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Music Theory Pedagogy for the Violin: Cognitive Philosophy and Three Model Curricula

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Introduction

When I entered my freshman music theory class for the first time and watched the professor hastily scribble notes on the whiteboard, I panicked at how little I knew. My class was told to have all key signatures and intervals memorized for the second class a couple days later; the basics of counterpoint would follow. As a violinist who had decided to major in music only six months prior, I was completely overwhelmed. I did not yet know how to determine a key signature on sight, how to build chords, or even how to read bass clef. However, I quickly realized that if I leveraged the physical landscape of my instrument to learn music theory concepts, I could succeed. I started employing an imaginary violin fingerboard throughout my homework and tests to decipher intervals, scale degrees, key signatures, modes, chord qualities, and Roman numerals. That the instrument was imaginary made no difference.

Throughout the rest of my undergraduate and graduate years, I applied this skill to all music theory classes, including courses in aural skills, Schenkerian analysis, counterpoint, and post-tonal theory. Until recently, I had assumed that most musicians imagine their instruments to aid music theory and aural skills. But as I gained experience as a teaching assistant in aural skills and music theory, I discovered this reliance is an exception rather than a rule. I began to question why using the violin as a theory tool was so effective for me and pondered questions such as, “How does the violin afford this strategy of music theory learning?” And “How do music theory concepts map onto the landscape of the instrument and the body of the violinist?" I address these questions in this thesis by detailing how the physical attributes of the violin can be harnessed to provide the player with a deeper understanding of music theory, as well as how and why this aspect of the violin should be directly addressed during a violinist's musical education.

It should be noted that Chapters 1 and 2 are an abstract literature overview engaging these concepts, while Chapters 3–5 are a teaching method. Chapters 3–5 pair the structure of the violin with the ordering of theory concepts, including specific keys, scales, arpeggios, etc. These chapters restructure aspects of theory instruction that pianist music theorists may take for granted; for example, violinists learn to play in D major before C major. Because these chapters are designed to be instructional, I will change from a declarative, scholarly tone to a more pedagogical, imperative tone beginning in Chapter 3.

Chapter One: Embodiment, Cognition, and the Violin

By relating early theory concepts to my instrument, I was unknowingly employing two concepts from the literature on cognition of the last half century: embodied cognition and complementary cognitive artifacts (hereafter CCAs). I will briefly define both of these terms, and will subsequently describe how each intersects with music making and learning. I was embodying my musical cognition, translating my thinking about music away from symbolic manipulations of concepts and towards the enactment of movement on my instrument. "Embodied cognition" has been an area of active research over the last half century. Marina Korsakova-Kreyn, in her recent article that proposes that embodied cognition contains two levels (a surface level of bodily articulation and a deep level that relates to tonal relationships arranged in time), states, "The concept of embodied cognition proposes that sensory-motor experiences shape human consciousness."[1]

While the field of embodied cognition suggests a basis for why I was so quick to use my fingers to think about music theory concepts like scales and intervals, the idea of CCAs focuses on what my fingers were manipulating. CCAs, like a violin, enhance human intelligence by helping the user perform a cognitive task. Once that task is

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[1] Marina Korsakova-Kreyn, "Two-Level Model of Embodied Cognition in Music," *Psychomusicology* 28, no. 4 (2018): 240.

mastered, the user has an accurate mental representation of the artifact to use whenever they are without the physical artifact. Because I know how my body interacts with a violin in great detail, a "virtual" violin serves as a CCA just as well as my physical instrument.

In the remainder of this chapter, I will discuss how instruments mediate theoretical knowledge by providing background on the study of embodied cognition, explaining how the concept of embodied cognition is beneficial to music theory pedagogy, delving into the study of complementary cognitive artifacts and explaining how the violin can be considered a prime example of one, and lastly, why it is helpful to consider the violin as a tool for music theory.

Embodied Cognition in Music

The concept of embodied cognition does not originate in music. Rather, early studies focused on linguistics and psychology. Robotics, sports, medicine, and music, amongst many others, then followed. Michele Wellsby and Penny M. Pexman provide a comprehensive but concise description of embodied cognition:

> Embodied cognition (EC) is a broad term used to describe a class of theories within cognitive science, many of which emphasize the importance of sensorimotor experience gained through our bodily interactions with the environment for acquiring and representing conceptual knowledge.[2]

The concept of embodied cognition is a direct counter to "classical cognitive theories," of which the structural linguistics of Noam Chomsky is perhaps most emblematic. These theories sought to diminish the role our bodies play in cognitive processing. It was

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[2] Michele Wellsby and Penny M. Pexman, "Developing Embodied Cognition: Insights from Children's Concepts and Language Processing," *Frontiers in Psychology* 5 (2014): 1.

believed that "cognition strictly involved the processing of abstract and amodal symbols," or our brain's perception of objects, surroundings, etc., but now, "EC theories tend to assume that our actions and bodily experiences are crucial to our cognitive processing."[3]

Sensorimotor experiences, experiences that combine the senses, including seeing, hearing, or touching, with motion shape how we interact both physically and mentally with the world. Wellsby and Pexman ascertain that direct sensorimotor interactions are crucial in gaining cognitive capabilities, and that when we gain these capabilities, we can experience a "re-enactment of the bodily states from previous experience."[4] This experience is the aspect of embodied cognition that I want to explore most deeply, as it most directly relates to the experience of playing an instrument as well as complementary cognitive artifacts.

Although the label of "embodied cognition" in music is relatively recent, Marc Leman provides a comprehensive history of the study of "mind and matter" in a musical framework that dates back to ancient Greece.[5] Greek philosophers such as Pythagoras, Aristoxenes, Plato, and Aristotle laid the foundation for modern views of "mind and matter" and their ideas fueled discussion of topics such as acoustics (music as ratios of numbers), perception (music as perceived structure), and expression (music as imitation

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[3] Ibid.

[4] Ibid.

[5] Marc Leman, *Embodied Music Cognition and Mediation Technology* (Cambridge, Mass: MIT Press, 2008): 27.

of reality) for centuries until the Renaissance.[6] Leman mentions, "The scientific revolution of the Renaissance had a major focus on the mathematical and physical aspect of music; the link with musical experience was considered to be a practical consequence of this focus."[7] However, it was not until the late nineteenth century that the idea that a scientific study of subjective involvement with music was possible.[8]

The link between physics and perception was discovered during this time by scientists who founded psychoacoustics, psychology, and phenomenology.[9] Leman states that this provided the "physiological grounding for… the cognitive sciences approach of the second half of the twentieth century."[10] In the late twentieth century, the cognitive tradition began to be criticized by cognitive scientists such as Maturana and Varela for neglecting the action component in the subject's involvement with the environment.[11] Leman explains:

> The main argument (of Maturana and Varela) is that knowledge does not emerge from passive perception, but from the need to act in an environment. In that sense, ecology is not merely about the relationship between a subject and its

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[6] Ibid., 28.

[7] Ibid.

[8] Ibid.

[9] Ibid., 29–30.

[10] Ibid., 30.

[11] Ibid., 43; Humberto R. Maturana and Francisco J. Varela, *Autopoiesis and Cognition: The Realization of the Living* (Dordrecht, The Netherlands: Reidel, 1980); Humberto R. Maturana and Francisco J. Varela, *The Tree of Knowledge: The Biological Roots of Human Understanding* (Boston, MA: New Science Library, 1987); Francisco J. Varela, Evan Thompson, & Eleanor Rosch, *The Embodied Mind: Cognitive Science and Human Experience* (Cambridge, MA: MIT Press, 1991).

> environment, but also about the knowledge which is needed to act in that environment.[12]

This viewpoint, shared by others who criticized the cognitive tradition, has created increased interest and a new perspective of the relationship between mind and matter. The human body is now thought of as the mediator between physical energy and meaning and is the basis of the link between mind and matter.[13] In opposition, the previous cognitive paradigm emphasized mental processing instead of gestures and action.[14] However, Leman notes that "the idea that musical involvement is based on an embodied simulation or imitation of moving sonic forms has a long tradition that has been rediscovered only recently."[15] There was a school of philosophy and musicology researchers in the late nineteenth and early twentieth centuries that put more emphasis on action as opposed to the more popular "gestalt theoretical ideas" of the time that emphasized brain processes instead of movement and action.[16] Some of these early researchers whose works align with the current idea of embodied cognition include Lipps, Becking, and Truslit.[17]

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[12] Leman, *Embodied Music Cognition and Mediation Technology*, 43.

[13] Ibid.

[14] Ibid.

[15] Ibid.

[16] Ibid., 44.

[17] Gustav Becking, *Der musikalische Rhythmus als Erkenntnisquelle* (Augsburg, Germany: Filser, 1928); Theodor Lipps, *Ästhetik: Psychologie des Schönen und der Kunst* (Hamburg, Germany: L. Voss, 1903); Alexander Truslit, *Gestaltung und Bewegung in der Musik* (Berlin, Germany: C. F. Vieweg, 1938).

Leman's work champions the coupling of perception and action, as it "provides a new perspective for multimodal music perception, kinesthesia, affective involvement, expressiveness in music, and social music cognition."[18] Since 2008, the year Leman's book was published, many researchers and scholars including Zachary Wallmark, Arnie Cox, Jin Hyun Kim, and Leman himself have established that the coupling of perception and action is indeed the basis of embodied cognition, and this idea is what my project is founded on.[19]

A description of embodied cognition from 2001 by Thelen et al. particularly resonates with my project, even though it does not directly engage music:

> To say that cognition is embodied means that it arises from bodily interactions with the world... Cognition depends on the kinds of experiences that come from having a body with particular perceptual and motor capacities that are inseparably linked and that together form the matrix within which memory, emotion, language and all other aspects of life are meshed.[20]

Zachary Wallmark et al. recently put Thelen's description into a musical perspective, saying,

> By connecting the contingencies of the sensing body with the broader material and cultural ecosystem, embodied cognition offers an expansive framework for

[18] Leman, *Embodied Music Cognition and Mediation Technology*, 48.

[19] Arnie Cox, *Music and Embodied Cognition: Listening, Moving, Feeling, and Thinking* (Bloomington, IN: Indiana University Press, 2016); Jin Hyun Kim, "From the Body Image to the Body Schema, from the Proximal to the Distal: Embodied Musical Activity Toward Learning Instrumental Musical Skills," *Frontiers in Psychology* 11 (2020): 1–8; Zachary Wallmark et al., "Embodied Listening and Timbre: Perceptual, Acoustical, and Neural Correlates," *Music Perception* 35, no. 3 (2018): 332–63.

[20] Esther Thelen, Gregor Schöner, Christian Scheier, and Linda B. Smith, "The Dynamics of Embodiment: A Field Theory of Infant Perseverative Reaching," *Behavioral and Brain Sciences* 24 (2001): 1.

> understanding the role of human perceptual systems in the process of producing, hearing, and making sense of musical sound.[21]

This "expansive framework" includes the process of learning an instrument and the associated sensorimotor experiences such as feeling a certain set of fingers on the fingerboard while hearing the resulting chord or seeing your hand in a higher position while feeling the sharp tension of the string under one finger. The more a musician perfects their skills on their instrument, the stronger the connection between mind and body becomes, helping them to make sense of musical sound more quickly and accurately.

An innovator in the integration of embodied cognition and music theory is the scholar and guitarist Jonathan de Souza. I will be using multiple publications by de Souza due to our similar interests in how our minds and bodies interact with our instruments, as well as due to his expertise being on an instrument that uses a fretboard, an instrumental landscape similar to the violin's fingerboard. His book *Music at Hand: Instruments, Bodies, and Cognition* delves into three broad topics: music theory, phenomenology, and cognitive science. De Souza discusses the instrument-body interaction and investigates music's corporeal grounding, saying that although music is considered the most abstract art form as it cannot be seen or touched, music is bound up with physical things such as

[21] Zachary Wallmark et al., "Embodied Listening and Timbre: Perceptual, Acoustical, and Neural Correlates," *Music Perception* 35, no. 3 (2018): 334.

instruments.[22] De Souza's definition of embodied cognition in music juxtaposes the old and new way of viewing how humans use perception and cognition:

> Embodied cognition—like "embodied music theory"—distinguishes itself from approaches that treat mind and body as independent entities. To be specific, embodied cognition principally reacts against a computational conception of mind, which emerged in the mid-twentieth century. According to this model, bodily input is converted into "nonperceptual" data, and the brain deals in abstract symbolic representations that are essentially independent of the senses. Proponents of embodied cognition, by contrast, argue for the integration of perception and cognition, body and mind.[23]

Compared to the approach that treated the "mind and body as independent entities," the newer concept of embodied cognition more adequately represents how musicians approach learning an instrument, since the mind and body must be fully integrated to play a piece of any difficulty. Because musicians use their bodies to produce sound, they are uniquely situated to embrace an embodied account of cognition compared to linguists, computer scientists, or psychologists. Indeed, musicians are the natural allies of embodied cognitivists because they show extreme refinement in a task that requires constant thinking *in a body*.

How do Instruments Mediate Theoretical Knowledge?

This discussion on embodied cognition in music provides background on the mind-body relationship and gives insight into what goes on in our brain during the process of learning to play an instrument. Now that we know that embodied cognition, or combining the use of senses with motor skills, plays an integral role in enabling humans

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[22] Jonathan de Souza, *Music at Hand: Instruments, Bodies, and Cognition* (Oxford: Oxford University Press, 2017), 1.

[23] Ibid., 3.

to master an instrument, how do we use this knowledge to enhance our theory skills? The simplest answer is to be aware of this mind-body connection and harness our instruments' capabilities in order to embody music theory concepts.

This can be done in multiple ways. A study conducted by Jens Haueisen and Thomas R. Knösche found that when classically trained pianists listened to a piano piece, their brains' contralateral primary motor cortex (the primary region of the motor system) was affected, triggering involuntary respective finger movements.[24] This demonstrates how aspects of our instruments can be so engrained that our brains automatically recall both physical and aural attributes, a skill that could be used in the theory and aural skills classrooms and beyond. Students could potentially complete a Roman numeral analysis while listening to a piece if they were able to "feel" or "play" what chords or scale degrees were passing by. In another study on pianists' brains, Marc Bangert, Udo Haeusler, and Eckart Altenmüller found that if they had pianists practice silent dexterity drills, the pianists could hear audible tones inside the head, and vice versa. They discuss how practicing piano "promotes a joint mental representation of ear and hand."[25] After studying pianists from beginners to professionals, they concluded that "After years of practice, the described sensorimotor corepresentation is automatized to a high degree and can even be activated preattentively."[26] Students entering university have likely already

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[24] Jens Haueisen and Thomas R. Knösche, "Involuntary Motor Activity in Pianists Evoked by Music Perception," *Journal of Cognitive Neuroscience* 13 (2001): 786.

[25] Marc Bangert, Udo Haeusler, and Eckart Altenmüller, "On Practice: How the Brain Connects Piano Keys and Piano Sounds," *Annals of the New York Academy of Sciences* 930 (June 1, 2001): 425.

[26] Ibid., 425–28.

achieved this automation, and as I will discuss further in the conclusion of this thesis, it would be beneficial to have music professors (both music theory and performance faculty) bring students' attention to how they can use these engrained skills for music-theory purposes.

Almost every scientific study of how musicians relate to their instruments I encountered was conducted with pianists, with the exceptions being guitar studies, a trombone study, and a violin study. Nevertheless, the results of all of these studies are very similar. In his article titled "Guitar Thinking," de Souza describes a study on guitarists by Drost, Rieger, and Prinz where the participants were shown a chord label on a screen, such as "A" or "Am," and were asked to finger that chord on a guitar fretboard.[27] Simultaneously, they would hear a chord over the speakers that did or did not match the chord they were "playing" and would have to provide an answer whether or not the chord was congruent with the chord onscreen. Sometimes a noncongruent chord would be played by a different instrument such as the piano or flute. In this case, the participants would not hesitate to provide an answer of whether the chord was congruent or noncongruent with the onscreen chord, but when a noncongruent chord would be played by a guitar, the participants would hesitate in providing an answer due to their ability to aurally recognize the chord played over the speakers as well as the onscreen chord. The same study was conducted on pianists with similar results, showing a connection between embodied cognition and timbre familiarity. De Souza explains this

[27] Ulrich C. Drost, Martina Rieger, and Wolfgang Prinz, "Instrument Specificity in Experienced Musicians," *Quarterly Journal of Experimental Psychology* 60, no. 4 (2007): 527–33.

phenomenon by saying that these musicians "had a distinctive connection to music for their own instrument."[28] This distinctive connection can seemingly be applied to instruments other than piano, guitar, and strings, as evidenced in the next study.

The trombone study, conducted by Topher Logan and Roger Chaffin, aimed to explore how learning to play a musical instrument connects both motor and perceptual systems in a way that when a musician sees notes on a staff, their body is automatically primed to play them.[29] The authors asked trombonists, non-trombonists who were musicians, and non-musicians to move a joystick forward or backward when they saw notes on a screen that were higher or lower than the previous note. They also conducted this same experiment using the up and down arrow keys on a computer keyboard. The authors found that trombonists were faster than the other participants at moving the joystick when the direction of the notes correlated with the direction of their trombone slide, but were slower when the direction did not correlate. This result did not apply to the keyboard task, because changing pitch on a trombone is more like controlling a joystick than controlling a keyboard. This shows that "Learning to play a musical instrument creates instrument-specific links between music notation and sound-producing actions."[30] The next study also monitored musicians' sensorimotor functions away from their instrument.

[28] Jonathan de Souza, "Guitar Thinking: Perspectives from Music Theory and Cognitive Science," *Soundboard Scholar* 7 (2021): 5.

[29] Topher Logan and Roger Chaffin, "Movement Is Part of the Meaning of Music Notation: A Musical Stroop Effect for Trombonists," *Psychology of Music* 49, no. 4 (2021): 828.

[30] Ibid., 836.

The violin study conducted by Martin Lotze and his collaborators, mentioned by de Souza in *Music at Hand*, delved into the connection between violinists' ears and left hand.[31] Both amateur and professional violinists were asked to tap out the fingerings of a Mozart concerto, and using fMRI (functional magnetic resonance imaging), the conductors of the study found that the right primary auditory cortex and left auditory association area of the brain were activated. However, when the violinists were asked to imagine playing the piece without moving their fingers, the auditory-motor coactivation disappeared. This led to the authors' conclusion that "the motor and auditory systems are coactivated as a consequence of musical training but only if one system (motor or auditory) becomes activated by actual movement execution or live musical auditory stimuli."[32]

Auditory-motor coactivation, for de Souza, sheds light on one of the most sentimental chapters of European instrumental music, the continuing composition of Ludwig von Beethoven after his hearing loss:

> Early in his life as a pianist, Beethoven practiced common scales and melodic gestures, idiomatic textures and chordal patterns. He developed modally specific memories for their physical actions and sounding results, as any competent pianist does. These coordinated sensory representations supported musical schemas and concepts that he could reactivate and creatively recombine. While improvising, for example, Beethoven could imagine a melody and realize it with his hands. Yet since auditory-motor coactivation goes both ways, moving his hands on the keyboard would activate auditory regions in his brain. This suggests that

[31] Martin Lotze et al., "The Musician's Brain: Functional Imaging of Amateurs and Professionals During Performance and Imagery," *NeuroImage* 20 (2003): 1817–29.

