing? When do things change? What are the big key sections like?"

Edward's priority during the first reading was to identify the difficult spots because they will require more time and effort to prepare. Once he identified the difficult spots, he practiced those sections first. Edward added that he self-recorded during the early phase of learning because it was important for him to play with correct rhythms, details he might have missed while he was distracted by something else. Edward acknowledged that this piece was especially challenging for him because it featured techniques that he did not normally use as a violinist. He specifically mentioned the prevalence of slurred double stops with different intervals, an element he considered his weakness.

Edward played the first six measures, describing his desired articulation as "snappy and unexpected." To achieve his preferred articulation, he explained that the fingers should lead the bow stroke, not the arm. While his advanced technique allowed him to easily navigate technical challenges and create nuance early in the learning process, he has also learned how to be intentional about it as he matured as a musician. Interestingly, creating musical nuance was so important to Edward that he sometimes felt it slowed him down. "Where I waste time is, what

type of vibrato, what type of articulation?" He felt justified in making these decisions early, however, because he was more open to change during the early phase of learning. He added that it was important to be decisive because indecision can stunt progress.

As he demonstrated the next passage, Edward explained the concept of musical gesture as key to developing his interpretation. He used the term *gesture* to describe the physical movements required to play the music in a manner that effectively communicated the composer's style to the listener. "Mozart is operatic singing. Everything is about variation...it all comes from the voice. Composers like Bach, Bartok, Ysaÿe, Kreisler…they're so rooted in dance." He demonstrated specific movements he needed to execute with his left hand to accomplish his desired musical gesture, evidence that he understood how to use technique to realize interpretation.

Edward continued to read through the piece, playing double stop passages with relative ease. He attributed this ease of playing to diligent practice of technical exercises. He also stressed the importance of understanding each interval to build resistance to performance stress. "Understanding how the intervals are organized will allow the brain to build up to processing the information at faster speeds." He added that identifying patterns in music was another sure way of learning a piece more easily.

As a senior with an advanced level of musical skill, Edward had more autonomy in making musical decisions about his solo. Throughout the five-week process of preparing eight different pieces for his senior recital repertoire, it was impossible to spend too much time during lessons on every single piece. His teacher listened to the Ysaÿe sonata twice during recital preparation, giving only general comments about the style of the piece rather than technical issues.

Associative or Intermediate Phase. Edward submitted his intermediate phase practice video one week before his recital. He described the intermediate phase as the point in his study when he had settled with the majority of his musical decisions and could now work on execution. His primary goal was to be able to feel confident and relaxed about playing the musical and technical aspects of his piece. Additionally, he shared that experimentation was an important practice activity that fostered musical growth. "I believe it's the only way to practice." He reported experimenting mostly on tone colors and sonorities that bring different musical images to mind.

Edward appeared to have his music memorized and confirmed during the interview that he began the memorization process during the intermediate phase. Rather than allowing memorization to happen naturally through repetition, Edward described a more deliberate process of memorization that involved singing sections of his music and memorizing small sections at a time. He added that a mistake some musicians make is forgetting small, transitional sections in the music when practicing for memorization. "Most of us can memorize the themes or big sections. It's threading them together that's usually more challenging, at least for me." Edward described a process he referred to as *memory recall* to deliberately memorize a piece:

> I just bounce back and forth with the music. I play it a few times, looking at the music…a few times not looking, and then without reviewing, I'll go to the other spot and see if I can remember…I try to do it as many times throughout the day.

He played the passage several times at a slightly reduced tempo, stopping to correct intervals or single pitches that were slightly out of tune. He was meticulous about the accuracy of the short notes and how, in his words, "snappily" they were executed. He repeated these notes a few times, ensuring that the bow caught the string with the right amount of bite. Edward described the use of slow practice during the interview as an effective way to learn a piece that

moves fast in perpetual motion. Slow practice gave him time to think of the motion required to play the next note and build the movements required for fluency. He emphasized, however, that even when playing a passage slowly, he preserved its musical gesture. “Slow practice is supposed to be for…over exaggerating, whether it’s the gesture, harmony…whatever you’re trying to do beyond the notes.”

At two points in the video, Edward played a video on his laptop that showed performances of the passages he was practicing. He used these videos to analyze how two violinists he respected played fast passages with fluidity. Edward had to reduce the speed of the YouTube video to see this subtle movement. He also used visualization techniques to imagine himself playing like the violinists he observed. This exercise allowed him to realize that he was trying to execute too many things, and his performance was beginning to become too rigid. “(The violinist in the video) was so free. It was very inspiring to see where he took time, the things he did with his sound…he makes mistakes, but you almost don’t notice.”

Edward continued to the segment with thirty-second note triplet double stops. The first set is an ascending scale in thirds that quickly shifts to octaves as it progresses up the fingerboard. He played the passage as written several times. In some instances, he slowed down slightly and played a few notes at a time to solidify intonation as he transitioned from one note to the next. He also briefly used a dotted rhythm variation to play the passage, a strategy frequently employed by string players when running passages are performed unevenly. After several repetitions of this section, he continued to a similar passage that included intervals of thirds and tenths.

Ysaÿe’s sixth sonata is divided into two distinct sections by a grand pause in between. Edward reported running through each half of the piece during the intermediate phase to build performance endurance and readiness. He characterized the grand pause, although short, as an

opportunity to reset his mind before playing the second section of the piece. He reported playing each half of the piece under tempo three times a day. He eventually performed a run-through once he was able to play each half at performance tempo. He emphasized that once he committed to running a piece, he did not stop playing even when he made mistakes.

Edward relied on feedback to further prepare for performance readiness. He used self-recording during both the early and intermediate phases of learning to catch details he may have missed while he was playing. He also asked others to listen to him play, which accomplished two things: to receive feedback and simulate performance pressure. “There’s no replacement for…getting blood in the room.” He emphasized that playing for others is one of the best ways of overcoming nerves during a performance. “I think embarrassing yourself early on is the greatest thing you can do because it disassociates nervousness…gets it out of the way.”

I did not observe Edward using any practice tools during the early and intermediate phases of learning his solo. He confirmed during the interview that while he did use a tuning app to use to generate drones for intonation practice, he did not use a metronome because he felt that he had a solid sense of internal rhythm. Edward emphasized that his most important practice tool was a practice journal. It allowed him to track his progress. “I think it’s incredibly important to track your progress…to understand what’s working and what’s not. When I figure something out, I write that down.”

Autonomous or Final Phase. Edward recorded his final phase video during the week of his recital. He prefaced the video by saying that his practice changed during the final phase of learning a piece:

> As I get deeper in my practice process, I actually do less fast playing and do more slow playing and practicing…I like I'm mapping out mentally where I need to be and why I just like coordinate things and feel really balanced and just focus on really memorizing

the intonation and just trying to be really specific and aim with clarity. I found like if I've been playing things fast yet even if it's slightly inaccurate, I'm for sure going to miss it on stage, so the further along I am in the process actually like the more slow practice do.

During the interview, Edward talked about how people misused slow practice. “People take slow practice to zone out…but I think it’s more so an opportunity to actually engage 200% of your brain power…and to put…more effort than you ever would on stage.” Even at the slow tempo at which he was practicing, he emphasized the bow mechanics that allowed him to achieve his desired articulation. He was sure to practice the required gestures so he could replicate them at a faster tempo.

Edward did not appear to have sheet music in front of him. He looked at his fingers and occasionally monitored his practice by looking at the full-length mirror in front of him. He began his session by playing each interval of the double stop passage in varying rhythmic configurations. While he reported not using this practice strategy often, he acknowledged that it was effective for practicing fast notes in this particular solo. He also briefly practiced the passage without the left hand to isolate the bow movements. He appeared to go through his music sequentially, moving forward to the next practice segment once he was satisfied with his work.

Edward reported that he still used self-recording as a practice aid during the final phase of learning. Because the transitions between major sections of the piece were challenging to him, he used self-recording to help him diagnose issues when practicing these sections. More importantly, however, Edward used self-recording to gain a listener’s perspective on his performance. “The biggest priority is how close am I to what I hear in my head when I practice, to what I imagine the piece to sound like?”

Skill Development as a Performance Major. Edward studied with the same teacher throughout his entire undergraduate career. Since his teacher often had performance

engagements that made weekly private lessons difficult to schedule, his teacher instructed him in a way that fostered independence. Edward became increasingly self-sufficient as he progressed through his studies. “My freshman year, he held my hand a lot more. The last two years, as I’ve started competing and having more engagements…it’s been a little less frequent.” He credited his teacher for effectively showing him how to practice and how to form his interpretation of music. “(My teacher’s) greatest influence on me is teaching me how to think for myself.” Edward added that his teacher offered musical advice, especially when it involved interpretive choices on standard repertoire, but rarely imposed his own ideas on him. “He’s much more focused on the process of how to get there on my own.” He did add, however, that his teacher and collaborative pianist selected most of his recital repertoire for him.

Edward recalled that his freshman year as a performance major was a wake-up call for him to change the way he approached practicing:

> My freshman year, I practiced as much as I could in terrible ways because I had no idea what I was doing. It was just a lot of scales, and it was a lot of me running things. I did not understand slow practicing…then I got injured. I missed three months…my entire spring semester because I had acute tendinitis. So when I came back, I rebuilt my technique. I basically started from scratch.

After rehabilitating his technique and practice habits, Edward described his subsequent years of undergraduate study as a period of growth as an artist, marked by several career milestones. He began learning more difficult repertoire during his sophomore year, and by that summer, he had toured internationally with his orchestra as concertmaster. “I got to play the giant concertmaster solo…that was my first career milestone that put me on the map.” The beginning of his junior year was even more hectic. “I got into my first international competition. I was playing a lot of chamber music at school. I was gigging and teaching.” Edward took on less

work during the second semester after realizing he was spreading himself too thin, but continued to learn a heavy amount of solo repertoire at a fast pace. Before he even completed his undergraduate degree, he had already served as a fellow at a summer music festival known for its high caliber musicians. He summarized his senior year as an experiment to find out what he can do artistically and how quickly he can learn things.

Summary. Edward engaged in extensive familiarization activities before playing a new solo on his instrument. Edward thought it was important to identify the difficulties in any piece during the first reading and practice those sections first. Before playing any new piece on his instrument, he often looked at the full score to gain a more global understanding of the music. He listened to recordings of his solo performed by artists he admired as he examined the score. In addition to listening to multiple recordings of the same piece by different artists, he listened to recordings of other compositions by the same composer. He notated bowings and fingerings on the solo part before even picking up his violin because it accelerated his ability to learn the piece. He also shared that experimentation was an important practice activity that fostered musical growth and reported experimenting primarily with tone colors when he practiced.

He used self-recording during the early phase of learning because it was important for him to play with correct rhythms, details he might have missed while he was distracted by something else. Edward's advanced technique allowed him to easily navigate technical challenges and create nuance early in the learning process. He had a total of two lessons on the Ysaÿe solo with his teacher, one of them during the early phase of learning. He reported that his teacher gave him general comments that addressed the style of the piece rather than technical issues.

Edward confirmed during the interview that he began memorizing the piece during the intermediate phase. Rather than allowing memorization to happen naturally through repetition,

Edward approached memorization more deliberately by singing sections and memorizing small sections at a time. Edward referenced videos of two violinists he respected to gain a perspective on how they played fast passages with fluidity. He added that when he watched videos of other violinists, he imagined himself playing like the violinists he observed.

Ysaÿe's sixth sonata is divided into two distinct sections by a grand pause in between. Edward reported running through each half of the piece during the intermediate phase to inch it closer to being performance-ready. Edward relied on feedback to further prepare for performance readiness. He used self-recording during both the early and intermediate phases of learning to catch details he may have missed while he was playing. He also asked others to listen to him play, which accomplished two things: to receive feedback and to simulate performance pressure by playing in front of an audience.

Edward confirmed during the interview that while he did use a tuning app to generate drones for intonation practice, he did not use a metronome because he felt that he had a solid sense of internal rhythm. He used self-recording to help him diagnose issues in transitional material in his solo and to gain a listener's perspective on his own performance. He also reported using slow practice as he went deeper into studying the music. Edward discussed how people misused slow practice as a way to zone out when they should be using it to engage their brains more. Even at the slow tempo at which he was practicing in the final phase video, he emphasized the bow mechanics that allowed him to achieve his desired articulation, so he could replicate them at a faster tempo.

Edward studied with the same teacher throughout his entire undergraduate career. Since his teacher often had performance engagements that made weekly private lessons difficult to schedule, Edward was taught to be independent. Edward recalled that his freshman year as a performance major was a wake-up call for him to change the way he approached practicing after

he was diagnosed with acute tendinitis. After rehabilitating his technique and practice habits, Edward described his subsequent years of undergraduate study as a period of growth as an artist marked by several career milestones. He summarized his senior year as an experiment to find out what he can do artistically and how quickly he can learn things.

Henry, First Year Graduate Student

Henry chose to perform Amy Beach's *Romance for Violin and Piano, Op. 23* for a recital in February 2025. The Romance was written for violin virtuoso Maud Powell, a leader in the advancement of women in music. Beach and Powell premiered the work at the Women's Musical Congress in 1893 (Maud Powell Society, n.d.). Though lyrical and graceful, this work is characterized by technical challenges that require playing in the higher positions of the instrument (Beach, 1893). Beach was a piano prodigy whose marriage to a prominent Boston surgeon limited her musical activities to composition. Her husband's death in 1910 ushered in her return to public performance as a pianist with a concert tour of Europe and America.

Cognitive or Early Phase. Henry submitted his first video on December 30, 2024. Henry listened to various professional recordings of pieces to gain an idea of their stylistic elements. "I'm listening for style…and phrasing, how different artists phrase," before playing them on his instrument. Additionally, he looked through the score to become aware of challenging sections that will require more of his attention throughout the learning process.

After a brief scale warm-up, Henry paid special attention to the first five notes by experimenting with two different fingerings and settled on one that used the same finger to slide to a different position. He repeated the procedure for the next measure, practicing sliding from one note to another several times. Henry appeared to prioritize rhythmic accuracy early in his study. He subdivided longer notes into eighth notes to maintain the pulse and anticipate the eighth notes in the piano accompaniment. While I did not observe him using a metronome,

Henry confirmed that he used a metronome when practicing challenging rhythms. He was surprised during his lesson, however, when his teacher advised him to take a looser approach to the passage. “When I brought it to my teacher, he wanted me to take a lot more time and be a lot more free.”

One recurring feature of Henry’s practice activities was the care he devoted to tuning pitches, particularly those involving wide shifts. He practiced each shift deliberately and repeated the movement a few times until he was satisfied with the outcome. Throughout his practice session, Henry tuned pitches relative to different open strings. Although he used a tuner app for intonation work, he preferred using open string drones. “I try to go off the open string and just really get the note to resonate and ring as much as possible.” He used different strategies to solidify shifts on wider intervals, such as isolating pitches from their respective rhythms and only practicing the movement from one note to another. He also practiced sliding his left hand fingers lightly over the strings and put weight on his finger when he arrived at the target note in the correct position on the fingerboard.

In several instances, Henry played passages without vibrato in an apparent attempt to establish bow distribution that would best bring out his desired phrasing. When I mentioned that he seemed deliberate about how his bow distribution, he disagreed. “I honestly should think more about bow distribution first…especially at the early phase…sometimes, I don’t think about it as much as I should.” He added that his violin teacher has been instrumental in teaching increased awareness of how to manage the bow.

Henry focused on right hand elements, such as bow distribution, by simplifying what the left hand was doing. In one example, Henry practiced creating a more articulated sound by focusing on the bow mechanics without the added complication of hitting a wide shift. Despite isolating mechanical elements performed by each hand, Henry always practiced performing both

elements synchronously. Similarly, when Henry practiced technical elements of a passage without its expressive elements, he never moved on to the next practice target without playing the current passage musically.

Another notable characteristic of Henry's practice activities was that while he thoughtfully practiced small sections of music and spent time effectively correcting errors, he did not spend too much time on any one section. He repeated short passages until he was able to play them reliably, then moved on to the next practice target. Although Henry insisted that his focus during the early phase of learning was on basic dimensions of music, he still performed passages with discernible interpretive elements such as phrasing and dynamics.

While Henry did not mention formal elements of the solo, it was obvious that he used musical phrases when selecting practice targets. He started and ended at the musical boundaries of the piece, using either the musical phrase or the change in musical character as a starting or stopping point. While progressing through the piece, he also periodically circled back to passages he had already practiced, progressively stitching passages together to form longer sections of music.

Henry was expected to learn the piece before playing it for his teacher. "When it comes to the early stages, most of the work is on me." He added that he did not work on this solo with his teacher until closer to the recital. "It's a relatively short piece…and it's not too hard to put together." Henry's teacher offered guidance when needed, but left many decisions to Henry. "(My teacher) is not very strict with fingerings or bowings. My teacher wants me to be very artistically free and make my own decisions."

