Music That Moves Us: Meaning, Movement, and Musical Forces in Beethoven's Cello Sonata Op. 69

by

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LECTURE DOCUMENT ABSTRACT

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When thinking about and describing music, the music-as-movement conceptual model is particularly prevalent in Western classical music. Many descriptors of what music does also place it within a conceptual space similar to the physical world, able to go in different directions and exist dimensionally. But for music to do, go, or move requires a metaphorical understanding that, similar to language, connects something abstract to the physical world. George Lakoff and Mark Johnson (1980) proposed that language operates through such conceptual metaphors, and their work has been adapted to many other disciplines that can be understood in similar ways. In his 2012 book *Musical Forces*, music theorist Steve Larson—building off Lakoff and Johnson and others as well as his own research in structural analysis—developed a theory of musical forces that correspond to physical forces: gravity, magnetism, and inertia. In his theory, Larson suggests that motion connects musical and physical domains, and it influences musical meaning substantially. This document examines Larson's theory as a possible model for musical and physical motion on the cello. First surveying the subfields of music theory that address musical meaning and embodied cognition, Larson's theory and cello performance are then compared to establish how they overlap. Finally, in the first movement of Beethoven's A Major Cello Sonata Op. 69 musical forces and cello performance are analyzed contextually as sympathetic models of motion and interpretation.

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INTRODUCTION AND CONTEXT

It was around the year 2007 when I first encountered the famous video performance of Beethoven's Cello Sonata in A Major Op. 69 recorded by Leonard Rose and Glenn Gould in 1961. I had decided then as a high schooler to learn the work, and my teacher reluctantly allowed me to take on the project with the caveat of focusing on the first movement. We worked through the movement slowly, focusing primarily on how I was going to execute the many technical passages when my technique was not really up to the challenge. The Rose/Gould performance was my inspiration outside of lessons and I viewed it frequently. Though the process was slow-going (and certainly agonizing for my teacher), by the end of my junior year I had (I thought) learned it and was scheduled to play in my teacher's studio recital. It was then that the far more difficult challenge the sonata presents became clear; how to interpret the music. What Leonard Rose and Glenn Gould seemed to do with ease was infinitely engrossing, but hard to understand and even more challenging to try to emulate for a sixteen-year-old. How was I going to play all the notes, make beautiful phrases, and most importantly captivate a listener like Rose and Gould did? This story about my first encounters with the sonata is an example of one of the greatest difficulties of performing music, how to understand it and formulate an interpretation.

Interpreting music on stringed instruments, specifically the cello, has often taken second place to technical matters in pedagogical literature. Many of the historical cello treatises and manuals focus on technical skill at the cello and leave interpretation to be figured out by the cellist individually. Perhaps one exception is the book *Casals and the Art of Interpretation* (1977) by David Blum, which records anecdotal accounts of Pablo Casals's philosophy of interpreting music, but it admittedly does not attempt to offer a specific method applicable to string or cello playing. Interpretation is an immense topic that is fundamentally subjective both to the interpreter as an individual and to the ways it is mediated in the case of instrumental performance. Defining how to interpret therefore is necessarily elusive as each musician devises a personal—and often intuitive—interpretive lexicon for musical meaning. This dilemma brings to question how we can supplement the ways we talk about music and if articulating interpretive meaning through discourse enhances musical meaning.

Music theory offers many tools that a performer may use to understand and interpret music but can be daunting or confusing to implement. Perhaps because of the perception that music theory as a broad discipline is a difficult topic or that it provides information not fully reconcilable with performance, there are not a lot of works dedicated to interpretation that integrate string playing and music theory. It makes sense that something so subjective as interpretation would not call for study when works dedicated to something concrete and measurable like technique are everywhere. There seems to be a long-lasting divide between analysis and performance even though each discipline has much to gain from the other.

Concerning what has been written about string performance, there are many performance guides or performance analyses using formal, harmonic or prolongational (Schenkerian) analysis for particular pieces or works. These kinds of projects offer valuable musical insights but also run the risk of continuing to separate analysis and performance. The scarcity of recent works focused on an integrated theory of interpretation and technique suggests that interpretation in performance as a topic is difficult to reconcile theoretically. For me it brings up the following questions: In light of the theoretical work done in music cognition recently, why has there been such a lack of written discourse of musical and embodied interpretation on the cello? Are we utilizing all the means possible to analyze works in order to inform our performance? Or even more broadly: are analyses and thinking about interpretation useful at all or should it instead be left to each performer's intuition? These questions serve as my point of departure in research, which first looks to music theory for possible solutions.

In recent decades, a growing area in the field of music theory has produced new methodologies to explain how music theory concepts interact with performance. One extensive subfield is the study of music cognition and embodiment. Music cognition explains the complex ways humans perceive and parse information from music, in other words, how our minds interact with music. Embodiment is, briefly put, how our bodies and physical selves interact with music. Put together they make embodied cognition, which can explain musicmaking by taking both concepts into account. Interest in embodied cognition created several offshoots within music studies that have continued to be expanded upon. Steve Larson followed cognitive linguists George Lakoff and Mark Johnson and their book *Metaphors We Live By* (1980a) to explain musical features through conceptual metaphors. Larson spent several decades exploring this topic, ultimately compiling his work in his posthumous book *Musical Forces: Motion, Metaphor and Meaning in Music* (2012). Larson's ideas of musical motion, magnetism, and inertia are concepts that explain musical qualities and offer a possible way of understanding musical experience through metaphor. They also provide a potential analytical scaffold for performers, as Larson's theory deals with aspects of physical and musical motion.