[32] Ibid., 1817.

> Beethoven's actions would also enhance auditory simulations after his hearing loss.[33]

If a musician can "hear" while fingering a passage or "feel" while listening to a piece, the possibilities of harnessing these sensorimotor experiences for use in music theory are endless. With this information in mind, how can we teach students to use their instrumental skills for music theory purposes? How can they use their own "imaginary instrument" when doing theory homework or taking tests?

Complementary Cognitive Artifacts

The answer to these questions lies in the reconceptualization of musical instruments as complementary cognitive artifacts (CCAs). Although the concept of a cognitive artifact is not new, there have been recent changes as to how they are classified. The earliest source on cognitive artifacts is Donald Norman's 1991 article "Cognitive Artifacts," which provided this definition: "A cognitive artifact is an artificial device designed to maintain, display, or operate upon information in order to serve a representational function."[34] A pioneer in the field of cognitive science and usability engineering, Norman paved the way for others to expound on his work. Over two decades later, Richard Heersmink defines cognitive artifacts as "human-made, physical objects that functionally contribute to performing a cognitive task."[35] Although most authors'

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[33] De Souza, *Music at Hand*, 10-11.

[34] Donald A. Norman, "Cognitive Artifacts," in *Cambridge Series on Human-Computer Interaction* No. 4, ed. J. M. Carroll (New York: Cambridge University Press, 1991): 17.

[35] Richard Heersmink, "A Taxonomy of Cognitive Artifacts: Function, Information, and Categories," *Review of Philosophy and Psychology* 4, no. 3 (2013): 465.

definitions of cognitive artifacts are similar, Marco Fasoli, whose own work I will discuss shortly, pointed out that some authors classify and organize cognitive artifacts in very different ways. Whereas Philip Brey focused on a "cognitive-centered" approach in classifying these artifacts, Heersmink focused on the "artifact-centered" approach.[36] Fasoli states that the first approach focused on the cognitive capacities associated with cognitive artifacts, while the second approach focused on the artifacts' capabilities.[37] Fasoli chose to combine both of these approaches in his classification of cognitive artifacts, and this classification is the best-suited for my project.

To reiterate, a cognitive artifact is a physical object that facilitates human cognition. Fasoli expands on this concept in his 2017 article stating that "Cognitive artifacts distinguish themselves from other artifacts insofar as their specific function is to represent, store or retrieve and manipulate information, contributing to the solving of a cognitive task,"[38] and he believes that there are three categories of cognitive artifacts: substitutive, complementary, and constitutive.[39] He explains that although maps and GPS devises have the same function of helping us orient ourselves in space and that we may be tempted to put them in the same category of objects, they contribute to the cognitive task of navigating completely differently. With a map, the user must already know where

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[36] Philip Brey, "The Epistemology and Ontology of Human-Computer Interaction," *Minds and Machines* 15, no. 3 (2005): 383-398.

[37] Marco Fasoli, "Substitutive, Complementary and Constitutive Cognitive Artifacts: Developing an Interaction-Centered Approach," *Review of Philosophy and Psychology* 9, no. 3 (2017): 673.

[38] Ibid., 673–77.

[39] Ibid., 671–72.

they are in order to make sense of the map. But with a GPS, the user only has to know how to type in the address and how to follow directions; they do not need additional knowledge to use the GPS. Fasoli labels the GPS as a "substitutive cognitive artifact" because it carries out almost all of the work in the completion of a task. The map, on the other hand, would be considered a "complementary cognitive artifact" because it accompanies a cognitive process that can exist independently. In less formal discussions, the complexity scientist and evolutionary biologist David Krakauer has similarly defined cognitive artifacts as either complementary or competitive. Krakauer's definition of competitive cognitive artifacts is in line with Fasoli's definition of substitutive cognitive artifacts in that these artifacts do not enhance cognitive processes but replace them, and both scientists' definitions of complementary cognitive artifacts are almost identical.[40] Fasoli identifies one more category of cognitive artifacts which he labels "constitutive cognitive artifacts." These artifacts "are essential for the realization of the task" and constitute "a necessary condition for the completion of a task that could not otherwise occur."[41] Constitutive cognitive artifacts are mostly comprised of texts, since it is not possible to read without a text.

Musical instruments fall into the category of complementary cognitive artifacts, and Fasoli provides a disclaimer that "cognitive artifacts often not only interact with one of our cognitive abilities at a time, but may engage our cognitive system in many ways

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[40] Sam Harris and David Krakauer, "Complexity and Stupidity," *Making Sense*, Podcast Audio. July 11, 2016. https://www.samharris.org/podcasts/item/complexity-stupidity

[41]Marco Fasoli, "Substitutive, Complementary and Constitutive Cognitive Artifacts," 679.

simultaneously."[42] However, I will be focusing solely on how treating musical instruments as CCAs would enhance skills in music theory. Musical instruments fall into the "complementary" category of cognitive artifacts because the player does not need an instrument in their hand to complete the cognitive process of playing a piece with their mind and body, but they complement the cognitive process when they are physically held by the player. Of course, it takes many years for instrumentalists to reach this level of embodied cognition in relation to their instrument, but just like a map user must already know where they are to decipher a map, an instrumentalist must know how to play an instrument in order imagine playing it when the instrument is not in their hands. Interestingly, I was not able to find any sources that focused solely on how musical instruments are CCAs. The topic of CCAs seems to be researched mostly in the fields of neuroscience and psychology, and it has not made its way to the field of music like the concept of embodied cognition has. In my final chapter, I will discuss my hopes for the future study of CCAs in music, but for this project, I cannot delve further into the neuroscience behind CCAs in music due to the lack of literature.

Now that I have established how CCAs function and why musical instruments should be considered CCAs, we can begin to look at specific examples of how viewing instruments as CCAs would be beneficial to music theory learners at any level. In the article titled "Instruments of Music Theory," Alexander Rehding discusses how material objects are the "driving forces in the process of knowledge acquisition" and that we can

[42] Ibid.

view instruments, some better than others, as "music-theoretical instruments."[43] Rehding offers the monochord, an ancient, single-stringed instrument usually used for scientific purposes, as an example of a music-theoretical instrument, because although it has been debated whether this is indeed an instrument, it produces sound, therefore it produces knowledge about music.[44] Every instrument, in its own way, produces knowledge that can be utilized by the player for multiple purposes, although Rehding believes that not every instrument "carries very useful insights about the music system in which it operates."[45] Some instruments have been favored in music theory for their ability to play chords, although we should evaluate if placing all emphasis on only a couple instruments benefits every student in the theory classroom.

Rehding unsurprisingly mentions that the piano plays a supreme music-theoretical role and that "Anyone who has taught an introductory music theory class knows about the importance of the piano in explicating music-theoretical concepts."[46] Although the piano does lend itself to efficiently demonstrating music theory concepts, I believe placing so much emphasis on the piano in music theory education is detrimental to students who do not play the piano, as they are not taught about their own instrument's potential as a music-theoretical instrument. The piano-centric music theory education system has seemingly been perpetuated by theorists who are also pianists, and I would be curious to

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[43] Alexander Rehding, "Instruments of Music Theory," *Music Theory Online* 22, no. 4 (2016): section 4.1.

[44] Ibid., section 4.4.

[45] Ibid.

[46] Ibid., section 4.3.

see how theory students' proficiency would be impacted by a shift in thinking about all pitched instruments as music-theoretical instruments (for Western music theory purposes).

In his article, "Guitar Thinking," de Souza advocates that the guitar should be thought of as an "instrument of music theory," and a "tool for musical thinking."[47] De Souza mentions that jazz guitarist Pat Martino wrote instructional material for the guitar using fretboard shapes to demonstrate systematic relationships among triads.[48] If music theory can be effectively demonstrated on and generated from the guitar, then other instrumentalists could also benefit from music-theory instructional materials created specifically for their instrument. An aspect the creator of the materials would have to know deeply is the instrument's affordances.

De Souza, ultimately drawing on J. J. Gibson's ecological theory of perception, describes affordances as an object's possibilities for action.[49] De Souza gives the example of how a guitar affords playing, and a chair affords sitting. However, these objects have other affordances, since one can stand on a chair or use it to prop up sheet music, and the same actions can be applied to the guitar. All of the possible affordances of an object depend on the object's properties and also the user's abilities. De Souza clarifies that a chair does not afford sitting for a baby and that the guitar is not playable for a goldfish, so

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[47] Jonathan de Souza, "Guitar Thinking," 3.

[48] Ibid.

[49] Ibid., 5; James J. Gibson, *The Senses Considered as Perceptual Systems* (Westport, CT: Praeger, 1966): 285.

consequently, affordances are fundamentally relational.[50] He also observes that the guitar's affordances are relatively predictable due to a mostly tuning standardization, harmonics at particular locations, and pitch relationships. Such predictability in an instrument "grounds perception of affordances and is essential for instrument expertise."[51] De Souza adds:

> To play an instrument, then, a musician must recognize its sound-making affordances. And these affordances expand as a player develops new bodily skills and neural connections. This also supports distinctive perceptual habits, different ways of knowing. So, musical instruments are not just tools for making sound. They are also cognitive tools or "epistemic tools," which produce musical knowledge.[52]

Knowing the affordances of one's instrument would not only enhance technical skills but every aspect of musicianship. Music theory and musicality, then, could also be viewed through the lens of affordances, helping every instrumentalist relate to Western classical music concepts.

Both de Souza and Rehding imply that some instruments are better suited for music-theoretical purposes than others. De Souza cites another study by Bangert and Altenmüller where participants with no prior musical training were given ten weeks of lessons on the piano. One group used a regular keyboard while the other group was given a randomized keyboard where pitch locations changed frequently. Neuroimaging displayed the ways the two groups' brains worked differently after the ten weeks were

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[50] Jonathan de Souza, "Guitar Thinking," 5.

[51] Ibid.

[52] Ibid., 7.

over; the first group developed patterns of auditory-motor coactivation while the second group did not. This led the researchers to conclude that "the link between ear and hand, then, requires an instrument with stable affordances."[53] Rehding mentions that a rattle or a triangle would not hold much music-theoretical information of interest, and I would be curious to learn what other instruments he similarly dismisses.[54] Although it is true that some instruments, such as unpitched percussion instruments, are not able to play Western music-theory concepts like scales or chords, every instrument operates in its own "space," or instrumental paradigm, and should not be dismissed as a non-theoretical instrument based on its capabilities to play a certain set of theory concepts. As for "traditional" music-theoretical instruments, or instruments that have the capability to play that certain set of Western theory concepts, all of the pitched instruments in a band or orchestra could be considered music-theoretical instruments with stable affordances due to the majority having standard tuning and predictable pitch placement on the instrument. Although it seems like most instruments are music-theoretical instruments with stable affordances, some offer advantages to the performer by being able to play chords.

Many instruments, unlike the piano, cannot play chords. Woodwind and brass instruments can play scales, triads, and arpeggios, but not a simultaneous chord. Some of the instruments whose affordances allow them to play chords are piano, guitar, harp, marimba, and string instruments. The piano and guitar are the most convenient

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53 Ibid., 4; Marc Bangert and Eckart O. Altenmüller, "Mapping Perception to Action in Piano Practice: A Longitudinal DC-EEG Study," *BMC Neuroscience* 4 (2003): 26.

54 Alexander Rehding, "Instruments of Music Theory," section 4.4.

“traditional” music-theoretical instruments whose affordances allow endless possibilities of the displaying of music-theory concepts, as it is easy to walk up to a piano and press three notes to create a first inversion chord or pick up a guitar to demonstrate the dominant to tonic relationship. However, I would like to advocate for the violin to also be used as a music-theoretical instrument in the theory classroom. The violin is played by millions of people, and although so many people share this experience, the violin’s capabilities are not often discussed within a music-theoretical framework.

The Violin’s Affordances as a CCA

Most of the violin’s affordances are just as stable as those of the piano and guitar. The violin has a standard tuning and number of strings, predictable pitch placement, and a standard instrument size. Although it does not have frets or keys for pitch accuracy and the strings are placed on a curved bridge barring four-note chords, the four strings are tuned in perfect fifths and the neck of the instrument is short enough so that many theory concepts could be explained without even shifting the left hand. Two of the violin’s greatest weaknesses compared to the piano or guitar is that only certain inversions of chords are accessible on the fingerboard and that complete seventh chords are virtually impossible to play simultaneously. However, the violin’s strength as a CCA and its other affordances more than make up for its weaknesses.

As a CCA, the violin acts much more like a guitar than a piano. It is a stringed instrument, it has a similar shape, it can be plucked, and only the left hand is utilized to press the strings. The violin has one large advantage over the guitar, however, and this is due to all strings being tuned in perfect fifths, as opposed to the guitar which is tuned in perfect fourths and one third. This consistency allows the violinist to rely on all intervallic relationships being the same across the entire instrument, aiding in the understanding of intervals, chords, inversions and many more concepts that will be expanded upon in the next chapter. In this way, the violin is more like a piano. An advantage the violin has over the piano is the tightness of the violin's tactile attributes. As I will discuss in Chapter 2, the violin's fingerboard is so narrow that fingers are constantly touching and overlapping each other, providing the player with tactile feedback that allows them to determine interval distance and pitch accuracy, amongst other aspects.

De Souza touches on this topic in his article "Fretboard Transformations," saying that the fretboard, or in a violin's case, the fingerboard, is "a space of theoretical potentialities."[55] He observes:

> Banjos, guitars, ukuleles, and mandolins are places in Heidegger's sense. Though they come to life in performance, these instruments also imply a system of measurements (space as interval) and in turn a more general mathematical space (space as pure extension). Much like a map, transformational analysis of the fretboard juxtaposes these levels, coordinating places, spaces, and "space." It seeks correspondences among playing, listening, writing, counting, and drawing. And ultimately such perspective taking is essential whenever we build bridges between sound and thought—that is, whenever we pursue the work of music theory.[56]

Although the violin does not have frets, is has similar affordances to all of the instruments de Souza mentioned, and because of this, the violin can also be considered as a type of map that coordinates places, spaces, and "space."

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[55] Jonathan de Souza, "Fretboard Transformations," *Journal of Music Theory* 62, no. 1 (2018): 7.

[56] Ibid., 37.

In the next chapter, I will discuss the violin's affordances and how it can be used as a CCA. I survey a range of music-theory concepts from beginner- to university-level and relate them to the topics of embodied cognition, CCAs, and affordances. The violin offers a way of knowing that is equal to the level of pianos and guitars, and it would greatly benefit violin students if they were taught music theory through the lens of their own instrument.

Chapter Two: The Violin as a Music-Theoretical Tool

When a student begins their studies on the violin, many physical considerations demand attention: is the violin stable on the shoulder? Is the chin positioned correctly? Is the left hand squeezing too hard? Are the right-hand fingers curved enough? What should be done with the thumbs? And where should the left-hand fingers be placed? This last question plagues every violinist for many years. Without relying on frets, violinists at every stage of their career must focus on pitch accuracy. The best way to minimize error when navigating the continuous fingerboard is to memorize every aspect of how the fingerboard *feels*.

Some students begin learning the violin with brightly colored tape placed where each finger should be pressed. This tape acts as a visual aid for a short time, but the student must eventually learn to discern the correct pitches without it. However, while using this tape, the student can visually see that in first position, the second and third fingers (middle and ring fingers) are pressed tightly together, and that the first and second fingers (pointer and middle fingers) are placed further apart (the use of fourth finger is usually introduced months later). The interval between the first and second fingers is a whole step, and the interval between the second and third fingers is a half step, meaning that the very first theory concept that violin students encounter, whether explicitly pointed out or not, is that different combinations of half and whole steps create intervals that need certain finger placement.

This one simple idea, that half steps need abutting fingers and whole steps need distanced fingers, is not only the foundation of all violin playing, but also the foundation of how music theory can be understood on the violin. Fortunately, a violinist does not have to learn any position past first position to realize the full potential of what the violin has to offer in theory knowledge. Every interval, from a unison to a major seventh, is at the disposal of a violinist's left hand without having to shift positions or change sets of strings. Learning to feel the difference between half and whole steps for theoretical purposes is an aspect of violin playing that the violin community seems to take for granted, but I believe that this concept should be explored through the lens of music theory and embodiment.

As I discussed in Chapter 1, I view the violin as a complementary cognitive artifact due to its ability to facilitate the cognitive and motor processes of playing the violin. In this chapter, I delve into how the mental image of the violin's feeling in the hand (i.e., treating the violin as a CCA), aids in understanding basic theory concepts such as intervals, scale degrees, and chord qualities. The CCA-facilitated understanding of these basic concepts can progress to more advanced concepts such as Roman numeral analysis. In my experience, private violin instructors usually do not deliberately point out how the technical concepts students learn on the violin can also aid in understanding music theory. As a corrective, I argue that making these links between the violin and music theory explicit promotes both playing- and theory-oriented learning at every stage.

Types of Feeling

> Put a pencil in the knowing hand and watch a scale get played, a melody picked out. That scale and its distances are thoroughly incorporated for the body, an inner

> acquisition of spaces somehow arrayed all over as an ever-present potential. And when fingers in particular learn piano spaces in particular, much more is in fact being learned about than fingers, this keyboard, these sizes. A music-making body is being fashioned.[57]

This quote by David Sudnow perfectly describes, although in pianistic terms, how playing an instrument feels after many years of practice. Crucial to this feeling is the capacity for "proprioception." Proprioception is the ability to use the senses in a coordinated way, by means of the action of proprioceptors, that enables a person to identify spatially where parts of their body are located even when they are physiologically separate, and this sense has been described as our "sixth sense."[58] Proprioceptors, or specialized sensory nerve endings, are present in our muscles and tendons, orienting our extremities without mediation by the brain. As John C. Tuthill and Eiman Azim explain,

> Traditional senses like vision and hearing monitor the external environment, allowing humans to have shared sensory experiences. But proprioception, the sensation of body position and movement, is fundamentally personal and typically absent from conscious perception.[59]

Proprioception allows musicians to play their instruments without constantly having to look at their arms and fingers to see if they are in the correct place.

Further, Yu-Ting Tseng et al. found that training on an instrument can improve an individual's proprioceptive capabilities. They examined how a human wrist's

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[57] David Sudnow, *Ways of the Hand: The Organization of Improvised Conduct* (Cambridge, MA: MIT Press, 1993), 153. Quoted in Elisabeth Le Guin, *Boccherini's Body: An Essay in Carnal Musicology* (Berkeley: University of California Press, 2006), 22–23.

[58] John C. Tuthill and Eiman Azim, "Proprioception," *Current Biology* 28, no. 5 (2018): R194.