Associative or Intermediate Phase. Henry recorded his second video on January 29, 2025. He performed a run-through of the first section of the piece after correcting a minor mistake at the very beginning of the piece. He appeared to have sections of music memorized at

this point, reading from sheet music but occasionally looking away. Henry characterized his intermediate phase performance as one that showed consistency in rhythm and pitch and a clearer sense of musical interpretation. To sustain the progress he had made, it was important for him to maintain a consistent practice schedule. Henry's goals during the intermediate phase included managing bow distribution, creating a sense of melodic direction through phrase shaping, and playing synchronously with the piano accompaniment. Bowing variations, rhythm variations, and right hand isolation using open strings were some of the strategies Henry reported using regularly. Because the *Romance* was lyrical and did not have many technical elements, such as fast runs, Henry did not apply many of the practice strategies he shared during the interview. He added that self-recording was a practice tool he used to diagnose errors on basic elements.

Henry appeared to be secure about how he managed bow distribution. His movements were seamless and exuded confidence, as if he were performing them without much cognitive control. Although Henry admitted he needed to be more deliberate about bow management during the early phase of learning, he appeared to have done adequate work on this, as he seemed to have achieved fluency with bow distribution even when other elements of the piece still needed refinement.

Accurate intonation and rhythm remained a priority for Henry even during the intermediate phase, as evidenced by his practice activities. Henry used some of the same practice activities in the early and intermediate phases of learning, such as rhythm subdivision, tuning with drones, and isolation of inaccurate pitches. He took time to make sure his shifts were accurate. When focusing on intonation, he performed the notes plainly and without expressive elements such as vibrato. After being satisfied with intonation work, Henry played the passage expressively.

Henry continued to shape his interpretive ideas during the intermediate phase. He did not listen to professional recordings of his solo during the intermediate and final phases of learning because he wanted to create his interpretation without being continuously influenced by his favorite recordings. Additionally, he experimented with different combinations of bow speed, bow weight, contact points, and vibrato of varying speeds and amplitudes to find the desired sound.

Much of Henry's corrective work during the intermediate phase of practicing appears to be centered on intonation. Bowing variations, rhythm variations, and right hand isolation using open strings were some of the strategies Henry reported using regularly. Because the *Romance* was lyrical in nature and did not have many technical elements, such as fast runs, Henry did not apply many of the practice strategies he shared during the interview. While Henry corrected errors during practice, he normally did not repeat passages or musical fragments obsessively before continuing to the next practice target. When asked how he managed his errors during practice, Henry responded that he repeated fragments until he was able to play them correctly with consistency.

Henry did most of the work of learning the piece on his own and only presented the piece to his violin teacher a few weeks before the recital. Since it was one of the lighter selections in Henry's program, his teacher's comments centered on creating balanced ensemble playing with the collaborative pianist. Henry recorded every lesson with his violin teacher and listened back to these recordings to take notes about what he needed to practice.

Autonomous or Final Phase. Henry recorded his final phase video on February 3, 2025, one week before his recital. He appeared to attempt a run-through of the first section, but corrected two minor mistakes before he continued to the end. After completing playing through this section, he went back and corrected mistakes. He appeared to have memorized the piece at

this point, looking away from the music stand periodically as he played. Henry denied having a special protocol for memorizing music and claimed that it happened naturally through repetition.

Although technique is considered a basic dimension of music, a musician with complete control of instrument technique can use it as a tool to realize interpretive vision. In Henry's case, he was able to masterfully manipulate the weight, speed, and sounding point of the bow and the amplitude of his vibrato to create a variety of tone colors. Based on evidence observed in his early and intermediate phase videos, Henry worked very deliberately on bow distribution and elements of sound production very early in the process, so his performance of these elements seems to be automatized. He played until the end of the first theme, evidence that his attention to the formal dimensions of the piece. I did not observe any experimentation on sound production at this point.

Henry was still engaged in corrective work during the final phase of learning, which was done at or close to the prescribed tempo. He reported using a metronome during all phases of learning, but changed the rhythmic subdivision to allow for more expressive freedom towards the final phase. He targeted small details of a passage, repeating them several times before moving on. This appeared consistent with what he shared during the interview. "If I don't get it, then I drill it. I do more repetitions…but I don't think I spent like, more than five minutes drilling something." Although he did not have many tuning mistakes to correct at this phase, Henry corrected shifts with minor intonation issues and still uses open string or double stop tuning at this phase.

Henry reported spending less time practicing a piece and doing more run-throughs during the final phase of learning. As the performance drew closer, Henry often made recordings of his run-throughs in the performance venue to gain a sense of how he sounded to someone in the audience. "I'm recording myself and listening to it just to see…if everything is coming across,

and I'm expressing everything how I wanted to." Henry also reported not doing much slow practice, but consistent with what I observed in his final phase practice video, he still corrected errors, primarily errors in pitch.

Henry felt confident that a piece was ready to be performed when he was able to run through it from memory without any slips. He also determined performance readiness by soliciting feedback from others. "I usually play the piece…for a number of people. I invite them into my practice room. That helps me feel a lot more prepared." For Henry, performing for a small audience served two purposes: receiving feedback and simulating performance-induced stress.

Skill Development as a Performance Major. Henry's introduction to productive practice began early in his study with his parents, who are both professional musicians. "My parents really did a good job of making it fun and not forcing it on me…my dad always stressed the importance of slow and productive practice, which I definitely take with me in the practice room." He credited his undergraduate violin teacher for developing his consistently accurate intonation and strong technique. He acknowledged that although his undergraduate teacher's approach was more rigid and allowed less artistic freedom, it was necessary to establish a strong foundation. "(My teacher) was like, you have to do these fingerings and these bowings…being very picky about rhythms, intonation…the basics. But in doing that, she also allowed me to explore different characters and tones."

Henry's graduate school experience was the exact opposite of his undergraduate studies. "My (current) teacher is helping me…in becoming my own artist and developing a personality." While Henry's graduate violin teacher provided him with the support he needed to polish his technique, his teacher also emphasized independence and freedom to explore artistic choices. "(My teacher) offers…a suggestion about phrasing…(my teacher) always says, if you don't like

this idea after you leave this room, you can toss it in the trash. (My teacher) is very open to interpretation, but does offer very good ideas."

Summary. In summary, Henry's practice activities provided evidence that in the early phase of learning a solo, Henry is focused primarily on basic elements, specifically, performing accurate rhythms and pitches. While correcting pitches was the activity that I observed Henry doing most frequently, he also demonstrated that once he had reached a satisfactory level of competency in executing on these basic elements, he quickly practiced technical elements such as bow distribution that would help him realize his interpretive vision. Henry seemed to be doing this intuitively, admitting during the interview that he needed to be more deliberate in practicing this, especially during the early phase of learning.

Henry focused primarily on refining elements such as expressive shifts and minor intonation issues during the intermediate phase of learning. He performed corrections on partially memorized sections of music and continued to use the same corrective measures observed in the early phase of learning, such as intervallic tuning, rhythmic subdivision, and isolation of technical and expressive elements. Henry has solidified right hand elements from early phase practice that focused on bow distribution and sound production, allowing these movements to be automatized.

One week before his recital, Henry practiced from memory, refining small details such as minor shifting and intonation issues close to or at performance tempo. While he had very few errors to correct, Henry repeated musical fragments that he did not perform satisfactorily. He continued to use error correction measures observed in both early and intermediate phase videos, but to a lesser extent. His performance appears to be automatized at this point, having integrated deliberate work on technical elements that allow him to realize his interpretive vision and communicate it to listeners.

Henry used a variety of tools as he learned the new piece. He familiarized himself with the new solo by listening to professional recordings of the piece. He stopped listening as soon as he reached the intermediate phase because he wanted to begin creating his interpretation of the piece. Henry used tuning app-generated drones, open strings, and double stops to aid him in establishing accurate intonation. While not observed in the practice videos, Henry reported using a metronome to establish pulse. He used smaller subdivisions for more accurate rhythms during the early phase of learning and transitioned to using bigger beats as he progressed to allow for more freedom of interpretation. He used his phone to record his violin lessons, allowing him the ability to watch the video later while writing notes about what he needed to practice. He also recorded himself as a means of diagnosing errors in executing basic elements such as rhythm and pitch. As the performance date drew closer, Henry used recordings to gain an audience member's perspective to determine whether he was effective in communicating his musical intent to the listener.

Stephanie, First Year Graduate Student

Stephanie chose to perform *In Manus Tuas* (Articulate with Jim Cotter, 2020; Shaw, 2009) by Caroline Shaw, a contemporary work for solo viola based on a 16th century motet by Thomas Tallis. The piece showcases arpeggiated chords, *pizzicato* or plucked chords sometimes written in a way that presents difficulties in execution, *extended techniques,* or unconventional ways of playing the instrument, and improvisatory elements. One unique element of the piece is a section that requires the soloist to vocalize a note while performing arpeggios on the instrument.

Cognitive or Early Phase. Stephanie was already familiar with the piece before recording her first video on November 20, 2024, having attended one live performance and listened to multiple recordings of this composition. Stephanie thought it was important to be

familiar with a piece before attempting to play it. She accomplished this by listening to professional recordings of the piece while following the score. Although Stephanie's comments during the interview gave the impression that her initial vision of the piece was influenced by other performers, her willingness to experiment with different sounds and techniques indicated that she intended to form her own vision of the piece.

After reading the performance instructions written by the composer, she began playing through the piece. Stephanie completed a play through of the score with during which she did not spend too much time on any one section of the piece. In the improvisatory opening sequence, Stephanie experimented with different extended techniques to produce a variety of tone colors not typically associated with standard viola repertoire. She created new sounds by combining standard techniques such as glissando and natural harmonics while manipulating bow placement.

Stephanie appeared to possess the skill to handle the technical elements, such as fast arpeggiated patterns. She stopped occasionally but did not spend too much time on any one section. She briefly tuned arpeggios when they contained high notes that required her to shift to a different position on the instrument. She stopped and marked her music frequently, including sections where she needed her teacher's input. After completing her initial read through, Stephanie commented that she will be spending the remaining time figuring out "logistics" such as fingerings and bowings in problem spots she identified during the initial play-through. She spent a significant amount of time experimenting with pizzicato techniques for chords that were difficult to play using conventional techniques.

The most noticeable feature of Stephanie's first attempt at playing this solo on her instrument was that she did not show complete separation of basic and interpretive elements. Despite an obvious focus on deciphering notational elements and techniques required to play them, Stephanie made a clear attempt at also showing dynamics and phrasing, even in sections

that were not as technically easy to execute. Interestingly, Stephanie offered her perspective on how dynamic markings were not interpretive elements:

> I think dynamics are…almost as important as the right notes and rhythms…that will help me become musical later on, but that's not like, interpretive. That's something the composer put in the music. So, of course, I'm going to observe it right away…it's in the score…the composer put it there.

The clearest example of Stephanie's attention to interpretive elements was her experimentation with different ways of executing chords. Apart from navigating the logistical challenges of just being able to play the notated pitches, Stephanie expressed the importance of finding a way to pluck the chords without losing the melodic line. During one of her attempts at playing the chords, she specifically mentioned that one of the harmonic notes was overpowering the melodic line when she plucked the strings in a particular way. "So I'm going to have to come up with some sort of notation that tells me how I'm doing these individual ones."

When I asked about her goals during the early phase of learning during the interview, Stephanie shared that she devoted time to familiarize herself with the basic dimensions of the piece. Additionally, she aimed to get an overview of a piece to help her decide the next steps in learning. "Knowing how a piece sounds, being able to go through the piece, finding the places that are most technically challenging…isolate those sections…that's probably the beginning stage of any work." She solved logistical problems during the early phase so she could practice the music more deeply later on. "Can I play the right notes? Can I play the right rhythm? What are my fingerings? What are my bowings?" Despite focusing on basic dimensions, Stephanie also hoped that her graduate school education would give her the tools to go beyond the basics even during the early phase of learning. Her practice activities were consistent with the details she shared during the interview.

When asked about the role of a teacher in guiding students through the early phase of learning, he acknowledged that as a private teacher who teaches middle school and high school students, the responsibility fell on her to guide her students through the early phase because her students were young and inexperienced. When I asked her how her current viola teacher guided her through the early phase of learning, she felt strongly that preparing a piece during this phase was the student's responsibility. "As a master's student, that's kind of your responsibility …I need to come to my lesson knowing the notes and the rhythms…the problem spots and knowing what I need help with."

Associative or Intermediate Phase. Stephanie recorded her intermediate phase video on February 12, 2025, more than two months after she recorded her sightreading video. She did not work on the solo until closer to the recital date because it was the least difficult piece on her recital program. Stephanie practiced her first target practice slowly, heeding her teacher's advice on being intentional about changes in the note groupings in her arpeggios. She recognized that her left hand had some deficiencies, but the majority of the issues stemmed from her right arm. After a few slow repetitions, she gradually increased the speed, settling on a tempo that allowed her to keep control of the bow and articulate key notes.

One interesting aspect of Stephanie's practice was that she began her practice on a measure or group of measures that gave her the most problems, but after she was satisfied with the outcome of her passage work, instead of going forward to the next measure, she went backward. She continued to experiment with fingerings that allowed her to play the passage more fluidly and in tune. She often practiced small fragments of music several times before playing the whole passage. When asked why she did this, she answered, "It's more towards making sure that the very small details you just practiced are still effective when playing a larger chunk."

Stephanie returned to the beginning of the section to review what she had accomplished. She played the passage twice as if to confirm that she was doing it correctly, then played the longer passage, following the written instructions "begin slowly then poco accel into a groove." She made a few minor mistakes but did not dwell on them in favor of achieving her bigger goal of making the section sound seamless. "Creating the bridge between the sections is what I'm most concerned with, and making it feel natural."

After testing bow distribution and sound production techniques on a small section of a different passage, Stephanie played the passage in context to see if her experimentation worked. She said, "I really like that, the bow management portion of it…" as she wrote reminders in her music about what she needed to do to recreate the sound. She played the passage from the beginning and continued playing the rest of it until she arrived at a section where the string crossings were not as smooth. She stopped and moved the camera so it was focused on her right hand, and talked about an old habit that she has been trying to change.

In the previous video, she experimented with different ways to pluck strings from a purely technical standpoint. In this video, she talked specifically about how to achieve the sound that she wanted by plucking the chords in different ways. She mentioned that she listened to the original recording played by the composer, where in one passage, she plucked the strings individually rather than performing a downward swipe on the strings with the index finger. The next fragment of the passage was marked with an up bow, which was unusual for a plucked passage. She demonstrated an unconventional way of plucking the strings to observe the composer's markings.

Stephanie's goal during the intermediate phase was to build fluency. Error detection and correction were the main practice activities I observed during her intermediate phase video. Stephanie measured by the ability to play the music more accurately and consistently over time,

and to work towards improvement, problems need to be solved. Her approach to solving problems was to try different solutions, and if that change fixed the problem, she moved on to solve the next problem. If, however, she still did not hear any obvious improvement after trying several solutions, she recognized that spending more time on that section would be counterproductive. “Maybe I’m just too tired…I just need to…come back to it tomorrow.”

When asked the practice strategies she used the most to help her achieve fluency on the piece, Stephanie shared that I did not observe them in her videos because *In Manus Tuas* was not a technical piece, and these strategies worked better in repertoire with more technical elements. According to Stephanie, practicing fast passages by gradually increasing the tempo was not enough to learn how to play difficult passages with control. To remedy this, Stephanie practiced these passages with rhythmic and bowing variations

Stephanie admitted that she did not listen to professional recordings of her repertoire during the intermediate phase. “I’m in the trenches, and I’m just really wrapped in what I’m doing as a performer.” She initially used professional recordings to gain an overview of a piece, particularly in the early phase. During the intermediate phase, she used recordings to compare her interpretation with those of other musicians to gauge whether her own interpretation was “effective.” When asked what she meant by *effective*, she shared that her current viola teacher used this word frequently. “Effective…all goes down to the listener…so that a listener can hear this piece…as meaningful, as emotional. I think it has a lot to do with the emotions of the piece.” Stephanie’s viola teacher was instrumental in guiding her through the process of building an interpretation of the piece that communicated Stephanie’s vision to the listener.

Autonomous or Final Phase. Stephanie recorded her final video on March 7, 2025, one week before her first graduate solo recital. Stephanie began practicing a section of the music that she and her teacher thought needed more refinement. Stephanie’s teacher emphasized that

because this section was one of the few where there was a sense of discernible pulse, Stephanie must be clear about her rhythm. Stephanie talked about experimenting with different tempos before working on the passage. Stephanie did not usually use a metronome during the final phase, but thought it would be helpful to do it in this situation. The free form and quasi-improvisational nature of *In Manus Tuas* did not lend itself to metronome use, which explained why I did not observe her using it in the early or intermediate phase.