[59] John C. Tuthill and Eiman Azim, "Proprioception," R194.

proprioceptive acuity is linked to fine motor function in children undergoing piano training.[60] The authors emphasized, “Playing a piano is considered a complex, content-specific skill that requires the seamless integration of proprioception and the motor systems of the finger, hand, and arm,”[61] and the outcome of the study was consistent with the assertion that “improved wrist position sense acuity is linked to greater fine motor skills.”[62] The children who had been piano-trained for multiple years had superior manual dexterity compared to the children who did not receive piano training. The authors also mentioned another study that concluded that children who regularly played the piano produced fewer proprioceptive errors during active matching tasks at the elbow and wrist joints, suggesting that there is an improved upper limb proprioceptive acuity in young pianists.[63] The more we practice an instrument, the stronger the proprioceptive acuity, which can result in our bodies not even needing the instrument in the hand to know where the fingers are being placed. Thus, proprioception directly influences how our bodies interact with CCAs.

Proprioception’s capacity for spatial orientation is relevant to training on any instrument, but the concept of tactile feedback is specifically relevant to playing the violin. Tactile feedback informs the player of the motion of the fingers on the

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[60] Yu-Ting Tseng et al., “Wrist Proprioceptive Acuity Is Linked to Fine Motor Function in Children Undergoing Piano Training,” *Journal of Neurophysiology* 124, no. 6 (2020): 2052.

[61] Ibid.

[62] Ibid., 2057–58.

[63] Ibid., 2052–53.

fingerboard. While practicing the violin, every minute aspect of feeling is internalized by the hand. Not only do the pads of the fingertips feel the string below, but they also feel the string's increasing or decreasing tension depending on whether the notes in a passage move upward or downward. Also, because the fingerboard is so narrow, one fingertip might brush up against or even press two strings at once, thus creating a hypersensitivity to every finger's surroundings. Finger placement along the fingerboard facilitates tuning; additionally, finger placement *across* the fingerboard facilitates tone production, as any inadvertent finger interaction with a string will disrupt the clean line of the music at best, and derail a run of notes in a fast passage at worst.

The violinist brings these capacities for proprioception and tactile feedback to the spatial orientation of the fingerboard, which can be conceived as a two-dimensional space, curved in a third dimension. The violinist's left hand must orient every joint within this space. All fingers must stay close to the fingerboard and not lifted in the air for speed's sake, the fingers must be placed on the fingerboard at different angles depending on the desired type of vibrato for a passage, and the physical horizontal axis of the space must be completely internalized in order for the player to have a chance at playing in tune.[64] The physical and mental internalization of the fingerboard and its dimensions allows the violinist to play unthinkably difficult pieces with accuracy and organize physical patterns to apply to music theory.

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[64] Although the left arm plays a large part in allowing the left hand to play the violin, I will not examine the role the arm plays in the memorization of these planes since the placement of the arm does not affect the hand's ability to move around an imaginary fingerboard.

Intervals

As mentioned in the introduction, the learning and embodying of intervals is the foundation of both every violinist's technique and their music theory understanding. Although the beginning violinist inherently learns about intervals through being taught the difference between half and whole steps, the labeling of these intervals usually is not introduced until much later, if at all. The concept of major vs. minor intervals was foreign to me as a freshman in college, although it would not have been difficult to grasp this concept if it had been introduced much earlier in my education. Because beginning violinists are taught that fingers compress while playing half steps and expand while playing whole steps, all a teacher would have to do to introduce major vs. minor sixths would be to mention that when one finger is pressed on a string, if you put your next highest finger on the next highest string close to your original finger, the resulting interval is a minor sixth, as shown in Figure 1:

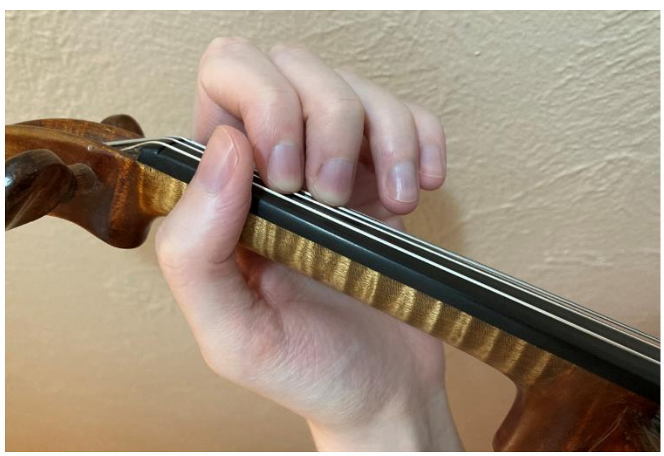

Figure 1. Minor 6th on Violin

Consequently, if the last-placed finger moves up its respective string to the next half step, creating a space between the fingers on separate strings, the resulting interval would be a major sixth, as shown in Figure 2:

Figure 2. Major 6th on Violin

It would be even simpler to explain major and minor seconds, since this idea was already encoded in the earliest mentioning that the second finger on the D string was F♯ with the close third finger being G. Bringing attention to the types of intervals and how they correspond with half and whole steps would help students understand the relationships between notes, and this might also help them begin to think of music theory in an embodied way.

Feeling the space between intervals and correlating this feeling with notes on a page is an everyday task when practicing etudes, concertos, or orchestral repertoire. As previously mentioned, the tactile feedback of our fingers in relation to one another is the only feedback besides aural feedback that determines if the correct note is being played, as we cannot see our fingers being placed between frets or on keys. Extremely small movements have an outsized impact on the pitch of a note (and hence chord quality), so sensitivity to the placement of fingers in relation to one another is crucial in the success of a violin player. This sensitivity becomes an advantage in relation to music theory once these precise interval shapes are engrained in violinists' hands. The more a violinist practices, the stronger the ear-hand connection becomes, allowing them to finger a passage on sight without a violin in their hand. If a violinist can finger a passage on an imaginary fingerboard without much effort, then they can apply this knowledge to determine types of intervals, chord qualities, and Roman numerals in the theory classroom.

As previously mentioned, the violin's four strings are tuned in perfect fifths: G, D, A, and E. This means that wherever a finger is pressed on one string, if that finger is moved horizontally to an adjacent string, that resulting note will be a perfect fifth from the original note. For example, in the key of D major, the second finger on the D string would be F♯, so if that second finger moves horizontally to the higher adjacent A string, the resulting note will be C♯, a fifth above F♯. Similarly, if the finger pressing F♯ on the D string would move horizontally to the lower adjacent G string, the resulting note would be B♮, a fifth below F♯. This concept applies to every note in every possible position, promoting a sense of consistency across the fingerboard. This consistency is one of the violin's most stable affordances, which allows for the "feeling" of the interval of a fifth to be one of the most embodied aspects of playing the violin. The significance of the violin being tuned in fifths should not be taken for granted, and having teachers point out such a structural way of thinking about the fingerboard would aid students in their understanding and embodiment of intervals.

Teaching the types of intervals on the violin can be very simple. I would suggest having the student play two open strings simultaneously, i.e., open D and A. Then, have the student put their first finger down on the D string to play E♭ while still playing the A string and say, "This is a tritone, or augmented fourth." Have them move up that first finger to E and note that the interval is now a perfect fourth. The student must then place the second finger right next to the first finger, playing an F♮, then slide up to F♯, creating a major and minor third, respectively. Figure 3 demonstrates this exercise:

Figure 3. Intervals with "A" String Drone

To demonstrate intervals larger than a fifth, use the D string as a drone and move up by half steps on the A string as shown in Figure 4:

Figure 4. Intervals with "D" String Drone

Introducing the names of intervals and how they feel on the violin will help build a solid foundation in the understanding of the geometric space of their instrument, in turn aiding in the embodiment of music theory.

The Hand Frame

Once a violin student can identify the types of intervals, they should encounter a preparatory book called Otakar Ševčík's *Preparatory Exercises in Double-Stopping for* *the Violin*, op. 9.[65] This book contains exercises that drill common intervals found in the repertoire; seconds, thirds, fourths, sixths, octaves, and tenths are practiced all over the fingerboard, helping students understand intervals in positions other than first position. All exercises are diatonic, so an exercise on sixths will have both major and minor sixths present. Consequently, it would be beneficial for students to label all intervals as either minor or major, as the difference between the two is not immediately explicit just by looking at the interval. I would suggest marking an "M" over major intervals and "m" over minor intervals so that students do not rely on their ear to tell the difference, as this can result in sliding or incorrect pitches. I will discuss this idea further in Chapter 4 below and will show examples of labeled half steps in a Ševčík exercise. The only intervals that do not need to be marked are the fourths and the octaves, as these are perfect intervals that maintain the same finger distance and shape.[66] Although octaves might be the easiest to identify aurally, the practicing of them is crucial in helping the left hand create what violinists call a "hand frame," a shape of the hand that allows the fingers to easily access every note in that hand shape.[67]

Positions up until sixth position, where the hand needs to move around the shoulder of the instrument, have the basic hand frame, shown in Figure 5. Beginning violin players are taught to curve their left-hand fingers over the fingerboard at an angle

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[65] Otakar Ševčík, *Preparatory Exercises in Double-Stopping for the Violin,* Op. 9 (New York: G. Schirmer, 1933).

[66] However, because each exercise is diatonic to C major, there is an occasional augmented fourth interval that can be marked as needed.

[67] Ivan Galamian, *Principles of Violin Playing & Teaching* (Mineola, NY: Dover Publications, 2013), 20.

so that the first finger can reach back toward the nut and the fourth finger does not have to stretch.

Figure 5. First-Position Hand Frame

The hand frame is best engrained by playing double-stopped octaves, for the need for the hand to be at a certain angle for the fingers to reach their respective notes is both felt and seen when playing octaves. The hand frame is another example of how the violinist embodies intervals and chords, for the hand, in addition to the fingers, provides another point of reference in "feeling" where notes should be placed on an imaginary fingerboard.

The hand frame stabilizes where fingers are placed in any position, and this is especially helpful when different types of tuning are used. Because the violin is not an equally tempered instrument and uses just intonation when not playing with piano, certain notes in a scale need to be altered for them to be in tune with the rest of the scale in any key.[68] Although the first, fourth, and fifth scale degrees are always fixed within the

[68] Equally tempered instruments, like the piano, split the octave into twelve equally spaced half steps. When playing with piano, string players must adjust their pitch to this equal temperament system by either raising or lowering certain pitches in a key. Often, when not playing with piano, string players use just intonation, where the octave is not split equally into twelve half steps. This means that some intervals are tuned closer than others, thus, the need for altered pitches, especially tendency tones.

frame, Figure 6 shows how seconds, thirds, sixths, and the leading tone are slightly altered:

Raised:	Major 2nds	Minor 3rds	Minor 6ths	Leading tone
Lowered:	Minor 2nds	Major 3rds	Major 6ths	

Figure 6. Altered Pitches Using Just Intonation

When playing with piano accompaniment, or any other tempered instrument, the tuning again needs to be altered to match the tempered pitches. The concept of tempered vs. just intonation is advanced and probably should not be introduced in the beginning stages, but once this concept is grasped and embodied, the player will have a deeper understanding of intervals and how they function within a scale.

Scales and the Circle of Fifths

Once students know the difference between half and whole steps and understand the concept of key signatures, they can begin to identify the intervals between scale degrees in major and minor scales. All major scales have the same progression of half and whole steps: whole-whole-half-whole-whole-whole-half. The G major scale in Figure 7 includes the vertex symbol ^ between notes that are half steps, a violinistic practice that will be discussed further in Chapter 3 of this thesis:

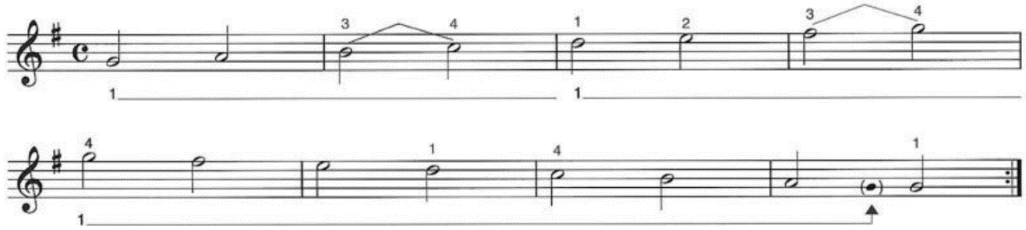

Figure 7. G Major Scale with Marked Half Steps[69]

For advanced violinists who use the Carl Flesch's standard *Scale System: Scale Exercises in All Major and Minor Keys for Daily Study*, these intervals are easily memorized because almost all three-octave major scales have the exact same fingering.[70] (G, A♭, and A major scales have slightly different fingerings due to the nature of the instrument.) All major scales can start with the second finger on the G string, and shifting the hand up one half step will produce the next major scale. Violinists who use the Flesch System also know that almost all minor scales also have the same fingering (again, except G, G♯, and A minor scales). The scales are in the melodic minor mode, so this provides another opportunity to point out the differing whole and half steps in scales. Having the fingering of all major and minor scales solidly memorized will help students embody the scale degrees in each key signature, aiding in part-writing, Roman numeral analysis, and many other music theory tasks.

The memorization and embodiment of scales will also aid in the understanding of the circle of fifths. My undergraduate violin instructor suggested that I play every scale in

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[69] Shinichi Suzuki, *Suzuki Violin School Volume 2* (Los Angeles: Summy-Birchard, 2007), 30.

[70] Carl Flesch, *Scale System: Scale Exercises in All Major and Minor Keys for Daily Study* (Berlin: Verlag von Ries & Erler, 1987).

the order of the circle of fifths every day, i.e., C major → A minor → F major → D minor, and so on. Doing this made me realize that the next key in the circle of fifths was always going to be an interval of a third downward; a major to minor key was a minor third down, and a minor to major key was a major third down. Whenever I needed to determine the relative key of any key, all I had to do was use my imaginary fingerboard to press whatever finger corresponded with the tonic and count two fingers backward, and whatever note that finger landed on was the relative key. For example, if I was asked to provide the relative key of D♭ major, I would press the finger I usually use for a D♭ on the G string, the fourth finger, and count two fingers backwards, landing on my second finger on B♭. I would double check that B♭ is a minor third down from D♭, and lock in my answer as B♭ minor. This cognitive process is almost instantaneous when using an imaginary fingerboard. By relying on the embodiment of intervals, key signatures, and scales instead of the memorization of every combination of these items, the accuracy rate in completing music theory tasks increases.

Chords

This same concept can also be applied to the building of chords. Chords are comprised of stacks of major and minor thirds, and if students can “feel” these thirds, then determining chords will go at a much faster pace. Students must first memorize the following information: major chords comprise of a major third then a minor third; for minor chords, the opposite is true; diminished chords contain two minor thirds, and augmented chords contain two major thirds. Seventh chords, although they are not playable simultaneously like they are on the guitar and piano, are able to be built by creating the bottom triad and then adding a delayed seventh. Students will also have to memorize the types of thirds for all seventh chords, such as major-minor, major-major, diminished, etc. When a student knows that a major-minor (dominant) seventh chord contains a major third and a minor third topped with another minor third, they can calculate the tones in a chord as such: if a student is asked to name the chord tones in an F♯ major-minor seventh chord, they would put their second finger on the D string in first position to play F♯, reach their fourth finger to an A♯, the major third above F♯, then place their second finger across the A string on C♯ as the fifth of the chord, then place their fourth finger a minor third higher on the A string, playing an E♮. Violinists practice dominant arpeggios in this way when practicing the Flesch System, so even though it is impossible to play all four notes in a seventh chord simultaneously, building them note by note is already being embodied when practicing technical exercises like arpeggios.

When calculating inversions of chords, violinists can feel how a chord is built from the root and "track" which fingers are placed on each chord tone. They then can count which finger corresponds with each inversion of the chord, then determine the corresponding note to that finger, providing the answer to the inversion. For example, if a violinist was asked to determine the inversion of the chord in Figure 8:

Figure 8. B♭ Dominant Seventh Chord

they would first find the root of the chord by determining the most compact hand frame, where all four chord tones can be played on two adjacent strings without having to leap around the fingerboard. After finding the root, they would build the chord up from the root, placing the first finger on B♭ on the A string, then placing the third finger on D♮. The first finger then slides across to the E string to play a fifth above B♭, which is F♮, and the third finger is placed on A♭. Once the violinist knows which chord tones corresponds with which fingers, they can look at the bass note in the example chord, then "track" when that corresponding finger was placed. In this instance, the first finger on F♮ was the second-placed finger after the root, so we know that this chord is in second inversion.

This embodied system of calculating inversions is also advantageous when realizing figured bass. In the scenario in which a student is asked to realize two measures of figured bass like that in Figure 9, they would calculate as follows:

Figure 9. Figured Bass in B♭ Major

For the first chord, the violin student will automatically know that a fifth above B♭ is the horizontal note on the D string, F♮. Then, a major third above the bass will be D. For the E♭ bass note, the student will know that a 6th above their first finger on the D string will be their second finger on the A string, a C♮, and a major third above their first finger will be their third finger, a G♮. For the F♮ bass note, the student will know that a 7th above F is a whole step below an octave, which is an E♭, fourth finger on A string. The fifth above F is the horizontal note of C, second finger on the A string, and the major third above F is A since the second finger to the fourth finger is a third interval. Lastly, for the D bass note, the student will know that a sixth above open D will be B♭ due to their work with the D string being a drone, and that the minor third above D is the second finger placed on F♮. Again, it takes many words to describe a cognitive process that takes place in the span of a few seconds, but it is important to point out how this process can work if students can link the names of intervals and types of inversions with how they feel on the violin.

Roman Numeral Analysis

This way of determining chord qualities, inversions, and figured bass can then be applied to Roman numeral analysis. Roman numeral analysis is the culmination of all of the concepts usually learned in a first-year theory course: intervals, scale degrees, chords, the phrase model, inversions, and figured bass. Each of the roots of the chords in a particular key, such as the tonic or submediant chords, corresponds with a scale degree, which in turn corresponds with a finger on the imaginary fingerboard.

Figure 10. A Major Chord Progression

Figure 10 shows a common chord progression in the key of A major, which would be calculated and then labeled as such: the root of the first chord is A, scale degree one, which corresponds to the first finger on the G string in A major, so it would be labeled as a tonic chord in root position. After finding the most compact hand frame, the second chord's root is B, the second finger on the G string and a supertonic chord in first inversion because the bass note lands on the finger that was placed first after the root. For the third chord, the most compact hand frame shows that the root is E, first finger on the D string and a fifth above the tonic A, so this chord is a dominant seventh chord in third inversion because the bass note corresponds with the third-placed finger after the root. The same method would be used to calculate the final tonic chord in first inversion. Realizing the violin's affordances and potential as a CCA for music theory would especially help first-year university students become more confident in their theory skills, as a complex process like Roman numeral analysis can be broken down into embodied, logical steps that do not have to be calculated on paper.