She set the metronome tempo slower than the tempo she had been practicing. She played the section plainly, without much vibrato or variation in bow speed or sounding point. This practice activity matched her goal of experimenting with a new tempo that would indicate a sense of pulse. She realized while practicing at a slower speed, she was playing it too fast. She specifically mentioned that she was not playing a particular eighth note long enough, and because she was playing too fast, it was not getting enough bow weight. She wrote a tenuto over the passage to remind herself that she needs to take a little time there. "I think I've been taking…this section wildly out of tempo."

Stephanie talked about the importance of observing the rests. She made some markings in her music and played the section again, whispering "Rest, rest," when she came upon the rest. While intellectualizing a task may be exhibited by someone in the early phase of learning, this makes sense in this instance because Stephanie is still consciously thinking about this new change. She continued to spend a little more time working on notes that she thought she had rushed.

She ran through the whole piece to play her corrections in context. She did not stop to correct any mistakes or details she was not able to execute in the exact manner she had liked. She offered an assessment of her run-through: "I'm feeling much better about the pacing of the bariolage. I felt like measure 20 was spot on. The only spacing thing I didn't like was (plays the

passage to demonstrate). I always feel so abrupt getting from the *mezzo forte* to that really awkward string crossing. I need to play it so slowly to get it to speak." She played the passage again and tried to incorporate the changes she had made earlier. "I still don't like that. It still feels awkward. I wish I asked (my teacher) about that. Maybe I'll ask my studio in studio class. I'm generally happy with it. I wish my voice would last a little bit longer (in the section with vocalization)…but I sound very funny, so I feel like practicing singing." She practiced some double stops that had intonation issues with minimal musical inflection. She was aware of the issues she needed to fix, but at this point in her study, these were all small, nuanced details that add to a polished performance.

Stephanie confirmed during the interview that while she memorized several pieces in her recital repertoire, she did not memorize *In Manus Tuas.* When I asked her if she prepared pieces differently depending on whether or not she would play them from memory, she admitted that memorizing music was one of her weaknesses but also said that she likely used that as an excuse because she was not often required to memorize music for performance. Memorizing her repertoire was one of her primary goals during graduate study. "I think if you just hyper take things apart to smaller and smaller degrees and then put them back together again, you almost have to memorize it to be that fluent in a piece of music." She added that she wished she could talk to world-class musicians and learn their memorization process. She also shared advice from her teacher that memorizing pieces involved learning pieces in different ways and that the process was not always linear.

Stephanie used self-recording as a means to listen to herself from the perspective of an audience member, recognizing that listening to an instrument right next to her ear will sound different when projected towards the audience. She also acknowledged that her brain was doing so many things at once that it was difficult to hear the sounds she was making in the moment.

Self-recording allowed her to focus on listening to herself without the added cognitive load. In addition to performing during studio class, Stephanie used self-recording as performance practice. She posted three videos of herself performing pieces from her recital repertoire on Facebook and opened up her posts for comments. While she did not perform in front of a physical audience, recording a video of herself and posting it online for a wider audience provided the stress she needed to replicate performance practice. "It feels different practicing by yourself versus practicing in front of other people, and that stress mimics the stress of a performance."

Skill Development as a Performance Major. Stephanie recalled that the first time she ever learned how to practice effectively was through the guidance of her undergraduate viola teacher. Her teacher gave her specific ideas on how to practice specific sections, including the primary methodology of working backward from a practice target. She demonstrated this technique several times during all three videos. The idea was to determine an endpoint and progressively work backward one measure at a time from there. She also applied this method to planning long-term goals, such as a performance:

> It was the first time it really taught me how to practice. Not only will we do backwards practice at a piece, but you backwards practice from your date of performance…I always like that perspective because it gives you…more of a structure of what you're going to do.

Stephanie added that her undergraduate study was geared towards solidifying instrument technique:

> We did a lot of etudes where we're really developing…intimate knowledge of what half steps and whole steps feel like on each string. She had me map out my instrument and get a really intimate left hand technique, unlike my high school (private) teacher, who was

more obsessed with the bow arm. Undergraduate was a lot of technique and…learning these big pieces that you have to learn as undergraduates.

One of the primary differences between her undergraduate and graduate schooling was that Stephanie had more control over the repertoire that she wanted to learn as a master's student. While she still found it necessary to include staple viola pieces in her repertoire, Stephanie was passionate about performing works by underrepresented composers. "It's pathetic, the representation of diversity in the classical music world. So that's a big thing for me right now…I want to be advocating for the works of underrepresented composers, which are, of course, women…African-American, just living composers in general. She added that her willingness to experiment with different elements of creating sounds on her instrument was a byproduct of studying new music:

> Maybe a composer like Mozart, you're less free to try something different…you have less options when it comes to composers that kind of have an established…correct way of playing them, right? I would not be doing that much experimentation. But a composer like Shaw…there is a wider range of accepted interpretations of those pieces. The Shaw was a piece that was really freeing in my ability…to come up with my own ideas of how to perform it.

Stephanie felt that her graduate viola professor emphasized playing with intention as a means of achieving refinement in her playing. Based on Stephanie's practice activities and interview data, her definition of intention was the ability to use technique to execute the sound she wanted. She added that an effective performance, one that communicates a performer's emotions to the listener, cannot be realized if she does not practice and play with intention. Stephanie felt that her current viola professor was helping her realize her goal of playing with more finesse by developing her ability to play with intention. "The more that I have (my viola

teacher) helping me see where the flaws are in my playing, the more my ears are developing…what (my viola teacher) has been really helping me with is…discovering how I can make my viola playing closer to what I want it to be."

Summary. Stephanie was clear about her practice goals by stating them at the beginning of each practice video. She shared where she was going to begin, what she wanted to accomplish, and what she was going to do to achieve her goal. She had a clear understanding of right and left hand technique that allowed her to achieve interpretive intent. Even during the early phase of practice, when her primary focus was deciphering musical notation and translating it into sounds, she demonstrated the ability to communicate a preliminary idea of musical intent. As she became more familiar with the basic elements of the piece, she used her understanding of instrument technique to create a variety of tone colors on her viola, laying the groundwork for a more nuanced performance.

She performed a run-through of the piece during the intermediate phase to work on the performance dimensions of the piece, even when details were not yet polished. She was self-sufficient and had an awareness of what she needed to work on and how to solve problems. Despite this, she did not hesitate to ask her teacher for help with problems she did not know how to solve, and was receptive to her teacher's advice. She focused on weaknesses and engaged in efficient error correction during practice, but she also practiced running through music without pausing to correct mistakes during the intermediate and final phases. She used self-recording as a means of error detection during the intermediate and final phases and as a way to simulate performance stress during a run-through of the piece. As an added stressor, Stephanie recorded videos of her run-throughs, intending to post them on social media for consumption by a wider audience.

While Stephanie's undergraduate degree allowed her to develop her instrumental technique, she felt that she needed to go back to school to achieve a high level of polish. Stephanie's current viola professor had been focusing on polishing Stephanie's ability to use instrument technique to create intentional sounds on the viola. Stephanie's study of music by underrepresented and living composers has allowed her opportunities to experiment with sound, bringing her closer to the intentional playing required to convey her interpretive vision to the audience.

Sonia, Second Year Graduate Student

Sonia studied the first selection in Silvestre Revueltas' *Three Pieces for Violin and Piano*. Revueltas was a violin prodigy who left Mexico at a young age to study composition and violin in the United States. After beginning his musical career as a violinist in a theater orchestra in San Antonio, Texas, and a conductor of an orchestra in Mobile, Alabama, Revueltas returned to Mexico to conduct the *Orquesta Sinfónica de Mexico.* While traveling to Europe to conduct his music, Revueltas was involved in the Socialist struggle against fascists during the Spanish Civil War (Los Angeles Philharmonic, n.d.). Revueltas' music is known for its use of colorful orchestration and rhythms that suggest ties to Mexican folk music (Sphinx Organization, n.d.).

The *Allegro* presents the violinist with several technical challenges. The piece opens with double stops followed by sixteenth notes and a false harmonic. The violinist must navigate several meter changes and *Sul G* passages that require the violinist to shift up and down the length of one string. Some fast passages are further complicated by the presence of double stops that require the violinist to shift to different positions. Despite the technical nature of this piece, Revueltas' writing was idiomatic to the instrument because he was a skilled violinist himself.

Cognitive or Early Phase. Sonia recorded her sightreading session on January 8, 2025, for performance during her graduate recital on May 3, 2025. Sonia played below the marked

tempo, sometimes even playing passages half-speed if they were especially challenging. She was unsure about how to interpret the notation for the harmonic note in the opening measures of the piece, misreading the false harmonic for a natural harmonic. She attempted to play with appropriate articulation at the correct part of the bow but did not spend much time working on musical nuance or experimenting with technical elements that affect tone and tone color. Sonia shared during the interview that she frequently used the metronome during the early phase of learning a piece, even when I did not observe this practice behavior in her video.

One of the most challenging sections of this piece is a section marked *IV* or *Sul G,* which requires the violinist to shift into different positions on one string. Sonia played the passage in first position, presumably so she could hear the pitches and create an aural reference. After hearing what the passage was supposed to sound like, she experimented with different fingerings to play the passage in Sul G by moving slowly through each pitch. Sonia practiced a similar section later in the piece in the same manner, but because she had spent the time to experiment with fingerings and found one that worked, she played the reprise more smoothly and spent less time practicing it.

The arpeggios sprinkled throughout the piece were another challenge for Sonia. Not only were intervals in the arpeggios unusual, but they also required the violinist to navigate the wide tonal range of the violin. Sonia took the same approach with the arpeggios as she did with the Sul G passages. She experimented with different fingerings and wrote it in her music when she found one that she liked. She played slowly, note by note, without any adherence to printed rhythms. Once she was more confident about the pitches, she played the passage again with the correct rhythm. Pitch was the obvious element of focus during the sightreading session, as she spent most of her time finding notes and experimenting with fingerings that would allow her to play the fast passages without impediment.

When Sonia was unsure of rhythms, she vocalized them before playing them on her instrument. Interestingly, this practice seemed to help her process the rhythm and play it correctly on her instrument. Her frustration was obvious when she got stuck on a passage and a solution did not come to her. After a few unsuccessful attempts, she moved on to the next target. "Oh well…I'll figure something out. I'm just gonna keep going." Double stops are a recurring feature of this piece. The time Sonia spent on each type of double stop varied based on their difficulty to execute and tune.

Sonia shared during the interview that she often listened to several professional recordings of the piece but did not like to wait too long before playing it on her instrument. "I just like to get hands-on as fast as possible. I like to decide on fingerings, try different fingerings…try to get through the music as fast as I can." She preferred to dive into hands-on practice right away so she could make decisions about basic elements of the music and learn the piece more easily. "I'm not a very good sightreader, so I want to get that out of the way." Her activities seemed to be centered on the left hand, the hand responsible for playing pitches. She did not think about right hand elements such as bow distribution until her left hand can play the notes.

Because of her perceived weakness in *audiation*, defined as a cognitive process where one hears music even when the sound is not present, Sonia listened to professional recordings of her pieces to help her learn the basic dimensions of the piece. "My aural skills are not that good to be able to just see the printed music and know how the music sounds like. I need a little more time to process it in my brain. So just listening to it…while seeing the sheet music…makes it easier for me." She added that knowing how the music sounded made it easier for her to play the notes on her instrument.

As a graduate student, Sonia was expected to be able to study a piece independently before presenting it to her teacher. “Right now, my teacher is not really involved in the early stages. When I bring a piece to (my teacher) is when I can already play through it.” Despite this expectation of independent study, she did not feel that she was on her own during the early phase.

Associative or Intermediate Phase. Sonia recorded her intermediate phase video on March 3, 2025, approximately two months after her early phase video. She reported being able to play through the piece but still had issues that she needed to work through. She reported that the Sul G passages were still giving her problems because she has difficulty establishing the pitches. “My ears still haven’t learned how it sounds, and my hands are not sure where to go.” She also recognized that she was not yet able to play the running passages at full speed. Sonia’s goal for this practice session was to focus on playing the right notes in the running passages and training her fingers to play the passage faster.

She began her session by practicing the passage that needed the most work. She turned on the metronome and played each note very slowly. When she hit a shift that was out of tune, she turned off the metronome and isolated the shift. She corrected out-of-tune shifts with visual feedback provided by her tuning app. She solidified shifting movements through repetition and counted each one out loud. “One…two…three…four…five…one more for good luck.” This particular passage was difficult to tune because the intervals were unusual and did not seem to follow an expected or familiar pattern.

Sonia confirmed during the interview that she liked to practice segments five times without mistakes before continuing to the next practice target. She added that when she was unable to meet the target number of correct repetitions and repeated the mistake too many times, that was a signal to practice a different section. She also set a limit on how much time she spent

on any one section. “If I spend around ten minutes doing the same thing and it’s not there, I just leave it there. I get frustrated…and I’m going to learn it wrong, and then it’s going to be much worse.” Sonia incrementally increased the tempo on the metronome as she practiced the passage. She offered a quick assessment of each run and attempted to correct the problem at each repetition.

She recognized that her underdeveloped aural skills were affecting how she learned music. “I’ve noticed a lot that if I don’t know how it sounds…my hand will not go to the right place.” Accepting this deficiency, she used different practice tools to compensate. She used a tuning app and drones to sharpen her awareness of pitch and tonal center. While Sonia thought the tuner was a helpful tool, she did not want to develop a dependency on it. She recorded herself with and without visual feedback provided by the tuner. She was satisfied with how well in tune she played in both attempts.

As she approached the end of her practice session, she acknowledged reaching her mental limit: “I’m going to stop after this because I’m getting desperate. I’m now just repeating for the sake of repeating instead of actually thinking about what I’m doing.” While Sonia’s intermediate phase video did not show her performing the music from memory, she maintained that she began the process of memorization during the intermediate phase of learning. Sonia explained that memorization required a conscious effort that involved more than simple repetition:

> I have to make a point of it…I tend to get glued to my music. So if I want to play memorized, I will…do a few reps and then just the music stand away and play it by memory. Whatever…I’m practicing, even if it’s like three measures, I’ll play those three measures, turn the stand away, and play those three measures from memory.

Sonia confirmed during the interview that she continued to listen to professional recordings while building her interpretation. As she became increasingly familiar with the basic

dimensions of the music, she was able to play longer passages with more confidence and security, allowing her to stitch more musical sections together and run through her music. She added that the intermediate phase was when she began to internalize the music, focus on musical style, and experiment with tone color. Sonia's teacher was more involved during this phase, providing her with musical ideas and showing her how to realize these ideas on the instrument.

Autonomous or Final Phase. Sonia recorded two final-phase videos approximately two weeks before her recital. She recorded a run-through of the piece performed from memory on April 21 and submitted a practice video later that day. The problem passages she identified in her intermediate phase video appeared to improve, as her movements in the final phase videos were fluid with no apparent errors in execution. Additionally, she successfully transitioned between sections that presented unique technical challenges. She appeared to be pleased with the run-through.

Sonia recorded a 16-minute practice video later that day where she addressed a memory slip that occurred during her run-through. Additionally, she practiced some spots that needed some detail work. She repeated the opening sixteenth note figures and appeared to focus on making the false harmonic ring. She repeated one measure of the first Sul G section several times in what appears to be an attempt to solidify the pitch of the first note in the new position. While doing intonation work, she occasionally gave herself audible feedback. "Lower…no…lower." Her facial expressions also provided a clue on whether she was satisfied or not with each attempt.

During the final phase of preparation, most of Sonia's practicing, including corrective work, was done in tempo. Sonia played small fragments of problem areas in the context of the longer passage after correcting errors, and continued playing until she hit another snag. She went through the music sequentially, spending time working on trouble spots as she encountered them.

She followed the pattern of repeating fragments several times before advancing to the next section of the piece. Occasionally, when the same issue persisted throughout several repetitions, she focused on an even smaller fragment and did corrective work at a reduced tempo. After going through trouble spots sequentially, Sonia did one final check of the harmonic note in the opening and quietly vocalized the sixteenth note subdivisions before playing her second run-through of the day. She later offered an assessment of her performance. “The places I looked at were better this time, but there are a few others that took me by surprise, so I’ll just make a note of those...so I can look them up again.”

Sonia gauged improvement by how well she retained practice gains during a previous session. When asked about determining if a piece of ready for performance, Sonia relied on the feedback of others. “I do have a few friends back home…they can be ruthless when it’s about music…so sometimes I call them…can you listen to me and give the most honest feedback?” Her teacher often provided feedback after a run-through. “It’s mostly…spot checking at this point….whatever mistakes I have, (my teacher) will try to understand why the mistake was there and teach me how to fix it.” Her university has also helped provide her with opportunities to perform for an audience of her peers through studio classes. These performances allowed her to acclimate herself to performing under pressure.