The Violin as a CCA

One of the most important ways in which a violin can be considered as a CCA was explored in two of the studies that I mentioned in Chapter 1. The study by Bangert et al. demonstrated that practicing the piano promoted a joint mental representation of ear and hand, and that when pianists "played" silent dexterity drills, they "heard" notes in their head. They also found that hearing piano music made the participants "feel" the notes in their fingers, suggesting a strong auditory-motor connection.[71] Although pianists were the only participants in this particular study, the study with violin participants by

[71] Marc Bangert, Udo Haeusler, and Eckart Altenmüller, "On Practice: How the Brain Connects Piano Keys and Piano Sounds," *Annals of the New York Academy of Sciences* 930 (June 1, 2001): 425.

Lotze et al. also concluded that fingering passages produced audible tones in the head, and vice versa.[72] This means that when violinists are part-writing or looking for errors in any music theory exercise, they would be able to "hear" the notes that they write if they would silently finger them on an imaginary fingerboard. This could help diminish the number of common mistakes such as writing incorrect notes, not raising the leading tone in minor keys, or omitting a necessary chord tone.

Although the skill of "feeling" notes that are being heard is not quite as applicable to performing music theory tasks as "hearing" notes while playing on an imaginary fingerboard, it is extremely beneficial in the aural skills classroom. If a violinist can feel which notes are being played, almost as if they have absolute pitch but just for their instrument, dictation and error detection exercises become simple tasks. The study by Drost et al. mentioned in the previous chapter addressed how instrumentalists have a unique relationship with their own instrument when it comes to timbre, and how instrumentalists internalize the sound of their instrument differently than other instruments.[73] Therefore, if a violinist does not have absolute pitch and hears a dictation played on the piano, the violinist most likely will struggle just as much as any other instrumentalist, especially if they have not internalized how intervals sound on instruments other than their own. However, if the dictation was played on a violin, there is a greater chance of the violinist recognizing the timbre of certain notes and registers,

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[72] Martin Lotze et al., "The Musician's Brain: Functional Imaging of Amateurs and Professionals During Performance and Imagery," *NeuroImage* 20 (2003): 1817–29.

[73] Ulrich C. Drost et al., "Instrument Specificity in Experienced Musicians," 527–33.

giving them an advantage over other instrumentalists. Although the topic of aural skills is not the focus of this thesis, the concept of how instrumentalists respond to the timbre of their instrument is a topic for further study in the field of cognitive artifacts, embodiment, and music.

Another topic for future study is how a violinist may not even need to initiate the motion of pressing the string on an imaginary fingerboard in order to perform music theory calculations once they reach a high level of embodiment on their instrument. In my experience, after years of physically fingering passages in the air to perform calculations, I found that I no longer needed to do this when I could just "think" of aspects such as the hand frame and how my fingers make chords. My hand does not have to move for me to "feel" the fingerboard, for I have a complete version of the violin in my mind. Of course, it is still easier to physically make the motion of playing on the fingerboard in order to "hear" the tones being produced, but not having to rely on making physical calculations can be advantageous in a public setting. Using the violin as a CCA for music theory purposes has deepened by understanding of important concepts that enhance my skills as a performer and music theory learner. I will demonstrate how students in multiple stages of learning can obtain this skill in the next three chapters of this thesis.

Chapter Three: A Model Curriculum for Beginning Violinists

As a beginning violin student, I was not at all concerned about music theory concepts such as intervals or key signatures, and I believe this was partly due to my violin instructor not placing any importance on these concepts. Both my instructor and I were focused on learning to play as many beautiful pieces as possible and little thought was given to the physical mechanics and the music theory behind every piece. I learned the names of the strings and the notes that correspond to the three fingers on the D string in first position from verbal instruction, then immediately began to learn note-reading in the classic violin method book *String Builder* by Samuel Applebaum.[74] Although this book contains simple instructional material and detailed diagrams to help students visualize where to put their fingers for each note, I ignored most of the written text and was eager to learn how to play the pieces, unaware that failing to internalize the seemingly intuitive information might have lasting consequences.

As a young student, the placement of the fingers on the fingerboard seemed like a means to an end, rather than a concept that was encoded with crucial patterning for the understanding and embodiment of music theory. Although not all violin method books explicitly point out this information, many do draw attention to important concepts that

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[74] Samuel Applebaum, *String Builder: A String Class Method, Book 1* (Van Nuys, CA: Belwin-Mills, 1960).

often get overlooked or taken for granted by both student and teacher. As discussed in Chapter 2, the difference between half and whole steps must be explained to students in a way that emphasizes not only the note names but also the "feel" of each interval on the fingerboard. Memorizing the feel of these intervals will also help students understand the differences between key signatures. To illustrate, this chapter systematically links the theory concepts of half steps, whole steps, key signatures, and the circle of fifths to finger position, space, intervals, and tactile feedback on the violin during a student's introductory years of playing. In doing so, the discussion shifts to a more pedagogical tone.

Beginning Stages

For the purposes of this curriculum, I will be using both Applebaum's *String Builder* and *Suzuki Violin School: Volume 1* by Shinichi Suzuki since I have the most experience either learning or teaching from these method books.[75] The Suzuki Method is renowned for its excellent selection of repertoire, although there is only a handful of introductory exercises to prepare students to play the method's first piece, "Twinkle, Twinkle, Little Star." As a result, I believe a method book that contains a more gradual increase in difficulty, like *String Builder*, can be helpful in filling in the gaps.[76]

When a student begins learning how to play the violin, they first learn the note names of the four strings, then they learn the note names of the first three notes in first position on the D string and A string (Suzuki is the exception, with students learning the

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[75] Shinichi Suzuki, *Suzuki Violin School Volume 1* (Los Angeles: Summy-Birchard, 2018).

[76] Other method books, such as *A Tune A Day* by C. Paul Herfurth, the *Maia Bang Violin Method*, and *Essential Elements for Strings* by Allen, Gillespie, and Hayes have similar ideas and exercises that portray the concepts I want to emphasize, some more successfully than others.

notes on the A and E strings first). If a teacher puts thin tapes on the fingerboard where each finger should be placed, this diminishes much of the guesswork for the student and provides visual feedback if the student has trouble discerning pitch in the early stages. However, using tape is not necessary for every student, and all of the method books discussed here present the material as if students did not use tapes. Figures 11–13 reprint diagrams from *String Builder* showing how the first three fingers should be placed on the D and A strings:

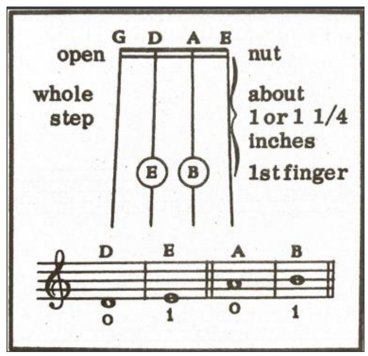

Figure 11. First Finger Diagram[77]

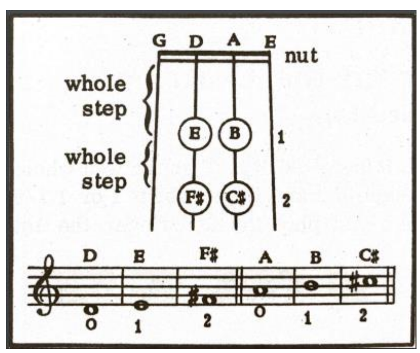

Figure 12. Second Finger Diagram[78]

[77] *String Builder*, 10.

[78] Ibid., 12.

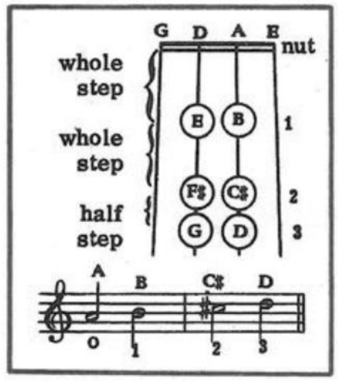

Figure 13. Third Finger Diagram[79]

These diagrams help students understand the important relationship amongst space, intervals, and tactile feedback. Not only does Figure 11, the first finger diagram at the top specify that the first finger should be placed "about 1 or 1 ¼ inches" above the nut of the violin, the diagram also indicates that the first finger is placed a whole step above the open string. In essence, the distance of 1" or so in first position is mapped to a whole step, an important CCA concept for the young student to grasp. The second finger diagram (Figure 12) includes both the first and second fingers, indicating that the interval between the first and second finger is a whole step. The third finger diagram (Figure 13) includes all three fingers, indicating that the third finger is placed a half step above the second finger. Here, depending on the size of the student's finger pad, the distance for the half step is at most ¼ inch, and in many cases the fingers may actually be touching. In any case, the tactile difference between half and whole steps is not only an essential idea for playing, but also for studying music theory.

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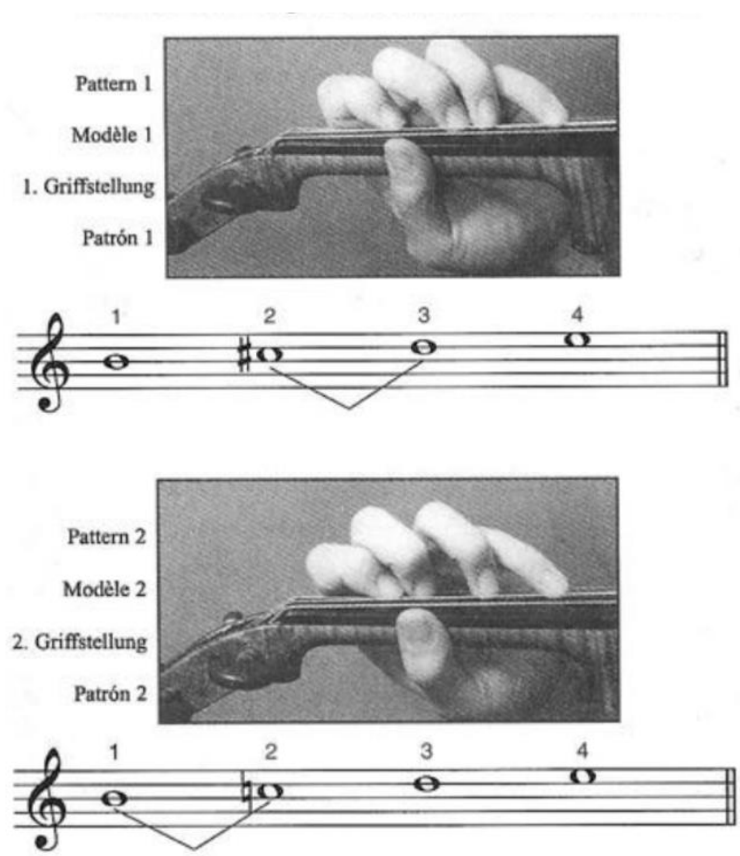
[79] Ibid., 15.

Finger Placement

The Suzuki Method diagrams finger placement in two ways. The last page of *Suzuki Vol. 1* (p. 48) contains diagrams similar to Figures 11–13, but I consider them less helpful compared to those of the *String Builder* diagrams and will not include them in this thesis. Second, the Method contains an introductory page that displays pictures of the three different finger patterns (see Figure 14):



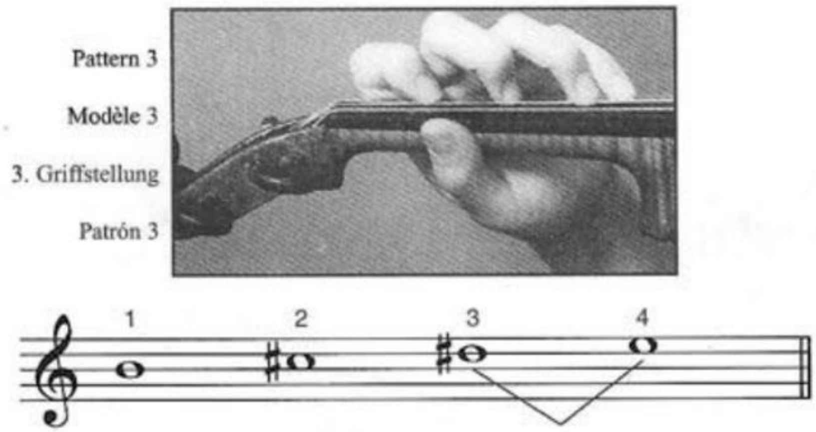


Figure 14. Suzuki, Left Hand Finger Patterns[80]

Figure 14 above shows three different fingering patterns, labeled Pattern 1, Pattern 2, and Pattern 3. Like the *String Builder* diagrams, these images help students understand the important relationship amongst space, intervals, and tactile feedback; further, given the notes included, these patterns can be linked to key signatures, an aspect that will be discussed shortly. In the images, all of the patterns start with the first finger in first position on the A string; the position of the second and third fingers changes to create new half and whole step relationships. Pattern 1 is the most common pattern that beginners use with the second finger placed closely to the third finger, producing C♯ and allowing for the key of D major. Young students will use this pattern for a significant amount of time before progressing to learn C♮, where the second finger is placed next to the first finger as in Pattern 2, allowing for a two-octave G major scale in first position. Pattern 3 includes both C♯ and D♯, moving the third finger close to the fourth finger (fourth fingers in their natural position are the same pitch as the next open string), and

[80] *Suzuki Vol. 1,* 20.

allowing for a two-octave A major scale and the new keys E major and B major, which will not be introduced until much later in a violinist's education.

Both method books introduce the vertex symbol (∧ above or ∨ below) to signify a half step between melodic notes. This symbol is crucial to the understanding of half steps; it signals to students that, as the notes are connected on the page, so are the fingers connected in the hand. Figure 15 shows two examples from *String Builder* of these symbols connecting half steps:

Figure 15. *String Builder*, Half Step Symbol in Use[81]

Exercise 60 shows a vertex underneath F♯-G pairs; Exercise 64 similarly labels C♯-D dyads. Although I used *String Builder* as a beginning violinist, I was not shown the value in using this symbol to mark half steps until I entered university. It is a common practice in advanced orchestral and solo playing to mark the half steps between notes to orient one's hand to a particular piece's key, but the act of marking half steps should be introduced and implemented early on in the education of a violinist. After getting used to playing music with these markings, students will inherently know that whatever set of stepwise notes does not have one of these symbols is likely a whole step, thus, allowing

[81] *String Builder*, 14-15.

them to further internalize and embody intervals on the fingerboard. Also, being more familiar with how half and whole steps are mapped onto the violin aids in the understanding of key signatures due to how the major scale combination of half and whole steps is consistent throughout the fingerboard.

Key Signatures

After introducing the names of the four strings, the note names of the full octave D major scale, and the concept of half vs. whole steps with the vertex symbol, students are ready to understand the concept of key signatures. Method books usually begin with exercises and excerpts in D major and move on to A and G major (Suzuki is the exception, as the first key introduced is A major). It is sometimes confusing for students to remember the names of F♯ and C♯ since all the other notes learned so far do not have a "sharp" added, but this can be an opportunity to teach the meaning of key signatures. In Figure 14 above, three different finger patterns that start on open strings are shown: G/D/A major, G major second octave (or C major), and E/B major. Although students will not encounter G major until halfway through a method book and will not see E major or B major until much later, the concept of how differing half and whole step combinations can create specific keys could be introduced and explained through these images, as well as by these diagrams in Figures 16–17 from *String Builder*:

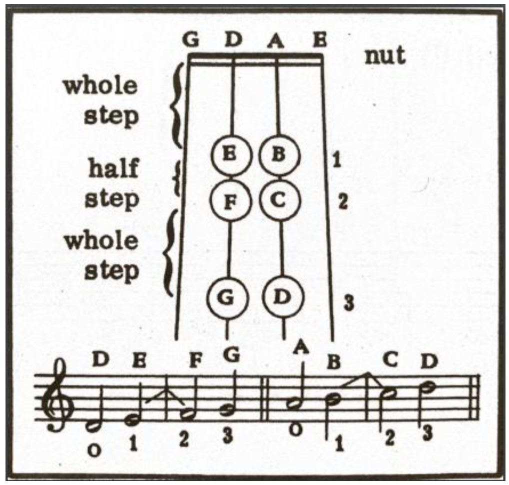


Figure 16. Low Second Finger Diagram[82]

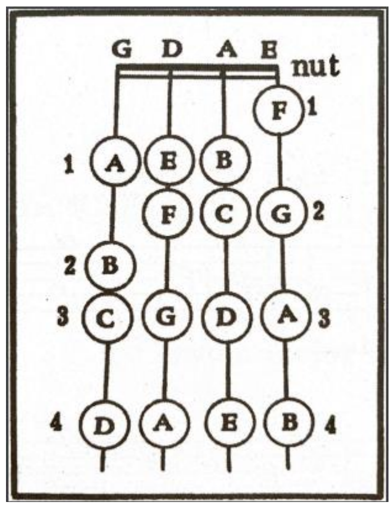


Figure 17. Various Finger Positions Diagram[83]

Demonstrating how each of the pictures and diagrams sounds when played on the violin will also help students internalize these concepts.

When demonstrating the finger pattern and key of D major, instructors should show students the diagram of the D and A strings with the corresponding fingering and play the

[82] *String Builder*, 15

[83] Ibid., 27

scale while emphasizing half step placement. They will be most familiar with D major at this point, so this scale will act as a comparison to other scales and keys. Note that, as the major scale pattern is isomorphic from one scale to the next, so too is the physical patterning across different strings. The same fingering and spacing between fingers can be used to create new scales if they start on different strings; if they use that same fingering pattern starting on the open G string, the scale and key will be G major, and if they start on the open A string, the scale and key will be A major. Students may have already figured this out on their own, but it is best to be explicit in why this fingering can create so many scales by explaining how the major one-octave scale pattern can be used on the G, D, and A open strings to create their respective scales.

The concept of open-string key signatures and scales can then be applied to pieces. The simplest example is “Twinkle, Twinkle, Little Star,” found in *String Builder* in D major (and the Suzuki Method in A major):

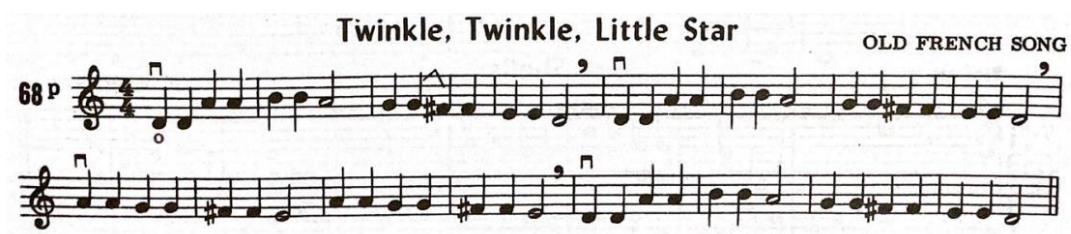


Figure 18. Twinkle, Twinkle, Little Star[84]

The instructor can explain that if a piece has F♯ and C♯ and ends on D, it is most likely in D major. And if a piece has F♯, C♯, and G♯ and ends on A, it is mostly likely in A major. Although *String Builder* does not use key signatures, Suzuki does, so you can also point

[84] Ibid., 15.

out that pieces in D major have two sharps in the key signature, and that pieces in A major (like the Twinkle arrangement in Suzuki) have three sharps in the key signature. As you can see in the *String Builder* arrangement of Twinkle (Figure 18), it is the 68th exercise in the book and there is a half step marked between the second and third fingers, reminding students that the second finger should be placed close to the third finger.

Introducing the concept of key signatures increases in difficulty when the keys do not line up with open strings. This is partly due to the change in second finger placement, for with keys other than open string keys, there is now the option to have a lowered second finger that touches the first finger instead of the third, as shown in the diagrams above (Figures 16 and 17) and the second photo in Figure 14. I believe the best way to introduce a lowered second finger is to teach the two-octave G major scale. The first octave has the normal, high second finger fingering, while the second octave has a lowered second finger on both the A string and E string. This second octave can be viewed as merely "adding on" to a scale the student already knows so that they will not be overwhelmed by the new second finger placement. The idea of a lowered second finger on the E and A strings can then introduce the student to a lowered second finger on the other two strings, a skill they will need for upcoming repertoire in *Suzuki Vol. 2*.

Tonic-Dominant Relationship

Once students have a handle on playing in the open string keys of D major, A major, and G major (two octaves), they will be able to easily understand how to play all of the pieces in *Suzuki Vol. 1*. As previously mentioned, the book begins with all pieces in A major until the tenth and eleventh pieces, "Allegretto" and "Andantino" by Suzuki, which are the only D major pieces in the book, while the rest of the book is focused on G major.[85] The first piece to "combine" keys, or the first piece to modulate, is the thirteenth piece in the book, "Minuet No. 1" by J. S. Bach. Playing this piece is an excellent way for students to "exercise" their second finger because it has to switch between the low and high position frequently.[86] The piece begins in G major with a high second finger on the D string (i.e. F♯) and a low second finger on the A string (i.e. C♮), then modulates to D major where the second finger is raised on the A string (i.e. C♯). The last two lines of the piece then modulate back to G major. The constant changing of the second finger placement helps students memorize the "feel," or finger placement, of each of these keys, for G major has a low second finger on the A string while D major has a high second finger on the A string.

"Minute No. 1" provides an opportunity to introduce the concept of the tonic-dominant relationship, as it is not too early in the music education to do so. Because all keys the student has learned so far are open-string keys, and the open strings are tuned in fifths, the concept of I-V-I using open strings could be easily grasped by students who can play in the open-string keys. Having students count the number of notes in the scale from G to D or from D to A will reveal that the distance between each set of strings is five notes, and the teacher can point out that a distance of five notes is the interval of a fifth. Therefore, when a piece is in G major, and there is a section that sounds like it is in

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85 *Suzuki Vol. 1*, 35.

86 Ibid., 38.

D major because it "ends" on D and it contains a C♯, or a high second finger on the A string, this new key in the piece is called the dominant key, or five notes above the original "home" note.

Another piece that displays a tonic-dominant relationship, and perhaps the best piece to illustrate how different combinations of half and whole steps can be present in one piece, is the last piece in *Suzuki Vol. 1*, "Gavotte" by F. J. Gossec.[87] The piece is in G major, although it tonicizes D major in three separate instances, allowing for all three fingering patterns from Figure 14 to be used. The first finger pattern with a high second finger is used on the D string throughout and on the A string during the short tonicizations. The second finger pattern with the low second finger is used on the A string to create a C♮ for the key of G major, and the third finger pattern with the raised third finger is used to create a C♯ on the G string during one of the D major tonicizations. In this piece, and in all pieces that modulate or tonicize another key, it is important to mark the half steps with the vertex symbol so that students realize that not all second fingers will be in the same position.

Learning Other Key Signatures

The entirety of the first Suzuki book comprises of pieces in G, D, and A major. It is typical for students to play from this book for around one year before moving on to the second Suzuki book, where three more key signatures are introduced. D minor, B♭ major, and A minor are introduced almost halfway through the book, and all of these keys come

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[87] Ibid., 43.

with new fingering positions that differ from the open-string keys of G, D, and A major.[88] Suzuki displays the new fingering patterns with another page including images of the hand along with the vertex symbol connecting half steps on a staff, shown in Figure 19:

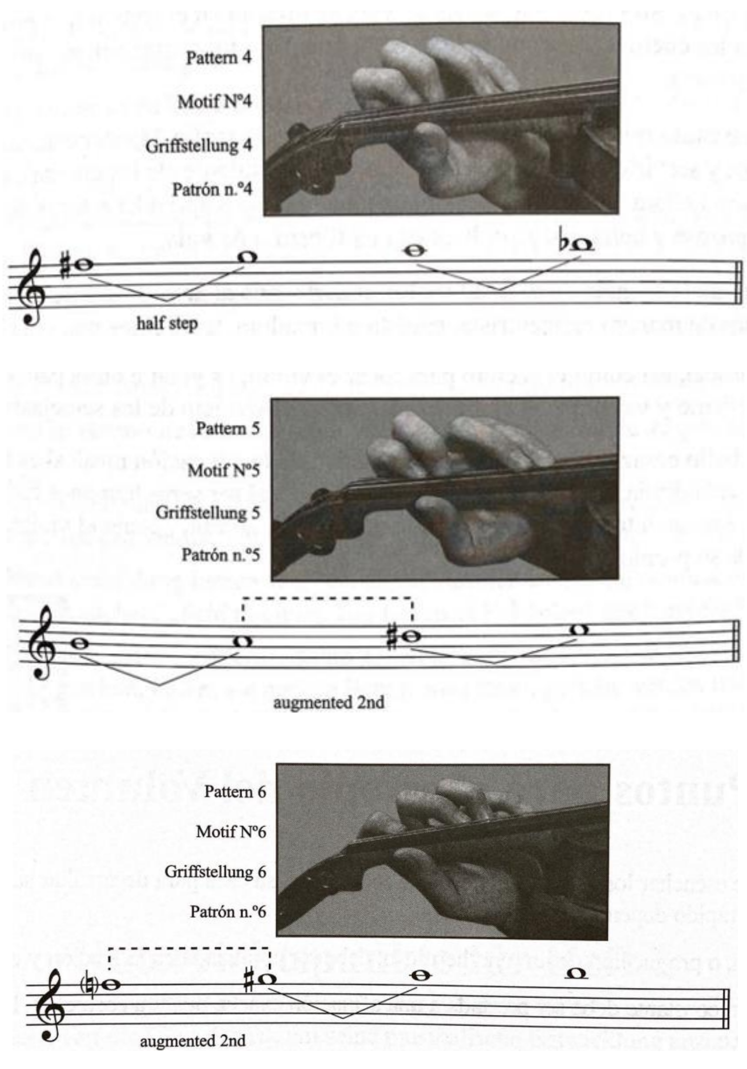

Figure 19. More Left-Hand Finger Patterns[89]

[88] *String Builder* introduces C major at the end of the first book, and this key uses fingering Pattern 2.

[89] Shinichi Suzuki, *Suzuki Violin School Volume 2* (Los Angeles: Summy-Birchard, 2007), 8.

After learning these new finger patterns, the student will have learned almost all of the possible combinations of first position fingering and will be able to play a one-octave scale in any key. The new finger positions, as shown in the pictures, are a lowered first finger (Pattern 6) which is placed close to the nut of the violin, and a lowered fourth finger (Pattern 4), which is placed closely to the third finger. The new position for the first finger allows students to play a B♭ on the A string and F♮ on the E string (shown in Pattern 6) in order to play a B♭ major scale. Finger Pattern 6 also allows students to play in a minor key, such as D and A minor, for the lowered first finger on the B♭ (for D minor) and F♮ (for A minor) is needed for these keys.

Pattern 5 and Pattern 6 contain augmented seconds between fingers, and these patterns are used to play harmonic minor scales. Harmonic minor scales provide an opportunity to introduce the concept of the leading tone, as this concept will also help students identify key signatures. Because students will already have spent time with the idea of a half step leading up to the “home” note in major keys, they should not have difficulty in understanding that the same idea apples to minor keys. The teacher can even mention that if one looks for a raised pitch or accidental in a minor key, the note above that raised pitch is usually the “home” pitch, or the key of the piece. Additionally, the tactile relationship between fingers playing half steps will aid in the understanding of leading tones.

Out of the six finger patterns learned so far, Pattern 1 is used the most. The open string keys of G, D, and A major, as shown below in Figure 20, solely use this pattern for

2-string, 1-octave scales. The other five patterns are mixed-and-matched to create the fingerings for the other keys learned at this stage.

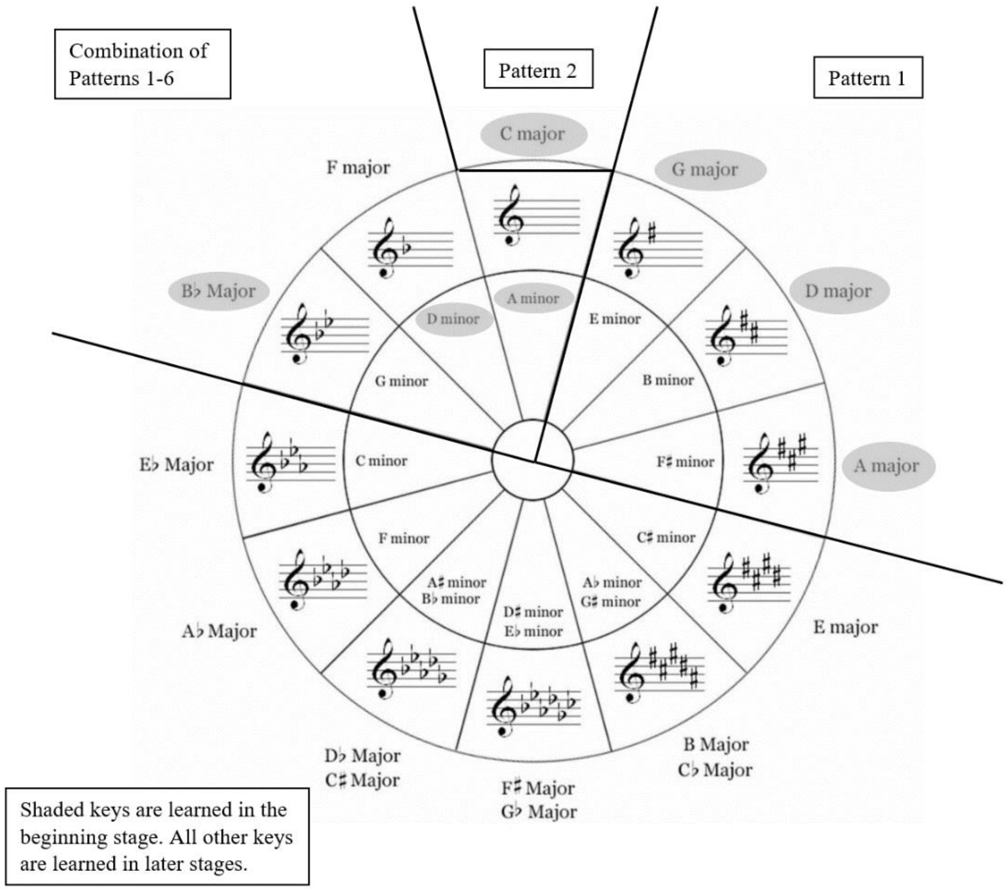

Figure 20. Circle of Fifths with Finger Patterns

All of the finger patterns addressed thus far have been in first position on the fingerboard; the first finger is placed between 1 and 1 ¼ inch above the nut unless it is in its lowered position, and the other three fingers each have a low and high position. The beginning violin student will learn how to play one-octave scales in the keys of G, D, A, C, and B♭ major as well as D and A minor by the time they reach their second year of playing. They will also have learned how to play G, A, and B♭ major two-octave scales which combine finger patterns. The concept of how different combinations of half and whole steps can create various key signatures will help the student decipher what key a piece is in, and the tonic-dominant relationship will have been explained in terms of key area and scale degrees. All these concepts, especially the tactile aspect of playing half and whole steps, will have started the process of the violin becoming a complimentary cognitive artifact for the student.

Chapter Four: A Model Curriculum for Intermediate Violinists

Although every stage in a violinist's education is important and must be carefully crafted by the instructor, the intermediate stage is crucial for providing the violinist with a solid technique for the violinist to advance in their studies. The intermediate stage expands on concepts introduced in the beginning stages, but also introduces new concepts such as higher positions, double stops, hand frames, three-octave scales, and playing in keys with more than two accidentals. By the time a student reaches the intermediate level, they will have moved past most method books aside from the latter Suzuki books and will need to learn the concepts mentioned above through studying etudes, technical studies, and standard violin repertoire. Music theory concepts should infuse these technical undertakings, since technical studies, etudes, and repertoire all provide an opportunity to learn music theory through the physical attributes of the violin.

Due to the vast range in difficulty of techniques and ideas present in the intermediate level, it can be split into two categories: beginner-intermediate and intermediate-advanced. At the beginner-intermediate level, etudes and repertoire usually do not deviate from first and third position, whereas the intermediate-advanced level, repertoire moves on to higher positions. The technical studies I include in this chapter would fall into the intermediate-advanced category, while the etudes and solo repertoire would fall into the beginner-intermediate category. However, depending on how quickly a beginner-intermediate student learns and embodies the concepts discussed in this chapter, they could also benefit from incorporating the technical studies in their daily practice.

In this chapter, I pair hand position embodiment techniques with relevant repertoire and theory concepts. The technical studies I will examine are Ševčík Op. 8, *Shifting the Position and Preparatory Scale-Studies for the Violin,* Ševčík Op. 9 *Preparatory Exercises in Double-Stopping for the Violin*, and the *Carl Flesch Scale System*. These books help the student memorize the feel, or muscle memory, of the many positions on the violin, the distance between each interval of a double stop, and the hand frame. The etudes I examine will be from Wohlfahrt Op. 45, *Sixty Studies for the Violin*, Books I and II. These etudes are standard studies for a beginner-intermediate violinist, since the early etudes in the book merely expand upon basic concepts of finger dexterity and pitch, while the latter etudes include third position and double stops. Lastly, the standard solo piece I will briefly analyze will be the first movement of *Violin Concerto No. 2 in G Major* by Joseph Haydn. The technical studies and etudes prepare the student to understand the technical and theoretical demands of solo works at the intermediate level and beyond. The goals of this chapter are to put standard violin exercises and repertoire in a music theory frame, showing how the techniques in these books can help students embody music theory concepts such as scales, key signatures, harmonic and melodic intervals, and modulations and tonicizations.

Shifting to New Positions

Although a violinist does not have to learn more than first position to memorize the feeling of all intervals and key signatures, shifting to new positions provides an opportunity to further embody intervals and keys all over the fingerboard. Each position is based on specific intervals, or the next interval on a string, which means that a new position emphasizes new whole and half step combinations. After a student obtains solid technique in first position, discussed in Chapter 3 of this thesis, they must learn third, second, and fourth position, usually in that order. Students spend the most time learning first and third positions, especially in the beginner-intermediate stage. The etudes and concerto discussed at the end of this chapter are almost exclusively in first and third position.

Third Position

This new position allows the player to reach new notes and to play multiple-octave scales. However, due to the nature of stringed instruments, the higher a position, the closer the notes will be because the string is shortened. Therefore, in third position, and in any position above first position, the fingers will be placed slightly closer together to accommodate the shortened string.

This is one reason why the violin is such a difficult instrument to play. Although half steps always employ close fingers while whole steps require some distance, the amount of space between every interval gets smaller the higher one plays on the violin. In the uppermost register, there may not even be enough space to place the full pad of the finger on the string, and the player must attempt to squeeze two notes in the span of a quarter inch. However, because the strings are tuned in perfect fifths, the space between each interval in a certain position is consistent across the strings (i.e, in third position, an in-tune half step between the third and fourth fingers on the G string will also be in tune if placed on the other three strings). This consistency aids in the memorization of intervals across strings, as will be shown in the following technical exercises.

In the Suzuki Method, third position is not introduced until the very end of Vol. 2. The last three pages provide exercises for shifting to third position to prepare the student for Vol. 3. To shift into third position, the violinist must slide their hand up the string and place their first finger where their third finger used to be, hence, it is called third position. Figure 21 below shows how a student should practice shifting to third position. In first position, the first and the third finger play their respective notes, then the hand shifts up the fingerboard and the first finger replaces the third finger, sounding the same note. The shift back down to first position takes place in the same manner. Figure 22 displays a G major scale in third position with half steps marked, with the first finger starting on G on the D string.:

Figure 21. Shifting to 3rd Position[90]

[90] *Suzuki Vol. 2*, 29.

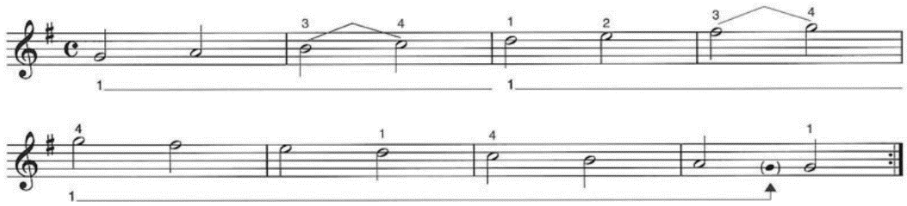

Figure 22. G Major Scale in 3rd Position[91]

Second and Fourth Positions

Next, violinists learn the second and fourth positions, introduced almost simultaneously in the Suzuki Method at the end of Vol. 3 and the beginning of Vol. 4.[92] Second position can be confusing for students as the placement of the fingers is close to that of first position, but second position is advantageous for many reasons. Second position accommodates note combinations that may not be comfortable in the first or third position.

Fourth position is perhaps the position with the most effortless tactile feedback for the hand, for not only do the fingers rest on the fingerboard and the thumb touches the side of the neck, the palm gently touches the nose of the violin, as shown in Figure 23:

[91] Ibid., 30.

[92] Shinichi Suzuki, *Suzuki Violin School Volume 3* (Los Angeles: Summy-Birchard, 2018); Shinichi Suzuki, *Suzuki Violin School Volume 4* (Los Angeles: Summy-Birchard, 2019).

Figure 23. Hand in Fourth Position

As previously mentioned, since fourth position is significantly higher up the string than first position, the space between intervals must be minimized.

Fifth through Eighth Positions

Once students feel comfortable playing etudes and repertoire in second, third, and fourth positions, understanding that the space between intervals gets smaller the higher one plays on the string, the addition of the fifth and sixth positions comes as no surprise to the student. In fact, if the student seems to be handling positions above fourth position well, seventh and eighth position may also be introduced. Note that it may take some time for the student to be comfortable reading ledger lines but introducing the positions incrementally will build their skill in identifying high notes on sight.

Technical Study: Ševčík Op. 8, Shifting Positions

At this stage, it is appropriate to introduce Ševčík Op. 8 into the student's daily practice.[93] The fifty-nine shifting exercises aid in the methodical embodiment of where each finger should be placed in each position, and they provide the student ample opportunities to practice and embody the difference between half and whole steps all the way up the fingerboard. However, learning positions past fourth position and playing exercises from Ševčík Op. 8 should be attempted during the intermediate-advanced stage and should only be attempted after beginning-intermediate concepts such as half vs. whole steps, key signatures, and shifting have been understood and embodied.