Skill Development as a Performance Major. Sonia completed her undergraduate degree from a university in her native Mexico, an education that allowed her to gain technical skills on her instrument and learn how to practice effectively. The focus on technique development during Sonia’s undergraduate study may have contributed to her memory of undergraduate study as a regimented learning experience. “I was told what to do most of my undergrad…fingerings, bowings, repertoire, phrasing…most of it was given to me. Despite expressing satisfaction with her undergraduate education, she reflected on shortcomings as a

student that may have prevented her from maximizing her educational experience. “I had a lot of tools. I just didn’t know how to use them yet. I think I was too young to understand how to use them.”

Sonia pursued graduate school when she realized that her instrument technique was not developed enough to win a position in an orchestra in her home country. When asked what two years of graduate study in the United States have allowed her to achieve, she shared, “I think it has given me a lot of experience…freedom to experiment.” Sonia’s numerous musical activities have taught her how to become an independent learner. “I have to play so many things, so I don’t have time to lose. I learned to be more efficient with my time practicing.”

Compared to undergraduate studies, Sonia found more freedom to develop her own artistry during graduate school. She shared that her teacher frequently offered musical ideas to her during lessons, but did not push them on her because he trusted her judgment. Sonia’s teacher also allowed her to select pieces for her recital program. While Sonia’s teacher gave her and other students the flexibility to program solo repertoire, her teacher did not hesitate to draw the line when needed. “If it is too hard for us, (my teacher) will say no.” The independence she learned as a graduate student, coupled with her teacher’s trust in her musical decisions, has helped Sonia become more confident. “(Graduate study) has given me no time to doubt myself…I just have to go for it.”

Summary. Sonia played through the piece slowly, sometimes at half tempo during particularly difficult passages, as she sightread through the piece during the first video. Sonia played Sul G passages in first position to create an aural model without having to move up and down the fingerboard. During the interview, she shared that because her aural skills were not well-developed, she had to find ways to establish the pitches “in her ear” so she could play the passage more easily on the instrument. Sonia also listened to professional recordings of the solo

to gain familiarity with the score that was difficult for her to audiate. Sonia's practice activities pointed to prioritizing pitch during the early phase of study, though she shared in the interview that rhythm was also important. She shared that during this phase, she used a tuner and metronome app often. Sonia's practice activities seem to be centered on the left hand, as she did not worry about interpretive dimensions of a solo until she was comfortable with the basic dimensions, such as notes and rhythms. Graduate students are expected to work independently, so Sonia's teacher was not involved in the preparation of the piece during the early phase.

Sonia was able to develop enough fluency with the basic dimensions of the piece during the intermediate phase that she was able to direct her attention to its interpretive dimensions. She acknowledged that while she was able to play through the piece and actively worked at memorizing small sections of the music, certain passages were still problematic because her fingers could not play up to tempo. She used various strategies and tools to correct problems. She isolated pitches and used the tuning app to check for pitch accuracy. She also used the metronome to practice passages while progressively increasing the tempo. Sonia used self-recording as a way to catch and correct errors. She used a system of repetition that required her to play a musical segment five times without error before she allowed herself to continue to a different practice target. When she failed to meet this goal, she moved to a different section before frustration and fatigue dampened her spirits.

Sonia's final phase activities included spot checks of difficult sections and run-throughs of the entire piece. Her performance in the final phase video showed a marked improvement in fluidity and confidence from the intermediate phase video. She determined performance readiness by relying on feedback from her teacher, friends, and peers. Performing in front of others also allowed Sonia to experience performance stress. Studio class was one such avenue that provided a safe environment for her to simulate a high-pressure performance situation.

From Sonia's perspective, undergraduate education was characterized by a focus on solidifying instrument technique and practice skills. How these skills were taught was somewhat rigid, with no room for her to make her own musical decisions. As a graduate student, Sonia felt more freedom to explore and develop her own voice as a violinist. Her teacher trusted her to make musical decisions, including selecting the program for her graduate recital. She learned to work more independently because of multiple performance opportunities that forced her to be more efficient with her practice time. The independence and freedom she experienced in graduate school have developed Sonia's confidence in her musical abilities.

James, Second Year Graduate Student

James selected George Perle's *Monody II for Unaccompanied Double Bass* for this study. He will be performing this piece for an upcoming recital in May 2025. American composer George Perle, a recipient of a MacArthur Foundation fellowship and a Pulitzer Prize, composed the piece in 1962 for double bassist Bertram Turetzky (Childs, 1964; Lansky, n.d.). It belongs in a series of pieces of unaccompanied melodic instruments which combine a variety of serial procedures in the twelve-tone idiom. In addition to exploiting the wide pitch range of the double bass, this piece also challenges the performer with extended techniques (Perle, 1966).

Cognitive or Early Phase. James recorded his early phase video on February 2, 2025.

His primary goal was to play the piece from beginning the end to identify and diagnose major problem areas. James shared that he preferred taking his time to study pieces whenever the timeline allowed it. He added that he liked to look at the music globally, go into the details, then eventually go back to seeing the big picture. He did not inspect the score in depth, opting rather to listen to various professional recordings of double bassists who knew the composer personally before playing it on his instrument. In addition to listening to professional recordings, James relied on self-recording during the early phase of learning. He tended to listen to himself less

carefully early in the process, so he recorded himself playing short sections of music to gain a third person's perspective and compensate for the lack of external feedback.

Within the first few measures of the piece, James encountered several changes in register that alternated between bass and treble clef. He was also required to whip the bow to allow it to bounce vigorously across the string, a technique called *battute*, and bend the pitch while executing harmonics. While he hesitated a few times, he navigated technical challenges fluidly and observed dynamic markings. He did not dwell on mistakes, instead prioritizing his goal of playing through the entire piece.

James selected the *Tempo I* section for targeted practice after the initial reading and provided commentary on his practice. He commented about how the piece was manageable with some challenging sections. He played the first measure and commented on how its chromaticism required awkward fingerings. "What I need to do is a little bit of experimentation with some fingerings here." James experimented with a few fingerings and wrote one that supported slurred articulation in the same position and offered more clarity of sound. He vocalized unusual intervals before playing them on his instrument. After settling on a fingering and hand shapes that worked, he recognized that he may change this later as his interpretation evolved.

The next step after finding a reliable fingering was to play the notes as long tones to solidify tone and intonation. To this end, James used the tuner app to provide visual feedback on centering pitch when playing passages as long tones. James focused primarily on intonation by using the tuner to provide visual feedback whenever he placed his finger on a pitch. "I sit in front of the tuner and watch the tuner. People say, no, you have to listen to your ear. Yeah, you do that, but you also need a proactive sense of intonation…more of a calisthenic sense." James added that he did not think about bow distribution at this point during the process because playing notes at a much slower tempo did not reflect how he would be using the bow when he

was not practicing long tones. “Once it approximates the tempo, then I find I really have to start…budgeting where in the bow I actually want to change.”

James described his teacher’s involvement during the cognitive phase as “seed planting,” which involved a very global approach with attention to interpretive elements. He described his first lesson on a new piece as an education on interpretation rather than technical elements. “My proficiency on the piece was not very advanced…but he understood I would take care of it. But we are mostly talking about, from the beginning, the pacing and the various colors and contrasts.”

Associative or Intermediate Phase. James recorded his intermediate phase video on April 26, 2025, one week before his recital. Since this piece is one of the less difficult ones in his program, he did not need to spend too much time preparing it for performance. James characterized the intermediate phase as the point in the process where he had good command of the playing mechanics and had a concept of how to play each note. Additionally, James described the intermediate phase as “physical drudgery” compared to the intellectual work required during the early phase. He added that different sections of a piece progressed at different rates and did not require the same amount of time and effort to develop:

After completing work geared towards technical familiarity and creating a musical concept of the piece, James reported that there were still issues he needed to solve away from the instrument, which would help him create a more cohesive interpretation. “I just haven't really figured out a way to relate (the recurring motifs) to one another. Sometimes there's something slightly or subtly different written about them…gotta come up with something a little bit more sophisticated.”

His practice goals centered on two passages where he did not feel technically secure. He added that while the notes were not difficult, he needed more work to make the passage feel

automatic. The biggest issue with the first target passage was the alternation of sul ponticello and ordinario. *Sul ponticello* involved playing extremely close to the bridge to produce a harsh or metallic sound, while *ordinario* was played more neutral sounding point. “That’s an unusual form of coordination I have to deal with. It’s something I have to…get the kinesthetics.” He explained that because the bow was so close to the bridge, the conventional ways of executing sound in different dynamic ranges did not result in the desired sound. He played the passage slower and experimented with possible solutions to the problem. After finding a solution, he repeated the passage several times in an attempt to internalize the action. “Ten more times, correct times, then it’s done!”

Still unsatisfied with the sound, James decided to try the passage again but with a different fingering. “I think that’s it! That solves a lot of the problems…it makes it so I can actually play the harmonic.” He played the passage a few more times as if to confirm that the change was a good idea and practiced the new shift a few times as if to ingrain it into muscle memory. He continued to work on the passage, trying different strategies and offering assessments of his attempts. He emphasized that at some point, a musician has to make a decision and stick with it. “Last thing you want to do…a week out from a recital is keep having these ideas and keep changing them. At some point, you just got to stick to something and hope you pick the best one.”

James continued to his second practice target in the opening section of the piece and assessed his performance after playing the passage. He continued to repeat the passage and try different ways to create the bounce he wanted. It took a few more repetitions before he realized that the bowing he chose was the culprit. Despite the last-minute bowing change to solve a technical problem that kept him from realizing interpretive ideas, James was not frustrated because he learned something from the process of experimentation. “It’s not wasted practice. It’s

better than it was when we started… on the intellectual level, you practiced it, you started to understand the music better because of that."

He reported using the metronome heavily during this phase since he was working on playing passages up to tempo. While he did not use self-recording as frequently as he did during the early and final phases, he still valued it as a diagnostic tool that he used to fix bad habits. He also used self-recording when he was unsure about what he needed to do to improve a passage and to listen to how his sound projected to the audience.

James reported that his teacher trusted him to take care of the notes and mostly provided him with guidance in developing his own musical ideas." Some teachers would be…more about technical solutions, but (my teacher) is mostly about how are your ideas speaking and are your current plans for how you want…to build this passage are…reflecting what you're trying to accomplish musically?" He often received reminders from his teacher about practicing to realize musical intention.

Autonomous or Final Phase. On May 3, 2025, James recorded a full run-through to begin his final phase video. His goal was to test whether his practiced movements could withstand performance pressure. While he performed with the music in front of him, he occasionally looked away. He focused his eyes on his left hand fingers as they climbed up the fingerboard, and lost track of where he was on the page. It was a small but noticeable mistake that he was able to correct almost immediately. Later in the piece, an audible sigh of frustration made the mistake more noticeable. He continued playing until the end with no other issues except a page turn that he forgot to set up.

After completing the run-through, James identified issues he needed to address and verbalized possible solutions. One solution was to apply *light drilling* to a passage, which he defined as multiple repetitions of a passage. He added that while repetition was necessary,

excessive and mindless repetition was counterproductive. James added that while he has learned to become methodical about the number of repetitions he uses to drill a passage, he moves to a different practice target when his mind is no longer actively engaged.

As the performance date drew closer, James played a run-through of the piece without using sections of that piece during his warm-up. He does this to simulate a performance where a musician did not have multiple opportunities to practice the same piece. While he acknowledged that run-throughs were an essential component of performance practice, he added that musicians must be intentional and thoughtful about including them in their preparation. He continued by saying that he often planned run-throughs and mock performances in front of people approximately one month before the performance.

James continued metronome work until the final phase of learning. While he performed full-tempo run-throughs of repertoire, James made sure he also included slow practice in his final phase preparations. “It keeps you from wearing yourself out, especially on performance day.” He added that slow practice was especially beneficial when auditioning for orchestral positions because musicians spent several hours waiting to go through multiple rounds of playing. “You don’t know when the knock on the door is going to come...so you can’t be too cold and you can’t be overworked. You gotta try and maintain this weird homeostasis. Slow, meditative playing…is a good way to do that.”

James continued to remind himself of bad habits he needed to change as he played certain passages. Practice was a process that involved constant diagnosis and evaluation. After playing the problem passage, he assessed the attempt and provided himself with feedback as he felt himself play with too much tension. He continued to do this evaluation and feedback loop as he played smaller fragments to correct specific errors in execution. When he realized that he had made a poor choice in fingering, he also accepted that it was counterproductive to change it at

this point. “Another element of late-stage preparation is sometimes you gotta stick…to the choices you made. You don’t want to change things every other day because you’re going to build no kind of consistency, and then you’re not going to build any kind of resiliency to the nerves.”

James thought that it was necessary to solicit feedback by performing for others during studio class or informal settings. Aside from receiving feedback, James thought this also accomplished the pressure training aspect of performance. “Get the feedback you’re looking for, but also just to know what it’s like to play with eyes watching you…it’s amazing how different things feel.” James’ teacher offered minimal feedback during the final phase of learning unless an issue needed attention. “(My teacher) is very big on once you’re on stage, you’re practicing the audition…not practicing the music. I think that’s the right approach.”

While it was difficult for James to feel perfectly ready for a performance, he believed that he had to be confident about the work he poured into the preparation of the music and the musical decisions made during the learning process. “Knowing that I’m able to work on this kind of small scale and address these problems that happened in an actual performance lets me walk out on stage and know that I did the work in a smart way, or I had a defendable logic behind it…if things didn’t go my way, well, I really did do my best.”

Skill Development as a Performance Major. James grew up in a musical household with parents who are professional musicians. James was ahead of many of his peers in terms of musical skill and development when he performed in his public school music ensembles, but he described undergraduate education as a humbling experience. “You figure out quickly that you are no longer a big fish in a small pond.”

James recalled his undergraduate studies as an education that solidified his technique as a double bassist. He emphasized the importance of learning solid technique because it allows

musicians to communicate musical ideas. James went through undergraduate education during the COVID-19 pandemic, so he recognized that the circumstances may have influenced his teacher's initial caution. Once restrictions on in-person classes were lifted, James' teacher took his usual approach with students. "He's very particular about my technical approach to pieces. I would say more of it has to do with technique as an undergraduate."

The primary consideration for James when applying to graduate school was its reputation for producing musicians who won positions in major orchestras in the United States. "I definitely wanted to be a part of that competitive culture." Another important consideration was its proximity to a major city with a symphony orchestra. The third consideration was finding an artist teacher in that school with whom he could establish rapport. These factors, in addition to a full scholarship with tuition and board, made it easy for James to select his current school.

James thought it was typical for graduate students to have more freedom to explore because of the assumption that their skills have been honed during undergraduate study. He added that his current teacher was more hands-off with him than with undergraduate students. James enjoyed freedom in making decisions about his recital repertoire. "There's always a circumstance that brings you to that piece…in this case, it was given to me as a recommendation. (My teacher) gives the ultimate decision to me." He added that he wanted to play the piece because his recital program would have been too conservative otherwise:

> I wanted to show something that could show some extended technique, something that…could not only prove that I'm serious about new music but…also make the case for it for the audience. Listening to the recording…I can really see myself doing justice by this piece.

James initially enrolled in graduate school to learn more solo bass repertoire. Instead, the focus of graduate study has been almost exclusively on preparing orchestral excerpts for

auditions. “I really wanted to (work on solo repertoire). I’ve always felt behind…especially when I got here.” This has been a welcome shift for James, however, as he recently won a titled position in a major symphony orchestra in the United States a few months before graduation. James believed, however, in the value of studying solo repertoire even for a musician who was actively auditioning for orchestral positions. He worked with his teacher to include solo repertoire in his study as a way of counteracting the stagnation brought about by constant involvement in the audition circuit.

Summary. James communicated clear goals about what he wanted to accomplish during the early phase practice session, and his practice activities reflected these goals. He listened to professional recordings of different performers performing his solo before practicing the music on his instrument. This process was particularly important for a modern freeform piece such as the *Monody II.* James reported playing some passages slowly as long tones while he looked at the tuning app. He recorded small sections of the piece to gain a third person’s perspective on his sound, a process that allowed him to more effectively plan his subsequent practice sessions. He corrected mistakes but did not dwell on them, opting instead to keep moving through the piece to perform reconnaissance work. James’ high level of skill allowed him an initial reading experience that was free of any noticeable difficulties, allowing him to play musically and pay attention to interpretive details.

During the intermediate phase, James focused on developing fluency for the kinesthetic movements and refining his musical concept of the piece. James diagnosed errors and experimented with different solutions. Whenever he made a change in bowing or fingering, he used repetition to build it into his muscle memory while also cautioning that mindless repetition was always counterproductive to improvement. He shared that his teacher’s involvement in the

intermediate phase of preparation was to provide James with guidance on communicating musical intent to the audience.

James inoculated himself against performance pressure by performing in front of others. He emphasized that final phase practice was not the time to change one's mind about decisions on fingerings and bowings because it will not withstand performance pressure. He added that it was easy for him to be unsure about his readiness for performance, but at some point, he had to decide to trust his own level of preparation. He shared that while he did perform run-throughs during the final phase, he used slow practice extensively as a way of conserving effort and as a means of exercising mindfulness before a performance.

James' music education began early because his parents were both professional musicians who taught him how to listen to music. While his early training put him ahead of his peers in the public school music program, undergraduate education was a humbling experience where he also learned to solidify his instrument technique. He described his undergraduate teacher as someone particular about technique, but James understood that this was also because of the nature of undergraduate study as a vehicle for technique development. In comparison, James' teacher trusted him to take care of learning the basic elements of the music and mostly provided him guidance about communicating musical intent to the audience. James considered institutions for graduate study based on their tradition of excellence and their proximity to a major city with a symphony orchestra. While he initially enrolled to learn more solo bass repertoire, he quickly learned that the focus of his graduate education was preparation for orchestral auditions.

Between-Case Analysis

Comparison between seven case studies revealed several themes: (a) students have similar goals during the three phases of learning even when approaches to learning were

different, (b) students' use of practice tools and aids reflected their dimension of focus, and (c) students perceived their teacher as a guide to musical independence. I used the global and sequential dimensions of the Felder-Silverman (1988) learning styles model and the dimensions of musical performance established by Chaffin and Imreh (1997, 2001, 2002, 2003) to analyze thematic connections between cases. Table 4 shows the summary for themes A and B.

Similarities in Behaviors and Goals During Different Phases of Learning

Cognitive or Early Phase. Participants focused on acquiring an overview and familiarization with the basic dimensions of the piece during the cognitive or early phase of learning. All seven participants reported acquiring an overview primarily by listening to professional recordings, even when they each focused on different facets of the recordings.

Table 4

Summary of participant goals at the three phases of learning

Phase	Participant goals	Frequently used tools
Cognitive	Acquire an overview Familiarity with basic dimensions	Professional recordings Tuner Metronome
Associative	Build fluency with basic dimensions Internalize interpretive dimensions and memorize Refine and pressure test performance	Self-recording apps Professional recordings Metronome
Autonomous	Build endurance Inoculate against performance stress Maintain automatized movements	Self-recording apps

Stephanie thought it was important to be familiar with a piece before attempting to play it on her instrument. "It's so easy to practice something wrong in the early phase, and that can become

part of your muscle memory." Edward shared that knowing what the piece was supposed to sound like helped him process the complicated notation of the virtuoso piece he was about to study. "My ear already knows what's about to happen, which is so helpful because I can't process what I'm looking at. There's far too much going on."

All seven participants reported listening to recordings of the same piece performed by different artists. Edward thought it was important to listen to different recordings to learn about different possibilities for interpretation while developing his own ideas. "We get bogged down by our favorite recordings, then we end up copying it…and I think it takes away from our own individual artistry." All participants reported listening to professional recordings while following the score, but the depth of their score study varied. James, who prepared a contemporary solo work for bass, admitted that he did not dig too deeply into the musical score because recordings of the piece by bassists who knew the composer offered a glimpse into the composer's musical vision. In contrast, Edward examined full scores of his solo because he wanted to know how his own part fit in with the accompaniment. Henry added that while he often followed the score while listening to recordings, he sometimes listened for enjoyment without the score.

Two participants reported that in addition to listening to different versions of the same piece, they also listened to different works by the same composer to gain a better understanding of the composer's style. Edward thought it was important for musicians to be familiar with the composer's musical language. "Best thing if you're studying Mozart…is listen to the arias…everything is so operatic even if it's instrumental." Sandra typically listened to different versions of the same solo, but at the suggestion of her teacher, she listened to arias by Rossini because her solo was based on themes from a Rossini opera. In addition to listening to Rossini, she also listened to arias by Mozart, a composer known to have influenced Rossini. Interestingly, the formal elements of music were not explicitly mentioned by any of the participants except

Edward and Sonia, who talked about sections and themes of the music. Despite this, I observed participants using the formal dimensions of the piece as musical boundaries when they practiced.

After acquiring an overview of the solo by listening to recordings with the score, the typical progression observed in participant videos was to play through the piece and mark preliminary fingerings and bowings as they moved through the piece. All participants played through the piece sequentially from the beginning and stopped when they reached the time limit for their practice video. Sonia specifically mentioned playing through the music soon after acquiring an overview because the process gave her a better understanding of the music. She said, "Obviously, I'm going to make mistakes, but just trying to get through it gives me an understanding of…the flow of the piece." One participant, Edward, reported marking fingerings and bowings before he even played the music on his instrument because he had a clear mental picture of the actions required to play the piece as he looked through the score. He also added that his perfect pitch allowed him to hear the notes in his head.

Some participants explained that playing through the piece for the first time allowed them to scout for difficult sections and make an initial assessment of the time and effort it would take to prepare the piece for performance. James was able to determine after the first reading that his solo was manageable and would not need much time and effort to prepare. "With this, I can really pick any spot to start…there is no clear…problem section. It's fairly consistent…but no areas that make me go, oh my goodness, this is going to take hours upon hours to make it playable." The participants' initial assessment allowed them to create a practice plan. Stephanie, who advocated practicing in reverse chronological order throughout her practice videos, also thought that this approach to planning long-term projects has provided more clarity in setting goals. "You literally build your practicing backward from your recital date."

Some participants reported beginning practice at the difficult sections of the piece immediately after listening to recordings with the score. Edward shared, “Those are the bits that I start with because I know it’s going to take the most amount of time.” Henry and Sonia both reported a similar process during the interview. I did not observe this behavior in the majority of practice videos, but a few participants selected particular practice targets for focused practice after completing a play-through. Sandra, for example, went through her first reading sequentially by playing the first 16 measures of the piece but returned to the passages she found challenging and marked left hand shapes on the music to help her remember finger positions. “I think I’m going to go through and find patterns in the music so I can do slow practice without being overwhelmed by all the notes.”

Six participants reported paying attention to interpretive dimensions of the music during the early phase of learning, even when they were focused on familiarizing themselves with the basic dimensions of their solo. Michelle stated in her first video that one of the most significant changes she implemented during her first year as an undergraduate performance major was to think of musical phrases during the early phase of learning a solo. Throughout her early phase video, Michelle intentionally manipulated bow speed, weight, and sounding point to create different tone colors and dynamic effects and shape phrases. James observed dynamics during his first play-through of the piece, evidence that he was already paying attention to interpretive dimensions of the piece. He also commented about how exploring the character of different passages in the piece will affect decisions about fingerings and bowings.

Stephanie, on the other hand, offered a different view of dynamics as an interpretive element of music. While she demonstrated an attempt at showing musical nuance during her first play-through of the piece, she argued during the interview that dynamics were not interpretive in nature because the composer wrote them in the music. “I think dynamics are…almost as

important as the right notes and the rhythm…but that's not…interpretive, that's something that the composer put in the music. So, of course, I'm going to observe it right away."

One participant reported focusing on only the basic dimensions of the piece during the early phase of learning because she believed those needed to be solidified early in the process. "Just the most basic: rhythm and pitch. If I get those wrong in the early stages…it's very difficult to fix it later on," said Sonia. Her focus on playing the correct pitches during the early phase video confirmed this statement. She added that she found it easier to include interpretive elements when her left hand was more fluent with playing the basic dimensions of the piece, which did not usually happen until the intermediate phase. Despite claiming during the interview that she did not pay attention to interpretive elements during the early phase of learning, however, she very clearly made an effort to observe dynamics and play with the appropriate articulation during her first attempt at the piece.

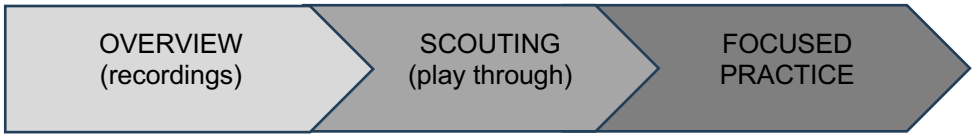
While instrument technique—the physical mechanics required to play an instrument—is classified as a basic dimension of music, a thorough knowledge and control of technique is required to produce a nuanced interpretation of music. Edward was a little more meticulous in his observation of interpretive elements during the early phase of learning his solo. He shared that he made decisions about technical elements that had a direct effect on musical nuance during the early phase of learning. Making these decisions early allowed him to make changes as his interpretation evolved and still have time to work on automatizing his movements. Edward was also very intentional about creating musical nuance early in the process because his priorities have changed throughout his undergraduate education.

To summarize, the typical progression followed by participants during the early phase was to acquire an overview by listening to recordings, play through the piece to scout or identify difficult sections, and focus practice in sections identified as troublesome (see Figure 5). Since

the participants' primary goal during the early phase was to acquire an overview of the piece and to familiarize themselves with the basic dimensions of the music, the participants brushed off mistakes that occurred as they read through their solo and did not spend much time on error correction. While they occasionally seemed frustrated or embarrassed that an invisible observer was witnessing them fumble through the music, they seemed largely unaffected because mistakes were an expected part of sightreading.

Figure 5

Progression of practice activities during the early (cognitive) phase



All participants played through their pieces slowly and engaged in problem-solving behavior that allowed them to play notational elements of the music. They made preliminary decisions about how to play these notational elements that brought them closer to building fluency. Although all participants were focused primarily on the basic dimensions of the music, it was apparent that they were also setting the groundwork for a more nuanced interpretation, whether they were aware of it or not.

All participants reported that their teachers were not involved in the preparation of their solo piece during the early phase of learning. Teachers expected the participants to be able to play through their music by the time they came to their first lesson with the piece. While participants were not expected to present a high level of proficiency with their solo during their first lesson, at the very least, participants were expected to be able to play through their music with a developing fluency in the basic dimensions of the music. This expectation was true for both undergraduate and graduate students. Stephanie likened this expectation to studying the

material before coming to class. “That early phase, kind of like coming to class prepared, having done the readings.” The majority of participants did not play their solos for their teachers until they reached the intermediate phase of learning. Participants emphasized, however, that their respective teachers were always willing to help with problems the participants could not solve on their own.

Associative or Intermediate Phase. The participants’ shared goal during the intermediate phase of learning was building fluency with basic dimensions, internalizing interpretive elements, and refining their performance. Henry described his performance during the intermediate phase as marked by consistency in executing basic dimensions and an increasing sense of confidence in musical decisions. Sandra talked about her increased ability to attend to other details: “When I’m at a spot where I can start working on details instead of just getting notes under my fingers, that’s a big sign that I’m in the intermediate phase.” While Sandra added that another clear indicator was playing the notes fluidly at a slower tempo, Michelle offered a different view. “Being able to play at the right tempo is a big one…when musical aspects aren’t in touch by the more technical ones are ready.” James offered an interesting perspective about how a piece of music developed asymmetrically. “You don’t always work everything exactly at an even pace…you get one section to the intermediate stage before you even start another section.” Despite differing ideas about what their performance during the intermediate phase looked like, the common denominator was the ability to play basic dimensions of the music with increased fluency. Participants were aware of their own progress and kept track of improvement by setting specific proficiency goals.

The developing fluency allowed participants to relinquish cognitive control over the mechanics of playing an instrument and devote more cognitive resources to solidifying interpretive dimensions of the music allowed participants to string shorter sections of music into

more complete sections. Sonia shared, "The intermediate phase is internalizing the music. I try to make longer phrases, longer ideas…whichever section I'm working in, I try to make it a whole thing." I observed a majority of participants freely experimenting to create different tone colors during this phase. Sandra shared that it was a process encouraged by her teacher. "My teacher likes to use the analogy of a science lab…you're doing all the experimentation, trying different things, seeing what works." Edward added that experimentation during practice was necessary for growth.

James thought it was important to make decisions about the basic dimensions of a piece before reaching the intermediate phase of learning. "Hopefully, I have enough information to know exactly how I want to proceed…I want to at least…have the bowing and the fingering that are going to work once everything is at tempo." While it was important to make musical decisions early in the process, the intermediate phase was where participants devoted the most work. I observed the most experimentation with interpretive elements and error correction in participants' intermediate phase video, so changes during this phase were inevitable. James embraced the idea of making changes as a part of learning. "Let's say you start with a fingering idea and realize that at the ideal tempo, it's not practical…on an intellectual level, you practiced it, you started to understand the music better because of that."

Stephanie thought it was important to know a piece well enough during the intermediate phase to be comfortable with starting at any measure. "You're not just building fluency starting from the beginning to the end of a specific section, but you could drop into any point and feel comfortable starting from all those points." She added that this was a good process for memorizing a piece, although she did not perform her piece from memory. I observed three participants practicing their solo partially from memory at this phase. Henry shared made a last-

minute decision to perform from memory, but because Henry thought that memorization was the natural consequence of repetition, he did not have any special procedures for memorizing music.

Sandra and Edward practiced sections of music from memory at this point. While I did not observe Sonia practicing from memory until the final recording, she shared during the interview that she began memorizing her solo during the intermediate phase. Sandra, Edward, and Sonia described a more systematic method of memorizing music rather than as a product of repetition. Sonia started by memorizing patterns in the music. As she gained more fluency in playing passages, she deliberately turned the music stand away, playing shorter sections of music from memory and progressively lengthening these sections. Edward sang musical passages to enhance his memory. Additionally, he paid more attention to transitions in the music because he usually had the most trouble with these sections. "Most of us can memorize themes or big sections. It's threading them together that's challenging." He also used a process he called *memory recall,* where he deliberately played different spots without looking at the music to test how much he remembered. Sandra described her process of memorization as follows:

> I would play it with the music really far away so I can see the outline of the notes, but I'm not staring at the notes. I would also play it with a metronome…faster than I would ever perform it…practiced getting the flow of the piece without focusing on each individual notes.

All participants engaged in error diagnosis and correction during the intermediate phase. While I did not observe any discernible pattern in their repetition, many of them repeated very small segments of passages for correction. Sonia was systematic in her repetitions in that she wanted to reach five correct repetitions before moving to the next target practice. James exclaimed in his video, "Ten more times correct!" Beyond the number of correct repetitions, participants agreed that it was time to move to a different practice target when frustration grew

with repeated mistakes and when the brain was no longer engaged. “If you’re not mindful about your repetitions, then you’re going to unwittingly bake in bad habits.” Sonia shared a similar thought. “If I start to repeat the mistake too many times, I just stop before I learn the mistake.”

Sandra was the most adventurous about applying practice strategies. I observed her applying a cognitive strategy known as *interleaving,* which allowed her to cycle through all the different practice targets without repeating any one target too many times. She confirmed using interleaving during the interview. Sandra shared that she learned this from her high school orchestra teacher. She thought it was an especially helpful strategy for avoiding overuse injury. Sandra also created practice variations for herself to address technical problems in the virtuoso piece she was studying. The process of creating variations helped Sandra improve faster because it engaged her brain.

Because building fluency in playing the basic dimensions of the piece was a goal shared by all participants, I observed them using the most practice strategies in their intermediate phase videos (see Table 5). In this context, a *practice strategy* is an action deliberately applied to a musical passage with the intent of solving problems in execution. All participants were able to run down a list of their favorite strategies during the interview, but the majority of them only applied a handful of strategies during their practice session. The most observed practice strategies were repetition, whole-part-whole, different variations of shifting and intonation work, and tempo manipulation. Many participants also mentioned using rhythmic and bowing variations during the interview, but the majority of them did not use them in their practice videos because they were not useful for the particular piece they were practicing.