In the first exercise in Ševčík Op. 8, displayed in Figure 24, each measure is a miniature exercise in shifting to the next position and back down again:

[93] Otakar Ševčík, *Shifting the Position and Preparatory Scale-Studies for the Violin,* Op. 8 (New York: G. Schirmer, 1933).

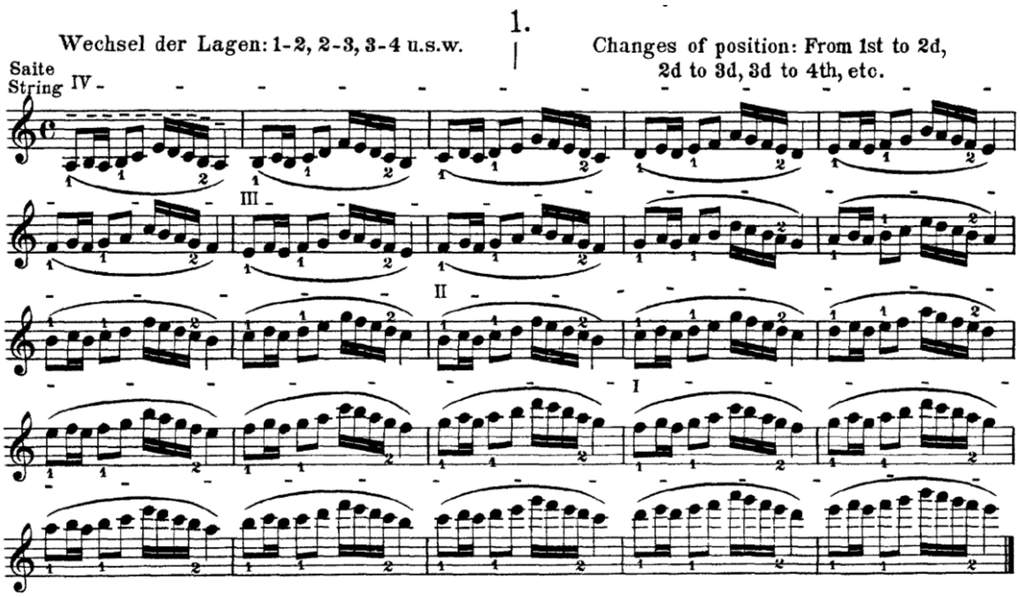

Figure 24. Ševčík Op. 8, No. 1[94]

The numbers above or below a note indicate which finger should be placed on that note. The first measure begins with the first finger in first position on the G string, and it shifts up to second position on the B♮. Later in the measure, the second finger is used to shift back down to first position on the B♮. This pattern is repeated for every position up to seventh position on every string. However, because this exercise is diatonic in C major/A minor, the pattern of half and whole steps constantly changes, forcing the player to be extremely aware of which note and position they are playing. For example, the first measure has a whole step between the A and B♮ first finger shift, but the second measure has a half step between the B♮ and C♮ first finger shift. Other exercises in this book have the student shift multiple positions at once, such as from first to fourth, first to seventh, etc., and for every one of these exercises, each shift must be carefully planned and

[94] Ibid., 2.

executed. Every shift, whether shifting the interval of a minor second or a major seventh, must be slowly engrained into the muscle memory to play in tune, and this aspect of violin playing aids in the embodiment of melodic intervals played on one string.

Scales

At this level, as scales expand through three octaves, they show intervallic positions in all registers of the fingerboard. Three-octave scales are introduced incrementally, and once students can shift comfortably, they can be introduced to certain scales in the *Carl Flesch Scale System* at the instructor's discretion. The 1-string, 1-octave scales and the three-octave scales in the keys of their repertoire will help further engrain the feeling of each key area. The 1-string, 1-octave scales allow the student to feel the gradual decrease in the size of the intervals between each finger as they move up the increasingly tightened string. For example, the student begins the scale with their first finger placed on the lowest B♭ on each string and shifts up the same string every couple of notes to create a one octave scale, as shown in Figure 25:

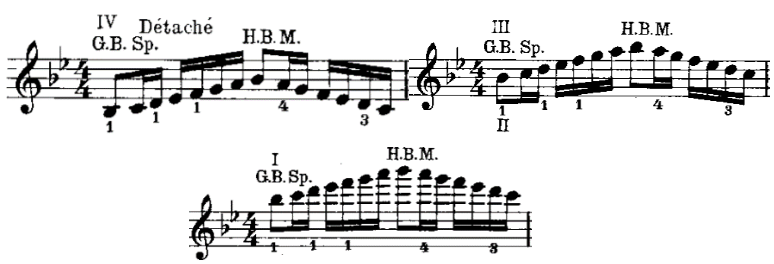

Figure 25. Flesch 1-String, 1-Octave Scales[95]

[95] Flesch, *Scale System*, 21.

By the time they reach the top of the one octave scale, their fingers will be pressed tightly together to play the A♮ to B♭ interval, much tighter than if they were to play that interval in first position.

Whereas the 1-string, 1-octave scales contain rapid shifting on one string, the three-octave scales provide the student with an opportunity to feel what a certain key and scale feels like in multiple positions all over the fingerboard. As mentioned in Chapter 2 of this thesis, all major-key three-octave scales in the *Carl Flesch Scale System* have the same fingering pattern except G, A♭, and A, and all minor keys have the same fingering pattern except G, G♯, and A. Both major and minor scales (save for the exceptions) begin with a second finger on the G string in whatever position the scale calls for. For example, for a three-octave B♭ major scale (shown in Figure 26), the second finger would be placed on B♭ in first position on the G string, and to reach the second and third octaves, the hand must shift upwards three more times during the scale (a "1" above a note indicates a shift):

Figure 26. Flesch B♭ 3-Octave Scale[96]

This exact fingering pattern shown above can be applied to almost all major scales. Minor scales have a slightly different fingering, and Flesch chose to present all minor scales in the melodic minor mode, as shown in Figure 27:

[96] Ibid., 22

Figure 27. Flesch E Minor 3-Octave Scale[97]

Because the fingering pattern of the scales is so consistent, it is not difficult for students to memorize every scale. However, some of the more difficult keys to play in, such as D♭ major or G♭ major, might be best introduced in the advanced level of violin playing. Keys with four or fewer accidentals could potentially be learned and embodied by the end of the intermediate-advanced stage, and these keys usually correspond to the keys of the intermediate etudes and repertoire.

Double Stops

At the intermediate stage, all types of triple and quadruple stops will not have been fully integrated into the etudes and repertoire, but many double stops (playing two notes at once) are frequently played. If students feel comfortable with the shifting exercises in Ševčík Op. 8, then they would benefit from incorporating exercises from Ševčík Op. 9 into their studies. This book prepares the student to easily play seconds, thirds, fourths, sixths, and octaves in a controlled setting so that the ease of playing these intervals is transferred to their repertoire. In the third exercise of the book, shown in Figure 28, sixths are played between each set of strings and the hand shifts to the next highest position every measure:

[97] Ibid., 116.

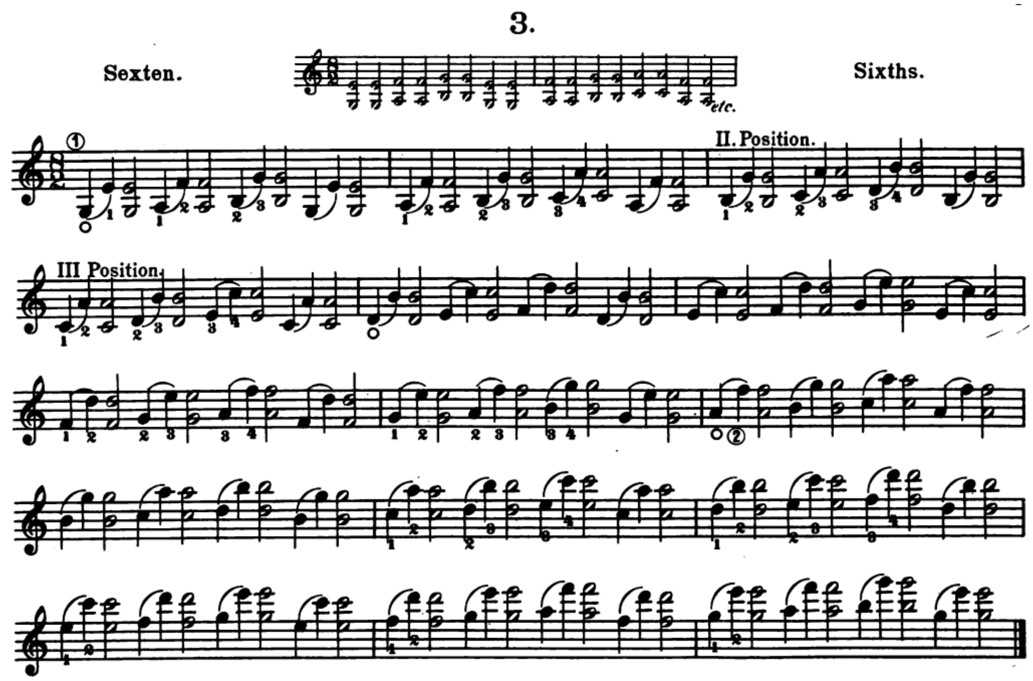

Figure 28. Sixths in Ševčík Op. 9, No. 3[98]

This exercise helps students internalize how each major and minor harmonic sixth feels all the way up the fingerboard on all three adjacent sets of strings. The exercises in this book are also diatonic, so the differences between half and whole steps and major and minor intervals must be embodied to successfully complete each exercise. As mentioned in Chapter 2 of this thesis, I recommend having students label each set of double stops as either major (M) or minor (m) to help distinguish between major and minor seconds, thirds, and sixths, as shown in Figure 29:

[98] Ševčík Op. 9 No. 3, 3.

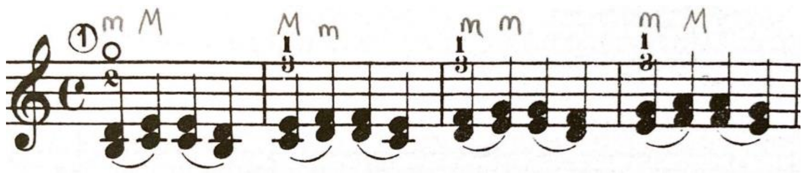

Figure 29. Labeled Major and Minor 3rds[99]

Etudes

I will focus on the most standard etude book for the beginner-intermediate level. Wohlfahrt's *Sixty Studies for the Violin* provides students with ample opportunities to practice precise pitch placement in keys with three accidentals or fewer, shifting to third position, playing double stops, scales and arpeggios in the context of a piece, and modulations and tonicizations. I will briefly analyze two etudes from this book that demonstrate the concepts mentioned above and will suggest ways to teach these etudes that incorporate theory learning and embodiment.

One of the main purposes of these etudes is to hone the skills of playing scales and arpeggios in a more realistically musical setting. Etude No. 36, shown in Figure 30, contains many arpeggios and scale patterns that one would encounter in a D major piece. It would be beneficial for the student to label each measure containing an arpeggio with the root name and quality of that arpeggio. For example, mm. 1–2 are a D major arpeggio, m. 3 is G major, m. 4 is back to D major, and m. 5 is E minor. Another aspect that students should pay attention to is how the accidentals affect key area. In m. 21, we see the first accidental, G♯, and can also see that it leads to A♮ multiple times in the scale with no other accidentals, implying that the measures containing G♯ are in A major. The

[99] Ibid., No. 14, 7.

etude provides another opportunity to point out the tonic-dominant key relationship between D and A major, and the instructor could mention that many pieces modulate or tonicize the dominant of the tonic key.

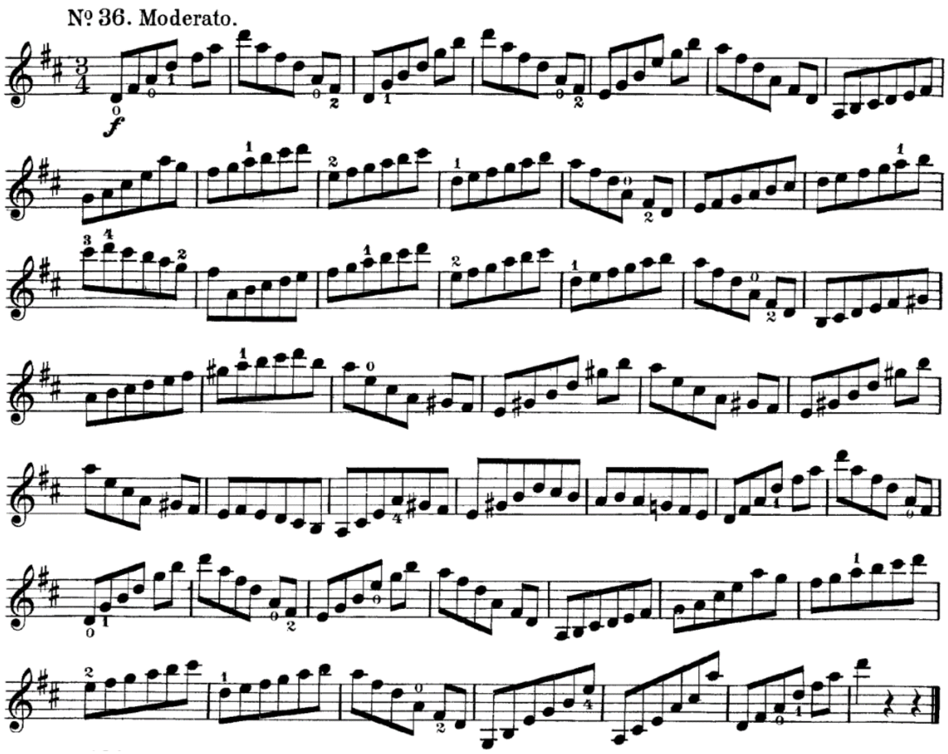

Figure 30. Wohlfahrt Op. 45, No. 36[100]

Another aspect of this etude that should be pointed out to students is how arpeggios are merely broken chords. Arpeggios are a great way to introduce the concept of three- and four-note chords to a violin student who has not encountered them very often. If a student has already labeled each arpeggio with its root and quality, the instructor could show what a root position arpeggio looks like on a piece of staff paper, since it is fairly rare for intermediate violinists to see chords in root position due to the

[100] Franz Wohlfahrt, *Sixty Studies for the Violin,* Op. 45 (New York: G. Schirmer, 2004), 33.

violin's tuning and the difficulty of playing three notes at once (if the student has never played piano before, this might be the first time they would encounter this concept). In m. 25, the first four notes create an E major seventh chord, and this arpeggiated way of playing this chord is exactly how advanced violinists would conceptualize an E major seventh chord when determining Roman numerals or part-writing, as explained in Chapter 2 of this thesis.[101]

Etudes with double stops are conducive for practicing interval knowledge as well as tonicization and modulation. In Etude No. 28, shown in Figure 31 below, students encounter almost every type of harmonic interval as well as short arpeggios and scales:

Figure 31. Wohlfahrt Op. 45, No. 28[102]

Having students label every interval in a double stop may seem tedious, but by this stage, they should be able to easily determine every interval in this etude because the key, scale

[101] Chapter 2, 39–43.

[102] Wohlfahrt, *Sixty Studies*, 23.

and arpeggio patterns, and all notes in first position have been engrained since *Suzuki Vol. 1*. Measures 9–16 provide an opportunity for the student to display their knowledge of tonicizations; if a student struggles to determine which keys are tonicized, remind them of the significance of accidentals and leading tones. As for the three- and four-note chords in this etude, have the student put each in root position to determine the root and quality.

Although the Wohlfahrt etudes are best suited for the beginner-intermediate level and only explore first, second, and third position, they cover a wide range of violin techniques from scales in the beginning of the book to complex passages of sixteenth-note double stops by the end of the book.[103] These etudes can help synthesize the music theory concepts mentioned above if the instructor is deliberate in bringing awareness to these concepts. Just as the technical studies prepare the student to play etudes, the etudes prepare the student to play and understand most technical and theory concepts in beginner-intermediate solo repertoire.

Solo Reptertoire

The careful linkage of theory to physical motion in the etudes applies to solo repertoire as well. *Violin Concerto No. 2 in G major* by Joseph Haydn features beginner-intermediate elements of scales, arpeggios, shifts to third position, simple double stops, and modulations. Haydn's concerto is the perfect piece to study along with Wohlfahrt's etudes since the technical and theory concepts learned and embodied in the etudes can be

[103] Once students progress past third position, Kreutzer's *42 Studies* can be introduced.

easily identified in this concerto. Because students often compartmentalize the work-a-day elements of technical studies and etudes as separate grunt work from expressive solo repertoire, it is essential to introduce theory concepts present in any solo piece early in the learning process.

The scales and arpeggios in this solo part’s opening seventeen measures (Figure 32) are not difficult to play since they will have already practiced short scales and arpeggios in G and D major. The student should label the root and quality of each arpeggio to determine what type of chord it would be if the arpeggio was stacked in thirds, as this will build upon the practice of labeling intervals.

Figure 32. Haydn *Violin Concerto No. 2 in G Major*, mvmt. 1, mm. 21–37[104]

[104] Joseph Haydn. *Violin Concerto No. 2 in G Major,* Hob. Vlla:4 (Leipzig, Germany: Breitkopf und Härtel, 1909).

Just like with etudes, students should always know the key areas and modulations. Usually, one can assume that the first modulation will be to the dominant key, and this is exactly the case for Haydn's concerto. The first C♯ is found in the sixth measure, which should alert students to a modulation to D major. Indeed, C♯ is present throughout the rest of this example without any other accidentals, and a strong cadence in D major occurs on the second measure of the last line. Later in this movement (Figure 33), there are further modulations, indicated by raised notes:

Figure 33. Haydn *Violin Concerto No. 2 in G major,* mvmt. 1, mm. 57–76[105]

[105] Ibid.

The modulation to a minor key will most likely be aurally obvious to an intermediate student, but it will be important to point out the exact minor key and how the key is determined. Not only are C♯s present in this passage, but D♯s as well, but since there are no G♯s present (which would be an indication of E major), the D♯s must act as a leading tone to E minor. Again, the conclusion of E minor can be supported by the cadence on E in the third measure of the last line.

The intermediate stage contains many technical and theoretical aspects that may seem “boring” to violin students, but the concepts learned and embodied during this stage are the reason why violinists have the physical and mental capability to tackle the advanced stage. Scales, arpeggios, shifts, simple double stops, and modulations become increasingly difficult in the advanced stage. When students build a solid foundation of technical and theory knowledge by intentionally practicing technical studies and etudes with music theory in mind, they will be able to understand and not be overwhelmed by music theory concepts in the advanced solo repertoire. It must be made clear to students that every scale, arpeggio, double stop, accidental, and even every note has a purpose in the grand scheme of a piece for students to understand the significance of music theory in their repertoire. The instructor’s insistence in having students put music theory concepts into practice in the intermediate stage will only help the physical and mental embodiment of all concepts mentioned above and will aid in the violin becoming a CCA for use in situations where quick calculations are needed.