Table 5

List of practice strategies for building fluency

Strategy	Justification for use	Example quotes or descriptions
Progressive increase in tempo/tempo variations	Increase fluency with the eventual goal of playing at the target tempo	Sonia: "I will start very slowly because the rhythm is not internalized. I'm gonna start very slowly, making sure that I'm hitting the right notes and that everything is mostly metronomic."
Repetition	Build fluency and "muscle memory"	James: "I just slipped up… so I think what I need to do there to ensure that this doesn't happen again is just a little bit of light drilling."
Whole-part-whole	Isolation of problem areas and performing them back in the context of a larger section	Stephanie: "That's less towards endurance and more just towards making sure that the very small details you just practiced are still effective within playing a larger chunk."
Rhythm and bowing variations	Increase technical facility by manipulating notational elements	Sandra: "I need to come up with little exercises that help me practice patterns in the music like this."
Slow practice	Typically used closer to the performance day as a focusing exercise and a way to conserve energy	James: It's like a calming agent, almost, to practice slowly, and if I can, like, tap into how I feel when I'm playing something through slowly, when it's in the performance, I just feel so much looser."
"Desirable difficulties"	Increasing the challenge by changing the timing at which the tasks are performed	Edward: "I just bounce back and forth with the music. I'll play it a few times, looking at the music, play it a few times not looking, and then without reviewing, I'll go to the other spot and see if I can remember it."
	Avoidance of overuse injuries	Sandra: "This section always makes my hand really tired, so I like to…play another section, then come back to this section, play another section…"

Even when the participants were still in the process of building fluency, internalizing interpretive elements, and refining their performance, several participants were already attending

to the performance dimensions by running through longer sections of music. Some participants even played for others in informal and formal settings, even when their piece was not fully prepared. Sonia specifically asked people who made her nervous to listen to her play to solicit feedback and also to practice performing in front of people. “I do have a few friends back home…I love them dearly, but they can be ruthless when it’s about music…I will sometimes call them…can you listen to me and give me the most honest feedback?” For Edward, playing in front of others helps him cope with nerves. “Embarrassing yourself early on is the greatest thing you can do because it disassociates nervousness.” Stephanie went further by posting videos of her run-through on Facebook because social media’s wider reach was enough to put her in the performance mindset.

The majority of participants agreed that their teachers were more involved in the preparation of solos during the intermediate phase. Sonia shared that she had confidence in her abilities to learn the music during the early phase, but needed her teacher’s guidance once she knew how to play the notes. “He helps me to get pieces into a really good place…I don’t need help learning the piece. I need help to make it sound good.” Teachers provided advice in solving technical issues and guided students in formulating their own interpretation of the piece, such as in Sandra’s case:

> With a piece like Servais, there were definitely lots of technical things he would address for me…at the beginning of the passage that I played in my videos, we worked a lot on getting a really playful character…in my lessons, he would try to make me laugh while I was playing which is something I can’t do in my own practice.

Autonomous or Final Phase. The primary goals for participants during the final phase were to build endurance, pressure-proof their performance, and maintain automatized movements. Participants continued error detection and correction measures during the

intermediate phase. By this time, participants were playing partial or run-throughs of the music and performing for others with increasing frequency, though many of them had been doing this during the intermediate phase of learning. Students who were performing with piano accompaniment have also begun rehearsing with their collaborative pianists at this point.

Three participants talked about using slow practice during the final phase of learning. Sandra admitted that it was tempting to do more run-throughs because it reassured her that she could play the whole piece. She also emphasized the importance of slow practice during the final phase because it helps her maintain the good qualities of sound that she worked hard to achieve. "If you're doing lots of slow practice, focusing on your sound…and intonation…it just makes the performance feel better." Edward used slow practicing to improve his focus and coordination so he could play more accurately in tempo. Similarly, James considered slow practice as some kind of meditative practice before a performance. "If I can tap into how I feel when I'm playing something through slowly, when it's in the performance, I feel so much looser." He added that during orchestra auditions where he would wait for hours for his turn, slow practice allowed him to preserve his energy for the real performance while staying warmed up and loose.

Participants' Use of Practice Tools Reflected Dimension of Focus

All participants either reported or were observed using the following practice tools: (a) professional recordings, (b) video and audio recording phone apps, and (c) a combination tuner and metronome app. Participants did not all specify their sources of professional recordings, but all seemed to have easy access to audio and video recordings of professional performances through streaming services such as Spotify and YouTube. Participants self-recorded their practice using their phones' built-in camera app or an audio-only recording app such as Voice Memo. Most participants reported using a combination tuner and metronome app called Tonal Energy, more popularly known as TE Tuner. The app has a laundry list of functions that include

a metronome with multiple time signatures and subdivision options, a precise tuner with multiple settings, and a tone generator for creating reference pitches and drones. While I occasionally observed participants using practice tools in their practice video, the majority of data about practice tool use was reported by participants during the interview. Based on these reports, the collective data showed that the manner and frequency in which the participants used practice tools changed to reflect their dimension of musical focus. In other words, the participants used practice tools to advance their current goal.

Listening to Professional Recordings. Sonia admitted that because her perceived weakness was in her aural skills and sightreading, she listened to professional recordings of her piece during the early phase of learning as an aural model that helped her learn the basic dimensions of the piece. “My aural skills are not that good to be able to just see the printed music and know how the music sounds like…listening to it…while seeing the sheet music makes it easier for me.” She added that listening to recordings allowed her to make sense of the notational elements on the printed music. “I’m listening for basics—rhythm and pitch—and how does…the sound translate to what I am looking at on the page?” Other students shared that they listened for interpretive elements such as musical style and phrasing when they listened to professional recordings. This was true for Michelle, who focused primarily focused listening to her own part during the early phase of learning. She added that when she listened to recordings during the final phase of learning, she listened to how her part fit in with the accompaniment.

Because students were heavily involved in studying their pieces with their teacher during the intermediate phase, most participants reported listening to professional recordings less. Stephanie shared that she did not deliberately avoid listening to recordings; rather, she was caught up in preparing the piece for performance that she did not consciously think about listening to recordings. While Sandra listened to recordings less because she relied primarily on

her teacher for input, she thought it was helpful to have professional recordings handy in case she had a question about the music and her teacher was not available for an immediate answer. I observed Edward referencing short segments of video recordings of his solo during the intermediate phase. He shared during the interview that he watched videos of performers he admired because he liked observing how they played and visualizing himself playing the same way. In this instance, he wanted to find a way to be less rigid when playing the solo.

Students reported they did not listen to professional recordings by the final phase of learning. Sandra was deliberate about her reasoning for this. “I don’t want to get other ideas in my head at this point since I’ve developed my own.” Henry tapered off listening to recordings beginning during the intermediate phase because he did not want to copy someone else’s interpretation. “If I listen to a bunch of recordings, there will be stuff that I really like in one recording, and I'll try and copy it. But I think it's better to not listen to a lot of recordings when you're putting in a lot of work on the piece, just so you get a clear sense of how you want to play it.”

Combination Tuner and Metronome App Use. Participants varied in their frequency of metronome use. Michelle used a metronome primarily when studying faster, more technical pieces, but did not find it very useful for practicing slow pieces. James used it during the very early phase of learning when playing each note of a passage as a long tone. Edward did not use a metronome at all because he was confident about his internal sense of rhythmic stability, but recognized that it was an important tool that he should be using when practicing.

Most students who used the metronome relied on it more heavily during the early phase of learning when trying to figure out target tempos for their solo**.** When used beyond the early phase of learning, students used the metronome for a variety of purposes. Sandra used it during the intermediate phase to push herself by setting the metronome faster than her goal tempo.

Henry used smaller subdivisions on the metronome when he was first learning the piece to work on precision. He changed to longer beats later in the process to allow him more freedom to execute passages.

Participants used the tuner app more often during the early phase, particularly when they were heavily focused on intonation. Its use tapered off as participants became more secure with their tuning. James described the use of a tuner as necessary because it reinforced the correct note with the exact placement of the finger on the instrument. He meticulously worked on intonation by playing each note as a long tone while watching how well he centered the pitch on the tuner. Edward seemed to agree with this view. Sonia used the tuner extensively in her intermediate phase video to reinforce her aural memory of the passage she was practicing. While she thought this was necessary to play in tune, she eventually practiced the passage without the tuner. She stated did not want to become dependent on the tuner because she would not be able to use it during the performance.

Self-Recording Using Video and Audio Recording Apps. The majority of participants reported using self-recording during the intermediate and final phases. Participants used self-recording during the intermediate phase primarily for error detection and error correction. Michelle shared that she used recording, especially when she had difficulty identifying issues with her playing. Henry used self-recording to listen to basic dimensions of music, such as rhythm, tempo, and pitch, but did not recommend it for listening to tone. During the final phase of learning, some students like Sonia still use it to find and fix mistakes, while some students like James use it to hear how their sound is projected to the audience. Additionally, James used self-recording as a more long-term diagnostic tool. “Usually it has to do with whatever habit I’m trying to address. Every time I take an audition…I want to have a checklist of roughly three habits or fixes I want to make that are big picture on my playing.”

Perceived Role of the Teacher as a Guide to Musical Independence

The two undergraduate students in the sample shared that the biggest realization during their first year as performance majors was that their practice activities were centered on the left hand, the hand responsible for playing pitches on the instrument. Michelle's teacher has taught her to be more conscious of the bow hand's contribution to her interpretation of the music. "My teacher has been encouraging me a lot to not just focus on the notes at the start, but also work in the musicality right from the beginning…if you just leave out that ingredient and then try to add it back at the end, it's a lot less natural." Sandra's teacher has expressed the same observation. "My current teacher… has been showing me that I am really left hand centered…the two of us have been working a lot on putting more focus and emphasis onto my right hand since I got to college."

After one year as performance majors, the two undergraduate freshmen in the sample experienced growth after a change in environment and perspective. For Michelle, becoming a performance major allowed her to leave behind distractions and focus on playing her instrument. "(In high school), I was not very methodical in my practicing. I was very busy…I didn't practice more than an hour in a day." Sandra realized that her pre-college and current teachers agreed on many of the principles of instrument technique, even when they approached teaching differently. "(My teachers) don't disagree with each other… I'm just realizing that I need to change the way I practice." For senior Edward, his growth as a musician began after acute tendonitis kept him from playing violin for three months during his freshman year. "I practiced as much as I could in terrible ways, because I had, I had no idea what I was doing." He described the process of rebuilding his technique to avoid another injury. "I relearned how to hold it…how to set up everything…basically started from scratch."

While the eventual goal of education was to shape independent learners, students like Edward, whose teachers were active performers themselves, had to develop independence sooner. Edward shared that throughout the process of preparing the Ysaÿe solo for his recital, he only had two lessons with his teacher. Edward added that his recital repertoire was rather heavy for the five-week preparation timeline he set for himself. The combination of challenges in scheduling a weekly lesson and the number of heavy pieces on his recital program limited the time his teacher could spend on any one of his solos. Edward was thankful that from the time he was a freshman, his teacher taught him how to be independent. "My freshman year…he held my hand a lot more…as I've started competing and having my own engagements…it's been a little less frequent…my teacher's greatest influence on me is teaching me how to think for myself because I see him a little infrequently." Edward credits the independence he learned from his teacher for the notable career milestones he has accomplished as a 22-year-old student.

Among the graduate students who participated in this study, there was a consensus that undergraduate study was primarily about developing instrument technique and learning how to practice effectively, while graduate study was focused on their own voice as an artist. Sonia shared that she did not have much freedom to select repertoire during her undergraduate studies. Her teacher was also more particular about the basic dimensions of a piece. "I was told what to do…even fingerings and bowings." While Henry's undergraduate teacher did not dictate how he should interpret a particular solo, the teacher was particular about the precise execution of basic dimensions of the piece. He credited this meticulousness teaching to his highly developed technique. James' teacher was also particular about the technical approach to pieces while allowing James to be free about musical interpretation. Stephanie's teacher gave her a solid technical foundation on the viola while also teaching her to practice effectively using the backward planning method.

Graduate students agreed that because they were perceived to have established their technical foundation during undergraduate study, their applied music teachers were more liberal in their approach to teaching. There was a consensus that their teachers trusted them to be more independent and required less intervention when preparing a solo. The participants also perceive their teachers to be more welcoming of the participants' decisions about music, whether they were decisions about fingerings, bowings, or musical interpretation. When students made a decision that did not fall within acceptable performance norms, however, the participants felt that their teachers would rein them in. The freedom to discover their own artistry has encouraged the participants to select their own recital repertoire, many of them choosing to play music by underplayed and underrepresented composers rather than the staple repertoire for their respective instruments. While the participants did not perceive that their teachers taught less technique, the focus of instruction has been on how to use technique to communicate their musical vision or intent to the audience.

Chapter 5: Discussion

The data collected through interviews and video observations showed that the participants, regardless of their years of study, pursued similar goals through the three phases of learning. In the cognitive or early phase. Participants focused on acquiring an overview of the piece. They also familiarized themselves with basic dimensions of the music, such as tempo, rhythm, and pitch.

The highest level of variety in practice activities occurred during the intermediate phase because participants were attempting to balance different goals. The primary goal was to build fluency with basic dimensions of the music while integrating interpretive dimensions. Participants pursued refinement through error detection and correction and the use of diverse practice strategies. Some participants had already begun memorizing their music and practicing performing in front of others.

The autonomous or final phase centered on building endurance, performance stress inoculation, and maintenance of proficiency. Participants continued error diagnosis and correction while increasing audience exposure. Some participants reported maintaining proficiency through slow, mindful practice as the performance date drew closer.

The most popular practice tools amongst participants were: (a) professional recordings, (b) video and audio recording phone apps, and (c) a combination tuner and metronome app. Participants used these tools to advance their practice goals. As their goals changed, tool use also evolved. Participants varied in their frequency of metronome use. Metronome use was more common during the early phase when participants needed to establish tempo targets**.** Beyond the early phase, participants used the metronome selectively to gain rhythmic accuracy and progressively work towards playing at the target tempo. Tuner use was more common during the early phase, especially among students who focused on intonation. In contrast, self-recording

was minimal during the early phase but increased during the intermediate and final phases as students focused more on refinement and performance practice.

Participant responses indicated that increased skill and experience led to more artistic freedom. Undergraduate study was largely geared towards establishing a solid foundational technique. Teachers were more particular about assigning repertoire and emphasized specific technical approaches. Graduate students, on the other hand, had more autonomy to choose repertoire and shape their interpretation of music. This shift in teaching approaches highlights the evolving role of teachers in developing independent musicianship.

Limitations and Participant Bias

The small sample size of this study limits generalizability. Although I contacted 20 diverse music schools, five out of seven students who responded were from highly selective institutions. While my goal was to present a realistic picture of how performance majors prepared solo repertoire for an actual performance, researchers have documented that observed practice behaviors did not often reflect actual practice behaviors (Chaffin and Imreh, 2001; Geringer & Kostka, 1984; Mikzsa & Tan, 2015). Additionally, participants may have behaved differently when recording practice session videos because they were aware that an invisible observer was reviewing their videos, a documented phenomenon known as the camera or observer effect (Barron, 2007; Becker & Martinique, 2014). While there was no easy way to mitigate observer effects, I attempted to make participants feel at ease by giving them instructions to practice normally. Additionally, I told participants they were free to provide as much or as little commentary as they wished. Considering these variables, one must always be cautious about generalizing the findings of this study to the larger population.

Strengths of the Current Study: Capturing Practicing Over Time

A key strength of the current study is the use of real-world, longitudinal data collection that more accurately captures practice behavior of music performance majors. Unlike research studies that observed practice behavior in experimental or quasi-experimental settings, this study followed participants as they prepared solo repertoire for a recital performance. The current study allowed observation of practice behavior in real-world contexts like studies by Nielsen (1999a; 1999b). The current study attempted to address known limitations in behavioral observations by incorporating interview data as a means of triangulation. This approach to qualitative research was recommended by Ravitch and Carl (2016) and Yin (2017). By collecting data tied to a real performance timeline, the study offers strong, valid insights into a musician's skill development over a period of time. Additionally, Fitts and Posner's (1967) phases of skill learning—a theory that has seen wide application in sports science—can offer a unique insight into studying skill development in musicians.

Coherence with Existing Literature

Participants Have Similar Goals During Different Phases of Learning

Cognitive or Early Phase. Fitts and Posner (1967) observed that movements during the cognitive or early phase were slow as a result of step-by-step thinking to accomplish the task. In addition to slow movements, mistakes were also predominant. Consistent with Fitts and Posner's (1967) findings, participants of the current study performed passages in a slow tempo and with many errors in execution. While the participants were all skilled musicians, the new task required them to apply previously learned skills to a new setting, likely contributing to the intellectualization of movements.

Examination of the music score without listening to the recording seemed to be an unpopular method of acquiring an overview, even for the performance majors in this sample,

students who are assumed to be advanced musicians. In contrast, prior research found that high achieving students preferred score study to gain an overview of a piece (Hallam et al., 2012; Marin et al., 2013). Hallam (1992) found that the success of the score study approach, however, was highly dependent on the ability to *audiate,* defined by the Gordon Institute for Music Learning [GIML] (n.d.) as the ability to form a mental representation of music even when the sound is not physically present. One participant in the current study, Edward, was an outlier, preferring to examine the musical score before listening to professional recordings, just like the top-performing pianist in a study by Suzuki and Mitchell (2021). While the levels of participants' proficiency fall beyond the scope of the current study, Edward's notable musical achievements provided evidence of his advanced skill. Additionally, Edward also reported having perfect pitch, highlighting that auditory abilities may influence learning preferences.

All seven participants acquired an overview of the piece primarily by listening to professional recordings while following the musical score (Suzuki & Mitchell, 2021; Wilson, 2023). Participants who were confident with their aural skills focused on interpretive nuances, while less confident participants listened to basic dimensions of the music. This finding can be explained by cognitive load differences, with advanced students being more capable of processing multiple dimensions of music simultaneously (Hallam, 1992). The current study showed that listening was an essential method of acquiring an overview despite differences in focus.

The current study reinforces Hallam's (1992) findings that the global approach was a temporary learning strategy rather than a preferred learning approach. After acquiring an initial overview of the piece by listening to professional recordings, participants diverged into multiple learning approaches too complicated to be explained by any one learning model. This finding highlights the complexity of learning behaviors in music practice. While acquiring a global

overview through listening to professional recordings may provide an accessible entry point, it is not a long-term learning strategy employed by musicians.

Most participants played through the piece in what Chaffin et al. (2003) described as an "under tempo scouting run." Two participants reported identifying difficult passages during the initial overview and began practicing in those sections. Despite the prevalence of errors during this scouting run, error correction did not appear to be a priority at this point, likely because familiarization with the music was the priority (Chaffin et al., 2003). This demonstrates prioritization of familiarity over precision during the early phase.

Previous literature indicated a shift in preference for methods to acquire an initial overview. Hallam et al. (2012) and Marin et al. (2013) reported that high achieving students preferred to gain a global sense of a piece by examining the score. Violoti and Williamon (2017) and Wilson (2023), on the other hand, reported a preference for recordings over musical scores among conservatory and high school students. This shift in preference likely reflected the growing accessibility of online resources. Easy access to online content has reshaped the way musicians learn music, with performances by respected artists now accessible and specifically released on free streaming platforms such as YouTube.

Associative or Intermediate Phase. After acquiring an overview and familiarizing themselves with basic dimensions of the music, participants transitioned into the intermediate phase, where goals and practice activities became more complex. The intermediate phase is characterized by increased fluency and fewer errors as individuals learn to apply an already established skill set to a new situation. Participants described playing with greater ease during the intermediate phase, aligning with Fitts and Posner's (1967) learning model.

The growing fluency in performing basic dimensions of the music allowed participants to shift their focus to interpretive elements. Consistent with Wilson's (2023) findings, participants

engaged in high levels of error detection and correction during this stage while employing a diverse range of practice strategies. Additionally, participants were aware of their progress and kept track of improvement by setting specific proficiency goals. This contrasted with findings by Mornell et al. (2020), where participants were unable to detect improvement even when they were making progress, leading to feelings of demotivation by the end of the practice session.

Participants applied the largest number and variety of practice strategies during the intermediate phase to advance their common goal of building fluency in basic dimensions of music, a finding supported by Wilson (2023). The list of practice strategies participants shared during the interview, however, was longer than practice strategies I observed in their videos. This finding is consistent with previous research (Barry, 2007; Bugos & High, 2009). One factor that may have contributed to this discrepancy is that different types of repertoire have different technical demands, and musicians adjust their strategy use according to the context (Strietelmeier, 2020). It was also impossible to document all practice behaviors from 20- to 30-minute practice videos. At best, these videos offered a small window into the participants' practice behaviors.

Repetition was the most widely used strategy among participants for building fluency, reinforcing findings from prior research (Byo & Cassidy, 2008; Maynard, 2006). Many participants reported and were observed *drilling*—the repetition of musical patterns—to internalize movements. Most participants repeated the music as exactly written while systematically counting repetitions. A few participants, however, employed more creative approaches that involved variations in rhythm, bowing, and execution of small fragments of music. One participant, Sandra, presented the most complicated variations to target specific technical issues in every passage. According to Sandra, this method kept her mind fully engaged

during practice and possibly improved retention (Bjork & Bjork, 2020). Despite variations in execution, all participants recognized the importance of repetition in building fluency.

Even when the participants were still in the process of building fluency, internalizing interpretive elements, and refining their performance, several participants were already attending to the performance dimensions by running through longer sections of music. Some participants even played for others in informal and formal settings, even when their piece was not fully prepared. Sonia specifically asked people who made her nervous to listen to her play to solicit feedback and also to practice performing in front of people. “I do have a few friends back home…I love them dearly, but they can be ruthless when it’s about music…I will sometimes call them…can you listen to me and give me the most honest feedback?” For Edward, playing in front of others helps him cope with nerves. “Embarrassing yourself early on is the greatest thing you can do because it disassociates nervousness.” Stephanie went further by posting videos of her run-through on Facebook because social media’s wider reach was enough to put her in the performance mindset.

Interestingly, participants in the current study had already begun integrating performance elements and memorization techniques during the intermediate phase. In contrast, Wilson (2023) reported that most participants did not employ performance-focused strategies such as partial and full run-throughs and performing for others until the final phase. This suggests that performance majors were able to integrate basic, interpretive, and performance dimensions earlier in the learning process than previously documented.

Autonomous or Final Phase. Participants continued practice activities observed during the intermediate phase into the final phase with less emphasis on error correction for increased emphasis on maintaining highly practiced, automatized movements. While participants still corrected errors, this appeared to be less of a priority (Chaffin et al., 2003). Fitts and Posner

(1967) stated that while improvement was still possible during the final phase of learning, the rate of improvement also progressively decreased. Participants seemed to understand this principle intuitively as they avoided making major changes in execution and focused instead on inoculating their performance against stress by performing in front of others or recording their performance attempts. This shift reflected participants' awareness that maintaining automatized movements and making them resistant to outside interference was necessary for a successful performance.

Participants in the current study integrated performance practice earlier than expected, beginning in the intermediate phase. Participants performed run-throughs in a progressive manner, stitching smaller sections together to form a longer unit of music with the eventual goal of running through the whole piece (Suzuki & Mitchell, 2021). Some participants performed run-throughs even when the technical elements were not fully polished, as Sandra did: "I'm gonna run through the piece not expecting it to be good but just for the purpose of practice performing." Additionally, participants performed in front of others to simulate performance stress. This contrasts with the findings of Wilson (2023) and Hallam (1992), who found that participants delayed performance stress exposure until the final phase. These findings support the view that performance practice must be integrated earlier in the learning process to adequately prepare for the stress of live performance.

Evolving Use of Practice Tools

Participants adapted the use of practice tools such as the metronome and self-recording as their learning goals and dimension of focus evolved. Hallam et al. (2012) observed that students incorporated these tools as their skills grew. Consistent with a study by Wilson (2023), participants used practice tools differently as they progressed through three phases of learning. During the early phase, for example, participants listened to professional recordings to gain an

overview of the piece and gain interpretive ideas. As their study of the piece deepened during the intermediate phase, participants listened less. During the final phase, some participants deliberately avoided listening to recordings to protect their carefully crafted interpretations from outside influence. Violoti and Williamon (2017) found that students were more likely to be influenced by professional recordings when formulating their interpretation of the piece, so the participants of the current study were justified in their avoidance. This finding supported the idea that participants used practice tools to advance their evolving practice goals.

Perceived Role of Teacher as Guide to Musical Independence

The participants perceived their respective teachers' role in their education as one that progressively guided them towards independence. Well-developed self-regulation was certainly evident in the participants' practice session videos, consistent with Kim's (2010) findings. While undergraduate Michelle and Sandra had limited perspective on how a teacher's role changed as students gained more skill and experience, senior Edward and graduate students Stephanie, James, Sonia, and Henry confirmed this evolving role during the interview.

Among the graduate students, there was a consensus that undergraduate study was primarily about building technique and learning effective practice methods (Maynard, 2006). In general, the more experienced participants had a clearer idea of planning practice to meet performance goals. Graduate student Stephanie, for example, learned "backwards planning," an approach shown to influence higher order thinking skills (Wiese et al., 2016) from her undergraduate viola professor and used it extensively as a practice strategy and a method of planning long term projects. Like the top performing pianist in a study by Suzuki and Mitchell (2021), senior Edward and graduate student James made sure they identified difficult sections in the music during the initial reading of the piece. In contrast, freshman Michelle felt that her first year as a performance major was an education about becoming more organized with her

practicing. While experience may not always guarantee the ability to engage in effective practice (Byo & Cassidy, 2008; Geringer & Kostka, 1984; Liu, 2024; Mikzsa & Tan, 2015), explicit instruction on effective practice methods during applied lessons can solidify students' ability to practice effectively (Barry, 2007).

Graduate students perceived that their graduate professors focused on developing artistic individuality. While their undergraduate professors were more particular about technical approaches to repertoire and expected students to follow them, their graduate professors trusted them to handle the technical challenges of the music without much intervention. This trust in graduate students' motivation to practice and the ability to self-regulate is supported by Liu (2023). During lessons, graduate students mostly received musical advice from their professors, who ultimately left musical decisions to the students. Additionally, graduate professors approached the teaching of technique as a tool for communicating musical intent and artistic preferences rather than a means to recreate notational elements such as notes and rhythms. These perspectives highlight how teachers progressively shaped students' independence and ability to self-regulate in practice throughout their education.

Directions for Future Research

An effective method for teaching practice skills must be tailored to its target population, making it necessary to learn more about the practice habits of various groups of students. The body of knowledge on this topic, however, remains limited, particularly concerning examining the process of how students learn the same piece at different points in time in a real-world scenario. Hallam (1992) suggested that musicians may have different processes for learning solo and orchestral repertoire. Researchers can explore how the same group of students study orchestral literature at different phases of learning. Additionally, the study of practice behavior must not be limited to elite-level students. As a public school educator, private lessons are not

accessible to all students (Yuen, 2021), so it is important to learn how these students practice without instruction outside what they learn in the classroom. Research can show how school-aged children learn solos at different phases of learning while relying only on skills they learn in their school instrumental ensemble. By investigating cognitive models and their alignment with real-world learning behaviors—from public schools to elite conservatories—future research can provide a framework that supports learning amongst diverse populations and across phases of musical development.

Implications for Education

Practice is a complex activity that involves many facets of human behavior and cognition. While the participants in this study demonstrated highly developed practice and self-regulatory skills, these skills were achieved through years of guided instruction from expert teachers. We must remember that, like instrumental technique, practice skills can be learned (Mieder & Bugos, 2017; Miksza, 2015; Weidner, 2021).

Young and inexperienced students focused primarily on the basic dimensions of music (Wilson, 2023). Understandably, they have not yet acquired the technique to create sophisticated sounds on their instruments, but as teachers, we can begin planting this seed early. While technique allows a musician to harness the possibilities of the instrument, the ultimate goal of using technique is to advance artistic interpretation (Galamian, 1962). To this end, the teacher must not only teach technique to play notes and rhythms. A string teacher, for example, can teach students how sounding point, bow weight, and bow speed interact to produce a variety of sounds and allow students to apply these tone colors to different emotions.

School-age children have access to apps that can be helpful tools for practicing. As teachers, we should not assume that students know how to use these apps effectively during practice, even when technology use is a regular part of their waking life. As Barry (2007) found,

students were more likely to incorporate practice strategy use if teachers provided demonstrations, reflective feedback, and opportunities to experience the techniques during the lesson. Additionally, the top-ranked pianist in a study by Suzuki and Mitchell (2021) indicated that learning to practice was a regular component of applied music lessons. If we want students to use practice tools effectively during individual practice, we must deliberately include lessons during rehearsals that allow students to learn and experience different functions of the apps while we are around to give them feedback.

Professional recordings can be a valuable tool as an aural model for young students. Violoti and Williamon (2017) found that students were more likely to be influenced by professional recordings when formulating their interpretation of a piece. While the advanced students in the current study can discern quality recordings, inexperienced students have not yet developed that skill. Listening to inferior performance can be detrimental to the development of their concept of tone and musicality. Teachers play an important role in curating a list of ideal recordings that provide good aural models, as unfettered access to recordings through the internet can be overwhelming to a young student.

Breaking down a large work into smaller, manageable pieces is necessary for practice. At some point, however, musicians must perform the work as a whole, but Hallam (1992) and Wilson (2023) reported that students typically waited until the final phase before building endurance and integrating performance stress. Performance stress affects performance, yet many students do not prepare adequately to manage it. Teachers must create opportunities for students to incorporate performance practice earlier in the learning process, as students may not willingly pursue this on their own.

While the participants in the current study showed evidence of well-developed practice and self-regulation skills, several studies on music majors revealed the contrary (Duke et al.,

2009; Maynard, 2006; Mornell et al., 2020; Suzuki & Mitchell, 2021). Rather than assuming music majors already have highly developed practice skills, teachers must explicitly teach practice skills during applied music lessons (Barry, 2007; Suzuki & Mitchell, 2021). These findings circle back to the argument that teachers must be primarily responsible for teaching students—regardless of achievement level—effective practice skills.

Finally, the work on Fitts and Posner (1967) offered a valuable insight into how humans learn in phases, with certain behaviors indicative of each phase. The theory's widespread applicability is evidenced by diverse studies across multiple domains. The current study expands its applicability to music learning. Recognizing that humans learn in phases is vital for teachers as we formulate activities that properly support students and enhance learning (Pennington et al., 2001). Integrating Fitts and Posner's (1967) theory not only informs educational practice but also supports the developmental needs of students.

Without explicit instruction on effective practice techniques, students are left to decipher a complex process on their own. It is therefore important that music educators make a deliberate effort to teach practice and self-regulation skills to their students. Teachers are in a powerful position in this regard, and we must not take our influence lightly.

Conclusion

My journey to this dissertation was a long one, stemming from the time I first held a violin 38 years ago. I was ten years old when my parents enrolled me in a government-funded community music school in the Philippines that provided group lessons for orchestral string instruments. Throughout my study there, I remember being singled out and publicly humiliated by my teachers for being one of the weaker students. I was labeled as "untalented" and "lazy" by my teachers, and after four years of slow improvement, I was removed from the program.

Determined to find another way to play the violin, I connected with Filipino Juilliard alumnus, Basilio Manalo, who was my private violin teacher from my freshman year in high school to my senior year in college. I improved tremendously under his tutelage, but because I started private much later than my peers—many of whom have been studying privately since they were five—I was very insecure about my abilities even when I was proficient enough to win an orchestral audition in the Philippines. I moved to the United States in 2001 and began my teaching career in 2005 when I was hired to build the orchestra program of a new high school in San Antonio, TX. In many ways, my motivation to become a teacher was driven by my teachers' failures during my formative years of music learning. I wanted to be the teacher I never had, who encouraged children to stay with music even when they were struggling. Little did I know that my own sob story would fuel my interest in the study of skill acquisition and practice.

Knowing what I know now, my 10-year-old self was probably overwhelmed with the details of playing a complicated instrument like the violin. Armed with nothing except directions to "Go practice!" practicing likely seemed like a chore that brought so much frustration that I avoided it. After all this research on effective practice, I know that asking young children to practice without deliberate instruction on how to do it is asking too much of them. The study of skill acquisition and practice was interesting to me because it gave hope to people like me who were not identified as naturals, that proficiency is attainable with the right kind of practice.

My idea of teaching students how to practice was to model effective practicing during rehearsals. I was operating under the idea that if I repeatedly exposed my students to effective practice techniques during class, they would automatically absorb these techniques like sponges and apply them to independent practice. This approach may have had a positive effect on my students, judging from how well my orchestras played despite having a majority of students who did not take private lessons. After spending four years researching this phenomenon, I now know

that this approach does not guarantee that students will use effective practice techniques during independent practice.

The COVID-19 pandemic was difficult for my students, many of them losing motivation because the ban on large group gatherings and public performances kept them from performing with others and for others. During the lockdown that began in March 2020, I discovered the work of Anders Ericsson on deliberate practice through an online seminar. In an attempt to keep my students motivated to practice through the notable absence of public performances the following school year, I put my newfound obsession with skill acquisition and deliberate practice to use. Even my haphazardly organized attempts at educating them about effective practice strategies gave them a sense of accomplishment. Around that time, I also enrolled in my first qualitative research class at Auburn University. Four years later, I've completed research projects on the practice behaviors of two different groups of students.

Even as a veteran teacher who has established successful programs, my teaching has evolved as I learned from my research. I had the privilege of observing the practice behaviors of high-achieving musicians. I took their best practices and implemented them into my ensemble rehearsals and my own independent violin and viola practice. One major change I have implemented during ensemble rehearsals was to incorporate run-throughs beginning in the intermediate phase, when students have achieved some fluency with the basic dimensions of the music, instead of saving them for the week before or the week of the performance. I used to think that high-achieving musicians only performed run-throughs when all details of the piece had been polished. Knowing that advanced students performed partial run-throughs before they even reached the final phase of preparation was refreshing. The idea that everything had to be spotless before students began making attempts at playing longer sections of music did not teach students how to deal with the very real possibility of making mistakes when confronted with performance

stress. Performing run-throughs earlier in preparation taught students how to calmly adjust to performance mishaps.