Chapter Five: A Model Curriculum for Advanced Violinists

The advanced category— most of the violin repertoire—features an extremely broad range of technical and theoretical concepts. In Chapter 5, I will focus on concepts and repertoire typically learned in the late-high school or early-university years, or early advanced years. Chapter 5 expands upon the concepts learned in the beginning and intermediate stages, adding new concepts and increasing difficulty. Technical aspects such as arpeggios and double stops become more complex, and these aspects amongst others become fully integrated into the etudes and solo repertoire. Once a student reaches this stage, they should know all key signatures and corresponding scales, interval sizes and qualities, and the double-stop techniques in Ševčík Op. 9.

New elements of the early advanced stage include 1) three-octave arpeggios and their inversions, 2) dominant and diminished arpeggios, 3) double stop scales, 4) sequences, 5) leading tones, and 6) the beginnings of chord type and Roman numeral analysis. In exploring these musical elements, the technical studies I will examine include parts of the *Carl Flesch Scale System*, while the etude book I will discuss is Rodolphe Kreutzer's *42 Studies for the Violin*. The solo repertoire I will assess is *Violin Concerto No. 1 in G minor* by Max Bruch and "Sonata No. 5 for Piano and Violin in F major" by Beethoven. Throughout, I link theoretical techniques to embodied learning.

Technical Studies

Students will already have encountered one- and two-octave arpeggios in the Wohlfahrt etudes and Suzuki books, but the *Carl Flesch Scale System* provides a more comprehensive study of three-octave arpeggios, as shown in Figure 34 below. Every key contains the minor and major root position arpeggios, as well as the submediant in first inversion, the major and minor subdominant in second inversion, the diminished-seventh, and the dominant-seventh arpeggios:

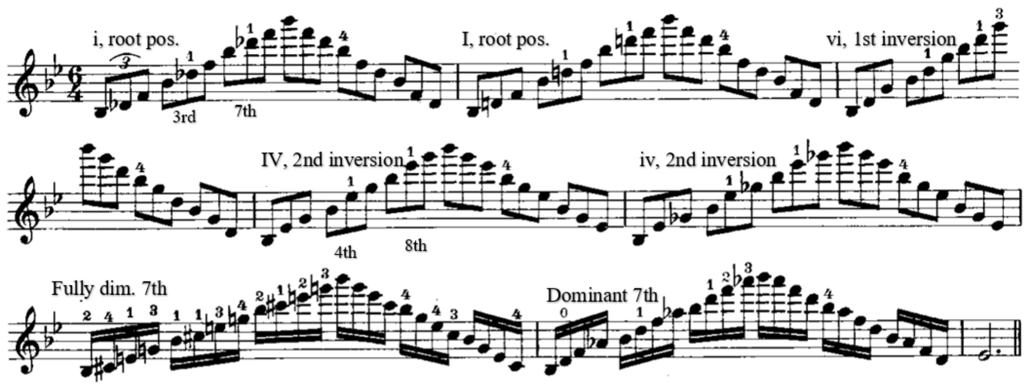

Figure 34. Flesch B♭ Arpeggios[106]

In the B♭ arpeggios shown above, the shifts for the first three arpeggios, i, I and vi^6, are to third then sixth position, whereas the fourth and fifth arpeggios, IV and iv in second inversion, shift to fourth and seventh position. This means that for most keys' arpeggios, including those that do not start in first position like B♭, the first three arpeggios shift two positions higher on the fifth note of the arpeggio and three positions higher on the eighth note of the arpeggio. For the subdominant arpeggios, because they are in second inversion, the first shift on the fifth note will be to fourth position and the shift on the

[106] Flesch, 22.

eighth note will be to eighth position. Before the student plays the sequence of arpeggios, they should know where they need to shift before each arpeggio and map that to the harmony (chord type and Roman numeral), as shown in Figure 35:

Arpeggio quality	5th note shift	8th note shift
i, I, vi^6	Two positions higher	Three positions higher
IV^6_4, iv^6_4	Three positions higher	Three positions higher

Figure 35. Arpeggios and their shifts

The last two arpeggios in the sequence, the fully diminished-seventh and the dominant seventh, are especially helpful in the embodying of these chords in every key. Because the diminished seventh and the dominant seventh have dissimilar fingerings and shifting patterns from the first five arpeggios, I did not include them in the table above. For the fully-diminished seventh, feeling the minor thirds (or augmented seconds) all up the fingerboard promotes a sense of closeness between the fingers that is only characterized by diminished arpeggios, and since it is almost impossible to play even a three-note diminished chord in root position, practicing diminished arpeggios is the best way for violinists to understand the interval relationship in fully-diminished seventh chords. For the dominant seventh chord, the addition of the minor seventh against the major triad promotes a sense of tension that is finally resolved at the end of the arpeggio, in B♭ major's case, to E♭. Every key in the *Flesch System* contains this sequence of arpeggios and the dominant arpeggio's resolution to the next key, which helps students memorize and embody the order of the circle of fifths.

Playing arpeggios of all types engrains not only accurate pitch placement, but also the motion of building chords. With the methodical practicing of arpeggios in not only root position but also in other inversions of chords closely related to each key, the hand becomes accustomed to feeling all types of broken chords all over the fingerboard:

- Minor Triad: compact "feeling" due to minor third between first and second notes, intervals are all thirds except for the perfect fourth between the third and fourth notes in each transposition.
- Major Triad: similar to minor triad aside from the major third between the first and second notes, hence, not quite as compact feeling.
- Submediant 1st inversion: the perfect fourth interval is now between the second and third notes of each transposition, feeling of the minor third between the third and fourth notes.
- Major subdominant 2nd inversion: perfect fourth now between first and second notes.
- Minor subdominant 2nd inversion: similar to IV^{6}_{4} but now with the minor third between the second and third notes of each transposition.
- Diminished-seventh: promotes feeling of closeness between fingers, all minor thirds.
- Dominant-seventh: feeling of major triad plus a minor seventh, with harmonic tension resolving at the end of the arpeggio to the next key in the circle of fifths.

Double Stop Scales

Although students have already practiced double stops in Ševčík Op. 9, the *Flesch System* offers different fingerings and longer scale patterns. Figure 36 contains examples of thirds and sixths scales: [107]

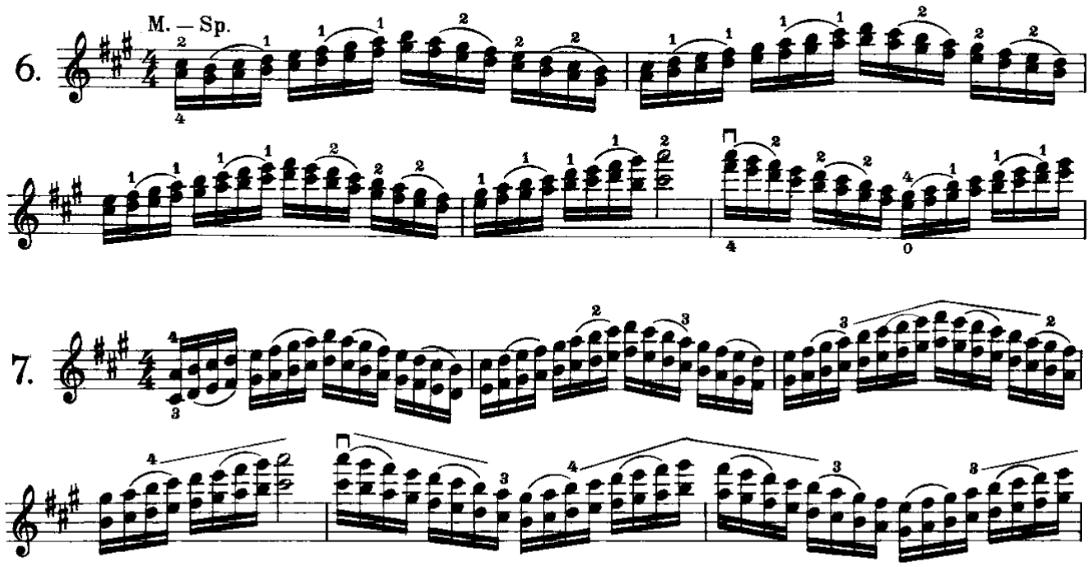

Figure 36. Flesch 3rds and 6ths in Scales[108]

Unlike the Ševčík Op. 9 double stopping exercises which were all notated in C major/A minor, the Flesch double stop scales are shown in every key. This helps the hand form relationships between intervals in new places, since no sharps or flats were played in the Ševčík exercises. The student must transfer their knowledge of half and whole steps to new keys and should still mark the double-stopped intervals as either major or minor to reduce errors and to embody half and whole steps. In the thirds scale, it should be noted

[107] Each example pasted above is not complete but is cut off in the middle of the exercise for space's sake.

[108] Flesch, 92–93.

that when the thirds reach the top of the scale, they turn into sixths for the last two double stops to mimic an IAC. Thirds then descend for the rest of the scale.

Since there are different fingerings for the thirds and sixths, new interval relationships are formed between sets of fingers shifting up and down the violin.[109] Because the scales do not ascend directly to the top of the scale but instead rise and fall during the ascension and descension, Flesch utilizes alternating fingering patterns that further solidify the minor vs. major intervals and half and whole steps between and in each interval. Once students practice and embody thirds and sixths in every key, they will be equipped to understand how to execute double stops in advanced repertoire and how to determine both interval and chord quality in many settings.

Etudes

Rodolphe Kreutzer (1766–1831) was a French violinist and composer who wrote 40 operas as well as many concertos and sonatas and was the dedicatee of Beethoven's famous ninth sonata, the *Kreutzer Sonata*. However, Kreutzer is best known for his *40 Etudes for the Violin* (*42 Studies*) which still help advance violinists' technique today. Kreutzer's *42 Studies*, like the Wohlfahrt etudes, encompass a wide range of techniques. The beginning of the book does not contain many double stops, but by the end of the book, double stops are pervasive. An etude that builds on the double stop technical studies mentioned above is No. 35 in E♭ major; the first section is shown in Figure 37

[109] In the Flesch System, there are also chromatic scales, broken thirds, broken double stop thirds and sixths, chromatic sixths, octaves, fingered octaves, and many more techniques that would best be tackled after the above exercises are mastered.

below. The etude incorporates double-stopped thirds, sixths, and octaves, as well as fifths and diminished sevenths. There are even some three- and four-note chords present, adding to the difficulty and encouraging the student to become comfortable playing chords they may have not encountered before. The first five lines of the etude contain almost all concepts discussed thus far:

Figure 37. First Section of Kreutzer Etude No. 35, annotated[110]

Figure 37 labels thirds, sixths, half steps, and harmonic elements. Types of thirds and sixths are labelled in only the first six measures; the student could label more double

[110] Rodolphe Kreutzer, *42 Studies for Violin* (New York: International Music Company, 1963), 66.

stops throughout if they have trouble determining the pitches or fingering. A handful of half steps are marked with the vertex symbol to remind students to keep the respective fingers close together to be in tune.

In addition to the technical aspects like double stops, shifting, and arpeggios, this etude contains many tonicizations and modulations for the student to find and label. Figure 37 includes a few examples. The first modulation is of course to B♭ major in the fifth line of the example above, but the tonicizations during the sequences in mm. 13–24 provide an opportunity to both introduce the concept of a sequence and ask the student what key each measure is "tonicizing."[111] The sequence in m. 17 is labeled with short "tonicizations," and the student's attention should be brought to the chromatic ascending line in that sequence and the diatonic descending line in the second sequence starting m. 21. Later in the etude, which is a full two pages long and mostly repeats the techniques from the first five lines, the key modulates to C minor for a while and contains many leading tone F♯s to dominant Gs, providing the instructor an opportunity to explain the concept of applied dominants in a solo setting before the student encounters applied chords in theory class. After cadencing in C minor, the main theme from the beginning returns in E♭ major, and the last measure of the etude ends with the flourish of a two-octave tonic arpeggio.

Every etude in this book is filled with complex technical and theoretical concepts that are approached in a methodical and pedological manner, and care should be taken by

[111] Chords and their functions are usually not labeled in sequences, though I like to still determine the "key" of each model and copy.

the instructor to guide the student through the techniques present in every etude and should not expect that the student will be aware of every technical or theoretical aspect while playing the etude. The roots of chords and arpeggios, sequences, key areas, and the function of leading tones should be labeled to help students digest these concepts in the structured and manageable setting of an etude, which will in turn help students transfer their knowledge of technique and theory to their advanced solo repertoire.

Solo Reptertoire

Bruch Violin Concerto No. 1 in G minor

Max Bruch's *Violin Concerto No. 1 in G minor* is perhaps one of the most popular violin concertos, and for good reason. The fiery first movement and the playful third movement employ many impressive-sounding violin techniques, and the lyrical second movement can even be performed as a solo piece. Luckily for early advanced violinists, the techniques in this concerto are manageable if the player has practiced and internalized scales, arpeggios, double stops, and higher fingerboard positions. In the section after the soloist's *ad libitum* opening comprised mostly of scales and arpeggios, the fiery theme contains many of the elements discussed in this chapter, as well as leading tones, shown in Figure 38:

Figure 38. Bruch, *Violin Concerto No. 1*, mvmt. 1, mm. 16–40 with markings (starting m. 16, the measure after "A")[112]

Double stops in thirds, sixths, and octaves, three- and four-note chords, arpeggios, and leading tones are pervasive throughout this passage. Since the student will most likely have heard this opening many times and may go on autopilot while attempting to play it, they should mark half steps with the vertex symbol before starting to work on this movement. Half steps should especially be marked between notes in the three-note chords in mm. 35–36 (fourth line, third and fourth measures), as the student may not automatically know where each finger should be placed in relation to one another.

[112] Max Bruch, *Violin Concerto No. 1 in G minor*, Op. 26 (Leipzig, Germany: C.F.W. Siegal, 1879).

By this point, students should be able to find and label half steps without guidance. However, not all half steps are leading tones; the instructor should explain that accidentals that lead up a half step may be a short tonicization, in which the accidental needs to be raised ever so slightly, and that lowered accidentals that lead down a half step may function as a chordal seventh or a tendency tone that may need to be lowered in pitch. The reason for the pitch alterations is explained in full in Chapter 2.[113]

Arpeggios

Practicing and embodying arpeggios will especially be helpful when playing this concerto since arpeggios are frequently used to quickly change register. Measures 77 and 79 are perfect examples of this (Figure 39), with m. 77 being a fully-diminished seventh arpeggio and m. 79 being a B♭ dominant seventh arpeggio:

Figure 39. Bruch, *Violin Concerto No. 1*, mvmt. 1, arpeggios, mm. 77 and 79[114]

Students should label these arpeggios as "dim" and "dom" so they remember the intervals between each note and how the arpeggios in the Flesch System translate into solo repertoire.

[113] Chapter 2, 36–7.

[114] Bruch, mm. 77 and 79.

Bariolage and chords

After the arpeggios and a chromatic scale passage, there is a lengthy bariolage passage beginning in m. 98 that students may not know how to approach (Figure 40). It would be best for the instructor to teach that every quarter note beat is one chord, not three or four individual notes. The student will have to utilize the appropriate hand frame so that their fingers will be in position before the bow plays their respective strings.

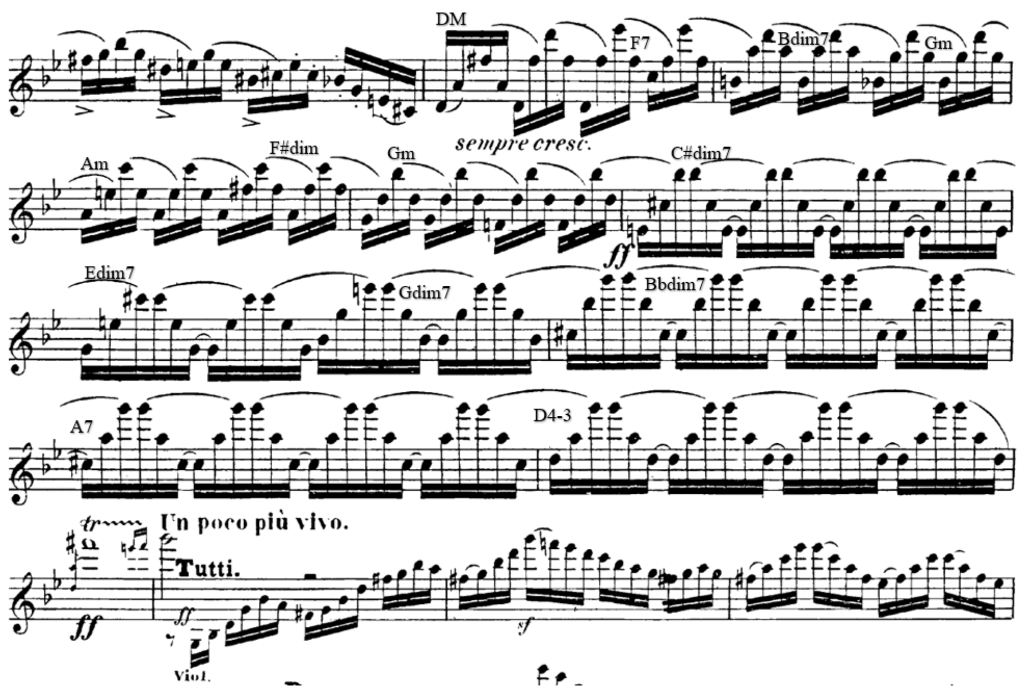

Figure 40. Bruch, *Violin Concerto No. 1*, mvmt. 1, mm. 97–107, annotated[115]

Students should always keep track of the moving line in this passage and should be aware of how the bariolage “chords” lead to the next harmony (labeled in the example above). Awareness of harmonic structures in solo repertoire can grow even if the student is not completely comfortable with Roman numeral analysis, since by this point, students

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[115] Ibid.

should be able to identify chord roots and qualities. If students are comfortable with labeling passages with Roman numerals, however, it is essential for them to study from the piano score of a work to receive complete information.

Beethoven "Spring" Sonata

Although students will have collaborated with pianists, or at least played with piano accompaniment, for many years by the time they reach the advanced stage, they may have never analyzed or played from a piano score. Violinists must study from piano scores to fully understand every aspect of a piece, and it is best if this practice is introduced early in the advanced stage so that reading piano scores will not seem as intimidating later in their career. Beethoven's "Spring" Sonata for Piano and Violin is an excellent introduction to both collaboration and score analysis since both the violin and piano parts are not extremely dense in harmony or rhythm. Sections of this sonata are appropriate for a first-year university student to analyze and label with Roman numerals.[116]

The first ten measures of the sonata, shown in Figure 41, contain simple harmonies that are not difficult to label if the student has learned, in addition to the tonic and dominant scale degrees and chords they encountered in earlier stages, the supertonic, subdominant, and submediant scale degrees and chords:

[116] Students may have encountered Roman numeral analysis and reading from scores before attending university, and in this case, analyzing the "Spring" Sonata would just count as further practice.

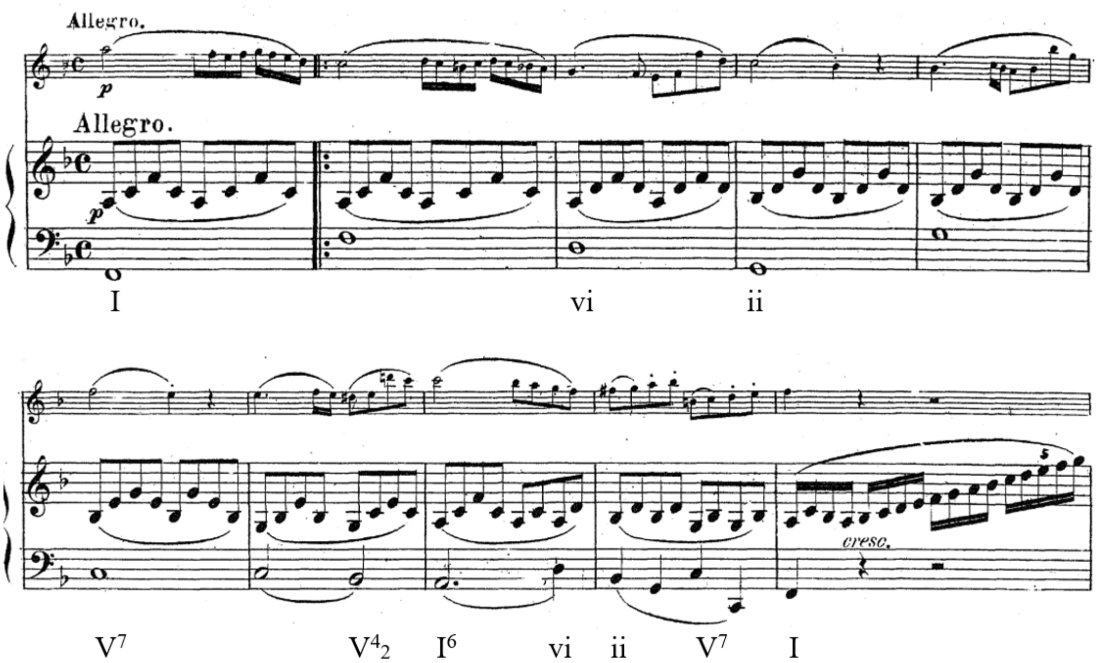

Figure 41. Beethoven, "Spring" Sonata, mvmt. 1, mm. 1–10 with Roman numerals[117]

The simplicity of the piano part aids in determining the chord tones from the non-chord tones played by the violin. The student can easily "count" the chord tones in a piano measure, then assemble the chord using the chord-building technique I discussed in Chapter 2.[118] As for inversions, once the student determines the chord type, they can use the same chord-building technique to reveal the inversion of each chord.[119]

Measures 11–25 (Figure 42) repeat the first ten measures, although the violin now supports the piano line, a feature that violin students may have not come across in solo repertoire before. The violin line takes over the broken chords in inversions from the

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[117] Ludvig van Beethoven, "Sonata No. 5 for Piano and Violin in F major", Op. 24 (Leipzig, Germany: C. F. Peters, 1868).

[118] Chapter 2, 39.

[119] Chapter 2, 40.

piano, which will help the violinist understand the piano material in the first ten measures more fully. However, the end measures signal a modulation like in the Kreutzer etude:

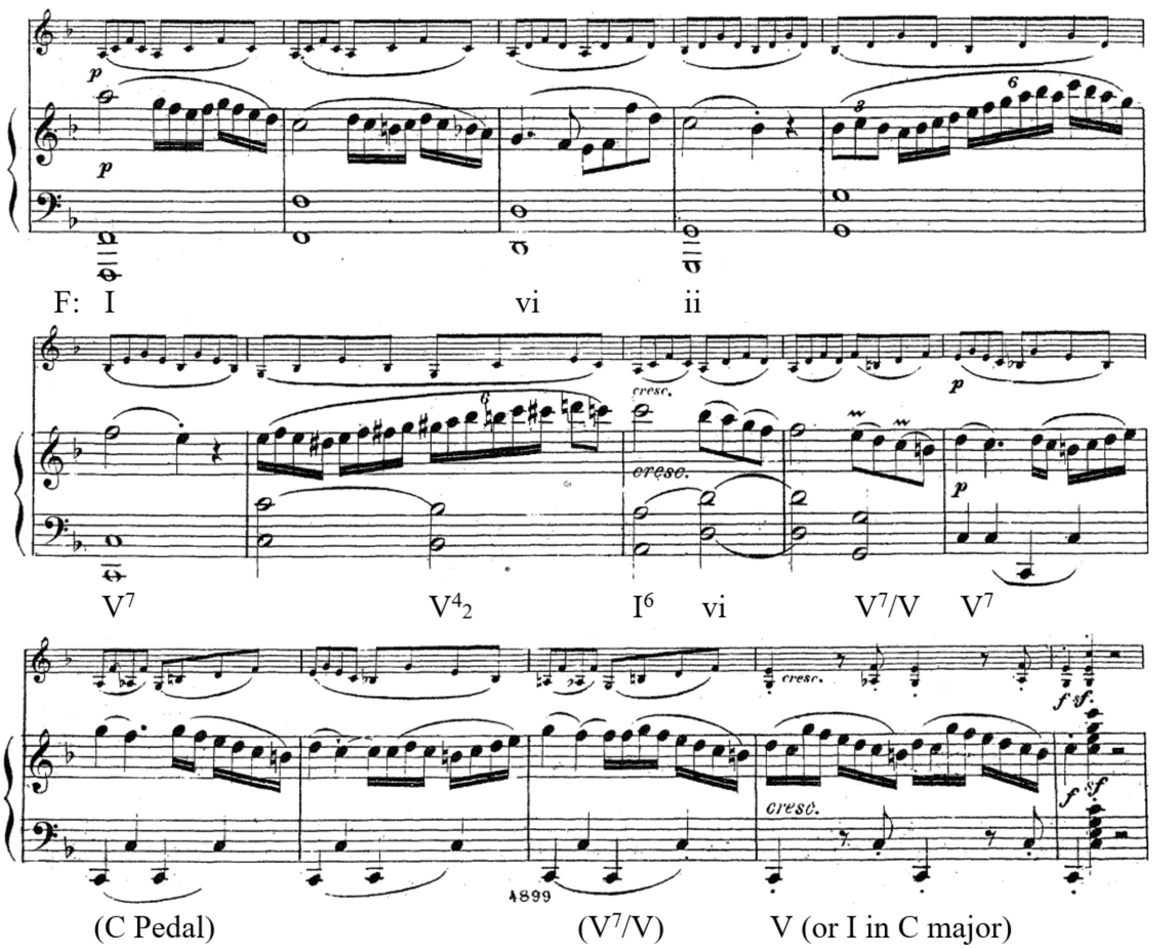

Figure 42. Beethoven, “Spring” Sonata, mvmt. 1, mm. 11–25 with Roman numerals[120]

Because students will have encountered the concept of an applied dominant and the dominant key area from etudes and previous repertoire, the modulation to C major at the end of this passage should not be difficult to grasp. However, depending on the student’s proficiency in analyzing Roman numerals, passages in keys other than the dominant

[120] Ibid.

should be analyzed after students complete the first year of university-level theory (or an equivalent in high school). There are many passages in this sonata that may be too difficult to analyze if the student does not have a solid background in Roman numeral analysis, but the passages pasted above are a good introduction to thinking about harmony, simple Roman numeral analysis, and how instruments collaborate in a sonata.

Chapter Six: Conclusion

This thesis explored ways the violin can be used as a tool for music theory. Chapter 1 delved into the topics of embodied cognition, cognitive artifacts, and affordances, and drew inspiration from de Souza's work in these fields. The theory of embodied cognition ascertains that sensorimotor experiences gained as a direct result of interacting with our environment impact how we attain and demonstrate knowledge. The study of embodied cognition in music reveals that playing an instrument promotes a strong connection between mind and body. Complimentary cognitive artifacts are objects that facilitate human cognition. The violin is a prime example of a CCA because once the player masters the instrument, a "virtual" version of the instrument becomes available to the player to use when they are not near a violin. Affordances are an object's possibilities for action. The violin's affordances, such as the string's tuning and fingerboard width, allow for many music-theory concepts to be embodied by the player.

Chapter 2 applied the concepts explored in Chapter 1 to a music-theory framework centered around the physical attributes of the violin. Types of feeling, such as proprioception and tactile feedback, allow violinists to play in tune and internalize the landscape of the instrument. The physical internalization of interval placement is especially crucial for theory learning, as the embodiment of intervals is the foundation of learning chord qualities and inversions. I suggested ways to teach intervals, chords, inversions, figured bass, and Roman numeral analysis using the violin's physical attributes.

Chapter 3 sketched a curriculum for a beginning violinist that emphasized theory learning and internalization. Aspects from two method books, *Suzuki Vol. 1* and *String Builder*, demonstrate how violin instructors can incorporate theory teaching into lessons, illustrating theory concepts that are appropriate for the beginning violinist to learn. Concepts studied during this stage include half vs. whole steps in relation to finger positions, open-string key signatures, and the tonic-dominant relationship.

Chapter 4 outlined a model curriculum for an intermediate violinist that expanded upon the concepts in the beginning stage. Because the intermediate stage contains a wide range of technical and theoretical concepts, the chapter splits the intermediate stage into two categories, beginner-intermediate and intermediate-advanced. Hand position and embodiment techniques are paired with relevant repertoire and theory concepts. The new concepts learned in the intermediate stage included shifting to new positions, playing double stops and three-octave scales, and embodying all types of intervals in etudes and solo repertoire.

Chapter 5 expanded on the previous two chapters and delved further into how concepts found in advanced violin technical studies, etudes, and solo repertoire aid in theory learning and embodiment. Since the advanced repertoire is vast, the chapter narrows the survey to repertoire typically played by late-high school or early-college students. The technical and theoretical concepts discussed in this stage were three-octave arpeggios and their inversions, dominant and diminished arpeggios, double-stop scales, sequences, leading tones, and the beginnings of chord type and Roman numeral analysis.

Overall, this thesis provides a picture of the violin's capabilities as a physical tool for music theory learning. The violin's affordances aid in the embodiment of music-theory concepts from intervals to Roman numeral analysis, and the three model curricula offer ways to incorporate embodied theory learning into violin instruction of multiple levels. Violin instructors can use the information in this thesis to enhance their curricula. The practical tips, exercises, and approach to repertoire in Chapters 3–5 will help both violin students and teachers understand how simple it can be to integrate music-theory learning with technique learning. The information presented in this thesis also helps non-violinist music theorists understand the violin's potential as a music-theoretical instrument, as well as how a violinist might approach completing music theory tasks.

Possible benefits of using the teaching methods presented in this thesis include deepening both student and teacher understanding of theory concepts in relation to the violin, as well as increased student proficiency in both the sightreading and memorizing of key signatures, scales, arpeggios, intervals, double stops, and chords. If students can identify all key signatures, interval sizes, and chord roots and qualities before they enter university and can physically feel these concepts with or without their violin, they will be prepared to handle all concepts introduced in the first and second years of university-level theory.

I created this thesis with my younger self in mind. While writing Chapters 2–5, I constantly inquired, "What would have helped me learn these theory concepts in the different stages?" As someone with almost no theory knowledge prior to entering college, the introduction of how the basics of music theory—scales, arpeggios, and intervals—can be mapped onto the violin and embodied by practicing simple exercises and pieces would have greatly enhanced my understanding of music theory in both the beginning and intermediate stages. For example, if I had encountered playing scales in the order of the circle of fifths in high school, I could have had all key signatures memorized before entering college. And if I had internalized the feeling of all intervals and arpeggios during the beginning and intermediate stages, identifying and building chords in my freshman theory course would have gone much more smoothly.

My hope is for instruments to be leveraged in the theory classroom as music-theoretical tools. I believe it would be beneficial for at least one class session in the beginning of the theory sequence to be dedicated to instructing students on how to use their instruments as CCAs. Instrumentalists from the performance department could offer short presentations on how to view their instrument in a theory framework, and non-pianist students would be encouraged to complete theory assignments using either a physical or mental version of their own instrument instead of the piano. I feel privileged to have discovered the violin's capabilities as a music-theoretical tool early in my theory studies, and my wish is for all students to rely on their instrumental knowledge in order to feel confident in their theory skills.

Future Research

As mentioned in Chapter 2, there are several avenues of further research in the study of aural skills that this type of pedagogical project can lead to. The concept of how violinists respond to their instrument's timbre is a topic for further study in the field of cognitive artifacts, embodiment, and music. Relevant research on this topic includes a 2020 article by Reymore and Hanson that delves into "instrument-specific absolute pitch," and how musicians without absolute pitch can gain a reliable, although not infallible, sense of absolute pitch specific to their instrument's timbre.[121] In addition to timbre familiarity affecting pitch recognition, the authors also found that motor imagery and kinesthetic memory impact musicians' ability to discern pitches. Congruent with the article's findings, I can usually discern exactly which pitch is being played on a violin even though I do not have absolute pitch. I am also curious as to why each pitch on the violin has a certain "feel" to the ear and if this phenomenon also applies to other instrumentalists, especially non-string players, and how the "feel" of a pitch sounding on the ear can be related to the concepts of embodiment, CCAs, and tactile feedback.[122]

Another topic for future study is how a violinist may not even need to initiate the motion of pressing the string on an imaginary fingerboard in order to perform music-theory calculations once they reach a high level of embodiment on their instrument. In my experience, merely thinking about the formation of intervals or chords on an imaginary fingerboard allows my mind to process the task well enough to not need the body's enactment of motion. There seems to not be an abundance of research solely on

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[121] Lindsey Reymore and Niels Christian Hansen, "A Theory of Instrument-Specific Absolute Pitch," *Frontiers in Psychology* 11 (2020): 1–19.

[122] Open strings are certainly aural markers, but they only account for four out of dozens of notes playable on the violin.

how the mind influences the ability to “hear” tones without finger motion, so this area of study needs further exploration.

Lastly, the concept of CCAs as musical instruments should be studied further. I would be curious to see if musicians who view their instrument as a CCA, intentionally or unintentionally, have more advanced music-theory understanding than musicians who do not view their instrument as a CCA. I would also be curious to see a long-term study conducted on instrumentals to see if introducing the concept of instruments as CCAs in the beginning stages of learning would impact theoretical and technical understanding and embodiment over time. Although the combination of embodied cognition and music has been explored extensively, the combination of CCAs and music has so far been neglected, and I believe that studying the connection between instruments and CCAs would benefit instrumentalists and music theorists alike.

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Appendix A

Beginner	**Suzuki Repertoire**	**String Builder Repertoire**	**Diagrams**
Half vs. Whole Steps	Every piece provides an opportunity to point out half vs. whole steps	Almost every piece provides an opportunity to point out half vs. whole steps	Suzuki Vol. 1 pp. 20, 48. String Builder pp. 15, 19, 20, 23, 24
Marking Half Steps (already marked in book)	Vol. 1 exercises found on pp. 30, 34, 36, 38, 40	Exercises on pp. 14–16, 20, as well as various pieces/exercises throughout	[none.]
Finger Patterns (shown visually)	[none.]	[none.]	Suzuki Vol. 1 pp. 20, 48. String Builder pp. 15, 19, 20, 23, 24
Open String Keys	All pieces in Vol. 1	All pieces until p. 19	[none.]
Other Keys	B♭ major, D and A minor pieces found in Vol. 2 along with open-string keys	C major begins p. 20, C scale on p. 29	Suzuki Vol. 2 p. 8, String Builder p. 27
Tonic-Dominant Relationship (tonicization)	Bach Minuet Nos. 1, 2, 3, Gossec Gavotte	[none.]	[none.]

Figure A1. Locations of Theory Concepts in Beginner-Level Curriculum

Intermediate	**Carl Flesch Scale System**	**Ševčík Op. 8**	**Ševčík Op. 9**	**Wohlfahrt Op. 45**	**Haydn, Violin Concerto No. 2**
Scales	1-string, 1-octave scales, 3-octave scales	[none.]	[none.]	Etudes inherently contain numerous scales	Short scales are present
Key Signatures	Scales should be practiced in keys of etudes and repertoire	[none.]	[none.]	Wohlfarht only contains keys with 3 or fewer accidentals	The piece is in G major, (an open string key) and modulates multiple times
Melodic vs. Harmonic Intervals	Double-stopped scales appear in Advanced stage below	Contains only melodic intervals, aids in embodying intervals between shifts	Contains both melodic and harmonic intervals, double stops aid in embodying of 2nds, 3rds, 4ths, 6ths, 8ths, 10ths	Most etudes are melodic and double stops do not appear until No. 28, but the end of the book contains mostly double-stopped etudes	The first movement is mostly melodic, with some double stops
Modulation and Tonicization	[none.]	[none.]	[none.]	Almost every etude contains modulation and/or tonicization	The first movement modulates to closely related keys
Chords	Double-stopped scales appear in Advanced stage below	[none.]	Double stops prepare hand and mind for chords	Arpeggios in etudes create broken chords	4-note G major chord in opening and simple double stops are present

Figure A2. Locations of Theory Concepts in Intermediate-Level Curriculum

Advanced	**Carl Flesch Scale System**	**Kreutzer Etudes**	**Bruch, Violin Concerto No. 1**	**Beethoven, "Spring" Sonata**
3-Octave Arpeggios	Should be played in every key along with the respective 3-octave scales. Promotes awareness of intervals and the forming of chords	[none.]	Present in opening	[none.]
Dominant and Diminished Arpeggios	Both dom. and dim. arpeggios aid in the memorization of fingering, scale degrees, and intervals in dom. and dim. chords	[none.]	Can be found in mm. 77 and 79 of mvmt. 1	Short arpeggios present throughout
Double-Stopped Scales	Building on skills gained in Ševčík Op. 9. Double-stopped scales now appear in all keys with new fingerings	[none.]	The embodiment of double-stopped scales will aid in the numerous double-stopped passages in mvmt. 1	[none.]
Sequences	[none.]	Can be found in many Kreutzer Etudes	[none.]	[none.]
Leading and Tendency Tones	[none.]	Modulation/ Tonicization in Etudes is usually signaled by leading or tendency tones	Modulation/ Tonicization in mvmt. 1 is usually signaled by leading or tendency tones (accidentals) and half steps should be marked and tuned carefully	Present throughout
Roman numeral analysis	[none.]	[none.]	[none.]	Students should label passages in the home key with Roman numerals and can label other passages if they are comfortable analyzing in modulated keys

Figure A3. Locations of Theory Concepts in Advanced-Level Curriculum