Perhaps the greatest benefit my research has brought to my teaching was that I have since let go of the naïve notion that students absorbed effective practice techniques I model during rehearsals. I regularly incorporate deliberate teaching of practice techniques into my rehearsals. I teach students the steps they need to take when learning a new piece. I teach them practice strategies that they can apply to solve different technical issues. I teach them how to use metronome and tuner apps. I teach my students how to do all these things that can help them practice more effectively and feel a sense of accomplishment, but I stopped assuming that they will incorporate these approaches into independent practice after only watching repetitive demonstrations.

During rehearsals, I provide opportunities for students to individually experience what they have learned while I am in the same room to provide them with feedback. For example, after demonstrating a specific practice strategy during class on an appropriate section of the music, I give the students several minutes of "chaos" when they are all practicing independently in the same room while I walk around and observe. To further reinforce the lesson, I give them an assignment where they submit a short video demonstration of how they applied a particular practice technique to an assigned excerpt, usually the most challenging sections of their orchestra music. I found that these practice assignments set students up for success for the excerpt performance test later in the grading cycle. Consequently, the students' individual improvement has resulted in collective success at our concerts.

In the immediate future, I hope to share what I have learned with the music education community. My plans include publishing my research in both peer-reviewed and practitioner journals. I recently submitted a proposal for the Pennsylvania Music Educators Association

(PMEA) state conference for a clinic on the practical applications of my research to teaching practice skills in an ensemble setting. This is but a small effort in the larger scheme of things, but I am proud to contribute to the role of music education as a positive force in students' lives.

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Appendix A

Detailed Commands for ChatGPT Qualitative Data Analysis of Participant Interview Transcript

Purpose	Associated command
Analyze interview transcript for initial coding	I will upload a transcript for an interview with a music performance major where I asked questions about the participant approached preparing a piece for performance at three different phases of learning by Fitts and Posner (cognitive or early, associative or intermediate, and autonomous or final). I also asked questions about how the participant's applied music teacher provided guidance on preparing a solo piece for performance. I want you to review this transcript and code it (a code is a unit of analysis in qualitative research) with descriptive codes that are detailed but not too wordy. The participant's name is _____ and the interviewer's name is Nile Wilson. Only apply codes to (the participant's) responses. I want codes to be as descriptive, self-explanatory and specific as possible, rather than short or abstract. I want all accounts, reported experiences, opinions, and comments, to be coded. As the output, I want you to provide a list of codes you created, and under each code I want you to provide a full segment of text (e.g. a sentence or part of a sentence) to which this code was applied.
List codes without associated quotes to initiate manual focused coding	Now, I want you to show the codes you developed as a list, without the associated quotes.
Group codes into categories	I want you to group the list of codes into broader categories.
Find recurring themes	From the categories of codes you created, find recurring themes. When you develop a list of themes, I also want you to find and list example quotes as evidence for each recurring theme.
Provide editing suggestions for clarity and logical flow of sentences in a paragraph.	Read the uploaded text and provide suggestions for clarity and logical flow of each paragraph.

Appendix B

Information letter

Undergraduate and Graduate String Instrumentalists' Approaches to Learning New Solo Repertoire: Descriptive Case Studies of Deliberate Practice Using the Fitts and Posner Model of Skill Learning

WHO IS THE RESEARCHER?

My name is Nile Wilson, and I am a PhD student at Auburn University majoring in Instrumental Music Education. I am also a violinist, violist, and orchestra director in Landisville, Pennsylvania. I have been teaching orchestra for 20 years. I am working under the supervision of Dr. Nancy Barry, principal investigator.

WHO IS ELIGIBLE?

Freshmen, seniors, and graduate violin, viola, cello, and double bass performance majors currently enrolled in a degree or certificate program in a music school in the United States and are at least 18 years of age are eligible to participate. <u>You must be in the sightreading or early phase of preparing a solo piece for performance within the current school year.</u>

WHAT IS EXPECTED OF ME IF I CHOOSE TO PARTICIPATE?

1. If you decide to participate, you will record and submit a total of three 20- to 30-minute videos of yourself practicing your new solo piece at different phases of learning: early, intermediate, and final.

2. I will ask for a PDF of image of your sheet music with your markings and annotations. If you keep a practice journal, I will request an electronic copy of your entries on the dates you recorded your practice videos.

3. After you submit your final practice video, you will schedule a 30-minute Zoom interview to answer questions about your practice habits. I will share the interview questions with you in advance to give you an opportunity to think about your answers. This interview will be recorded so that I can create a written transcript for you to review and verify through email communication. Only the principal investigator and I will have access to these videos, and written transcripts will not have identifiable information.

WILL I BE FINANCIALLY COMPENSATED FOR MY TIME?

Yes! You will receive $100 upon completion of all activities required for the study. I will send all payments electronically either as an Amazon gift card or through Venmo. In addition, I will mail you a set of strings for your instrument courtesy of D'addario Strings.

WHEN AND WHERE WILL THE INTERVIEW BE SCHEDULED?

The interview will be held through Zoom at a time that is convenient for everyone involved.

HOW WILL YOU PROTECT MY PRIVACY?

I will use security measures on Zoom to make sure that no unauthorized users join the call. I will assign you a pseudonym and remove any information that can identify you to anyone who reads the final report. All data will be kept in a secure cloud storage service called AU Box. Only the principal investigator and I will have access to the video or audio recording, interview transcript, and data with identifiable information.

WHAT IF I CHANGE MY MIND ABOUT PARTICIPATING?

You can choose to withdraw at any time with no negative consequences to you. You will only be compensated, however, if you complete all required activities.

I'M CONVINCED! HOW DO I SIGN UP?

First of all, thank you! To start the process, contact me, Nile Wilson at nmw0019@auburn.edu or text or call my personal cellphone at 717-654-4148. You may also contact me if you have any questions about the study.

Appendix C

Semi-structured Interview Protocol

Undergraduate and Graduate String Instrumentalists' Approaches to Learning New Solo Repertoire: Descriptive Case Studies of Deliberate Practice Using the Fitts and Posner Model of Skill Learning

PRE-INTERVIEW SCRIPT

Script for Introductory Message

Thank you for your willingness to participate in this interview. My name is Nile Wilson, and I am a graduate student at Auburn University. I also teach middle school and high school orchestra. The goal of my study is to understand how undergraduate and graduate string musicians at different years of enrollment at three different music school classifications learn a new solo from sightreading to performance. I would like to learn if students use different practice strategies as they become more familiar with the new solo. This interview will last for approximately 30 minutes. I will ask you questions about your musical experience, training, and practice habits.

The information you share with me today will be kept confidential. I will not call you by your real name during this interview. All identifying information about you will be removed so that no one can figure out who you are. All recordings will be uploaded to a cloud storage service called AU Box. This secure service has been approved by Auburn University for storing research data with identifiable information. As soon as I successfully complete my dissertation presentation, I will delete these recordings from AU Box.

Information Letter and Informed Consent

Before we begin the interview, I would like to confirm that you read the information letter that provided details about the study. Do you have any questions about the process?

Do I have your permission to continue with this interview?

Thank you for agreeing to participate. Remember that you may refuse to answer any question that makes you feel uncomfortable. You may also stop the interview at any time if you do not wish to continue. No one will be upset if you choose to do this.

I will be recording the interview to make sure that I can accurately recall our conversation and create a written transcript for review. No one has access to this recording except me and my supervising professor. If it will make you feel more comfortable, you may turn off your camera during the interview. I will be addressing you with the pseudonym _____.

Do I have permission to record the interview? Thank you. I will start recording our interview now.

MAIN INTERVIEW SCRIPT (SEMI-STRUCTURED)
RESEARCH QUESTIONS:
R1: How do freshman, senior, and graduate string performance majors practice solo repertoire during the early, intermediate, and final phases of preparation?
R2: How do students measure progress?
R3: How do students handle errors during practice?
R4: What practice strategies do students use and why?
R5: If students change their practice approach and strategies at different phases of preparation, what are the factors that drive this change?
R6: How do students perceive their applied professor's approach to teaching practice skills?
R7: To what extent do students in different stages of university enrollment vary in their approach to learning a new solo piece?

QUESTIONS	WU/ BG	R1	R2	R3	R4	R5	R6	R7
Warm-up/background Education Program Enrollment • In what degree program are you currently enrolled? • What year are you in your study? • Tell me about your musical training. (Possible prompts) • What is your primary instrument? • At what age or grade did you start playing your instrument? • When did you start taking private lessons? • What professional goals do you think this degree will help you accomplish after you graduate? • Do you currently perform with a professional orchestra either as a member or a substitute	X							
Warm-up/background I am going to ask you questions about your general practice habits. (Possible prompts) • How often do you practice? • Do you have a set schedule for practicing each week? • How much time do you spend on each session? • How much time to you spend playing different segments of your practice session? • How do you know what to practice during each session?	X							
Warm-up/background I'd like to ask you questions about the solo piece you used for this study: - What solo piece(s) are your preparing? When will perform this piece?	X							

QUESTIONS	WU/ BG	R1	R2	R3	R4	R5	R6	R7
<u>Initial learning process</u> • I will ask you questions about your approach to learning this particular solo. • Walk me through the very early phases of learning this piece. • If you didn't play the piece on your instrument right away, describe what you did when you first played the piece on your instrument. • Describe how your first couple of attempts at playing the new piece went. • What were your goals during the early phases of learning this solo? • Did you listen to recordings during this phase? Why or why not? • Did you use any practice tools during this early phase of learning a new solo? • Give me examples of when you would use these tools during the early phases of learning a piece. • Describe what you did in your applied music lessons when your teacher first assigned this piece to you.		X	X	X	X	X	X	X
<u>Improvement</u> (Possible prompts) • How did know you were past the familiarization phase? • How did you approach practicing when you were past the familiarization phase? • How do you know when something you have been practicing has improved? • Describe what you do when you make mistakes. • Tell me about the different things you did to practice tough spots. You can give examples of specific spots, what the problems were, and what you did to fix them. • Describe how you and your teacher work on difficult spots during your lessons. • Did you use any practice tools during this intermediate phase of learning a new solo? • Give me examples of when you would use these tools during this phase of the process?		X	X	X	X	X	X	X

QUESTIONS	WU/ BG	R1	R2	R3	R4	R5	R6	R7
Improvement/performance readiness (Possible prompts) • How do you know a solo piece is ready for performance? • Are there any particular things that tell you that a piece you are preparing is ready to be performed? • At what point did you prepare this piece for performance? • As you get closer to the performance, how do you approach practice?		X	X	X	X	X	X	
Is there anything else you would like to add that I didn't ask?								
DEMOGRAPHIC QUESTIONS • Do you identify as male, female, non-binary, other, or do you prefer not to say? • How old are you? • What is your race?								

END OF THE INTERVIEW

Those are all the questions I have for you, so I will stop recording the interview. As a token of my appreciation, for completing all the required activities for this study, I will send you $100.00 in the form of an Amazon gift card or a electronic payment through Venmo. Which payment option do you prefer?

Amazon gift card: Confirm participant's email address if the participant.

Venmo payment: Collect the participant's Venmo user name and cell phone number for confirmation or ask participant to send you're the QR code to their Venmo account.

Will you please confirm the mailing address you so that I can send you your D'addario Strings?

POST-INTERVIEW SCRIPT

Thank you for taking this time to speak with me about your experience. I will send you a copy of the interview transcript or your review. I will follow-up with you through email. During the follow-up, I will confirm if the transcript is an accurate reflection of our conversation. You may clarify or add to your statements. I might also have a couple of follow-up questions for you based on new information that I learn during our conversation.

I will be in touch soon. Thank you for your help

EMAIL FOLLOW-UP SCRIPT

Dear (Participant's Name),

Thank you for allowing me to interview you and gain insights on the way you learn a new piece. I have attached the interview transcript in PDF format to this email. Please read it at your earliest convenience. After you have read the transcript, please respond to this email to verify the accuracy of our conversation to the best of your knowledge. If you prefer a phone call, I will contact you and set-up a mutual time when we can talk. If you wish to add or clarify any details, please free to include that during the follow-up. Finally, if you agreed to submit an optional practice session video, please be sure to upload it through your personalized link within seven days of our interview.

I am grateful for taking the time to share your learning process with me. As soon as I analyze the data, I will share my initial findings with you.

Sincerely,

Nile M. Wilson
Graduate Student, Auburn University

Appendix D

PRACTICE VIDEO INSTRUCTIONS

Undergraduate and Graduate String Instrumentalists' Approaches to Learning New Solo Repertoire: Descriptive Case Studies of Deliberate Practice Using the Fitts and Posner Model of Skill Learning

WHAT SOLO SHOULD I USE FOR THESE VIDEOS?

You must select one solo that is in the early phases of preparation (see details in the instructions below) and will be performed within the current school year. You will use this solo for the duration of this study.

HOW WILL THIS VIDEO BE USED?

This video will be used for the sole purpose of observing and documenting practice habits and approaches. The video will give me additional information on how you apply practice skills you've learned over the years when working on a particular piece at different points in your preparation. This video will not be shared with anyone who is not involved in this study.

HOW LONG WILL YOU KEEP THIS VIDEO?

I will keep this video in AU Box, a secure cloud storage service approved by Auburn University for the duration of the study. Your video will be deleted shortly after I present my dissertation.

HOW MANY VIDEOS WILL I NEED TO SUBMIT?

The information you shared during the interview gave me an insight into your process of learning a piece. You will record a total of THREE 20- to 30-minute practice videos at different points in your preparation. You will upload each video to AU Box upon completion using a unique link. By submitting these videos to me, you are giving me permission to use the video for my study. If you agree to submit practice videos but change your mind later, just let me know. Compensation is dependent upon completion of all requirements.

WHAT DO I DO AFTER I UPLOAD THE THIRD VIDEO?

Contact me to schedule a 30-minute Zoom interview. Possible interview questions are included in the recruitment packet.

QUESTIONS?

Email Nile Wilson at nmw0019@auburn.edu or call or text 717-654-4148.

PRACTICE VIDEO INSTRUCTIONS

General Instructions:

1. You will be using your own mobile phone, tablet, or computer to record a 20- to 30-minute video of your practice session that involves the specific solo you are using for this study. Videos must be in mp4 format.

2. It's okay to break-up the video into smaller sections as long as it is filmed during the same session.

3. To make sure that internet bandwidth can handle the video upload later in the process, do not use high definition video formats.

4. Position your device in front of you so that I have a view of your left and right hands.

5. Say the following pieces of information at the beginning of the recording before you start practicing:
   a. The title (including movement, if applicable) and composer
   b. When the piece was first assigned, today's date, and your target performance date.

6. Practice like you normally would. Only record video of yourself practicing the piece you selected for this study.

7. Upload to AU Box using your unique link. Do not delete the video until I confirm that I received it and that it works.

YOUR UPLOAD LINK:

You will be assigned a unique link when you agree to participate in the study.

PRACTICE VIDEO INSTRUCTIONS (CONTINUED)

Video #1 – Early Phase

1. You will record one video during the early phase of study of this piece as defined by these parameters:
    a. You are sightreading the piece.
    b. Your movements are slower and not as fluid because you are not familiar with the piece yet.
    c. You are still thinking in a step-by-step manner when playing passages.
    d. You make many mistakes.

2. Start practicing!

3. Name the file *First and Last Initial_Early* (for example: NW_Early.mp4) and upload. If you are having trouble with this step, just upload the video as is. I will take care of renaming the file.

4. If you keep a practice journal, upload an image or PDF of today's practice session using the same link.

Video #2 – Intermediate Phase

1. You will record one video during the intermediate phase of study of this piece as defined by these parameters:
    a. Your movements are faster and more fluid.
    b. You are able to execute movements without thinking too much.
    c. Even if you are still making mistakes, you are making less of them.
    d. You are using skills you already have to problem-solve.

2. Start practicing!

3. Name the file *First and Last Initial_Int* and upload. If you are having trouble with this step, just upload the video as is. I will take care of renaming the file.

4. If you keep a practice journal, upload an image or PDF of today's practice session using the same link.

Video #3 – Final Phase

1. You will record one video during the final phase of study of this piece as defined by these parameters:
    a. You are able to play fluidly without much thought and are less likely to be disrupted by external distractions.
    b. You are within two weeks of your performance date.

2. Start practicing!

3. Name the file *First and Last Initial_Final* and upload. If you are having trouble with this step, just upload the video as is. I will take care of renaming the file.

4. If you keep a practice journal, upload an image or PDF of today's practice session using the same link.

What's next?

1. Contact me at nmw0019@auburn.edu or 717-654-4148 to schedule your 30-minute interview.

2. Using the same link you used to upload your videos, upload an image or PDF file of the sheet music for this solo which includes your markings.