Many musicians talk about music in metaphors on a surface level. For example, we describe pitches as high or low, tone and timbre in terms of being soft, hard-sounding, harsh, or grating. String performers inherently concern themselves with the quality of attack and decay of notes, the way notes connect over a period of time (i.e., over barlines or through phrases), yet much is left to the performer's intuition or the input of someone else. To think specifically about string playing, what in the music indicates the need to start on a down bow or an up bow? Are we considering all the musical as well as technical options and how do those concepts interact? I believe we have something to learn from Steve Larson's approach to understanding music through the metaphor of musical forces both as interpreters and players. Gravity, which to Larson is a musical feature, is often a topic of technical significance in string playing (e.g., how we talk about using natural arm weight, how we seat ourselves at the instrument in a stable, centered way). But perhaps the most obvious correlation of all Larson's ideas to string performance is the prevalence of movement.

It is not my intention to offer an authoritative reading or interpretation of either Larson or the sonata. But by applying concepts from Larson's work, analyzing the correlation between his concepts and the pragmatic way we think about and play the cello can add an analytical tool and hopefully a way of practicing an integrative analysis. While this lecture document will focus only on the first movement of Beethoven's Cello Sonata in A Major, I hope that the concepts can be applied to many other works for the cello and more importantly can offer a valuable means of playing and interpreting through integrated musical understanding. My hope is also that this document will engage with many different disciplines. For cellists it will offer one way to integrate musical analysis into playing as an embodied interpretive process. Other string players will hopefully find that there are commonalities between cello technique and their own discipline when applying this kind of work. Finally, as a continuation of Steve Larson's theory, music theorists can engage with this research as an example of how theoretical ideas play out in performance practice.

By using analysis and musical forces to understand how we can conceptualize music's features, performance can gain a new language through which meaning can be articulated. Steve

Larson's theory, because it conflates physical with musical motion, has the potential to help structure movement on an instrument like the cello and enhance how both types of movement work together to impart meaning. Looking from the side of analysis, performance also has something to contribute: the physical act of performing and the interpretive synthesis becomes itself a form—or a distilled version—of analysis. The dynamic relationship between embodied performance and analysis enhances music's constituent expression of meaning, but also potentially creates a different way of performing and understanding.

This document is organized into three chapters. The first includes this introduction and the following review of literature. A comprehensive overview of literature about music cognition and embodiment would be very lengthy, so I have chosen scholarship that relates mainly to Larson's musical forces and Lakoff and Johnson. In the second chapter, I explain the details of Larson's theory and how common principles of cello performance correspond. Since I am interested in integrating music analysis with performance through the physical metaphor of musical forces, I look at cello treatises and related studies that explain cello performance physiologically. Finally, chapter three is an application of Larson's musical forces as an analytical and performance tool in interpreting the first movement of Beethoven's Cello Sonata in A Major.

Review of Theoretical and Pedagogical Literature

I rely on scholarly works that are relevant to this study but have not compiled an exhaustive body. The following traces a thread through many related methodologies that complement Larson's work and subsequently the application to the cello. Some comprehensive literature reviews are listed here for selected subfields. For music cognition and embodiment, *Musical Bodies, Musical Minds* (2022) by Dylan van der Schyff, Andrea Schiavio, and David J. Elliott has a concise review chapter surveying the subfield's history from Ancient Greece to the present. Lawrence Zbikowski likewise offers a historical survey in *Conceptualizing Music* (2002), a work I discuss below. Zbikowski's *Foundations of Musical Grammer* (2017) also provides a very thorough overview of the relationship between linguistics and music. Finally, Nicholas Cook's chapter in *Rethinking Music* (1999) titled "Analysing Performance and Performing Analysis" is a good primer on the early scholarship of performance and analysis.

Cognitive Science and Conceptual Metaphor

Cognitive science is a broad interdisciplinary field that focuses on the ways humans perceive, respond to, and process information. At its core is the principle that the human mind creates systems of cognition that can be understood empirically. These systems are posited to organize and structure both the internal ways we understand information and the external ways we react or create a response. This is a field that is full of abstract concepts, but one way to simply explain how humans process information is to make a comparison to computers. In their most basic way, computers process information logically – that is, they collate data and process it through systems designed to deduce. Humans also process information logically, but not always through systems of deduction. Instead, they might understand something by connecting information to another, often experiential, concept. This is what some cognitive scientists like George Lakoff and Mark Johnson call the human conceptual system (1980b). One common expression of the conceptual system in our daily lives is language, the study of which has created the subfield of cognitive linguistics. Specifically, Lakoff and Johnson's influential book *Metaphors We Live By* (1980a), in which they argue that metaphor is a central component of conceptual systems in linguistics, continues to be a much-discussed theory. This subfield integrates psychology and neuroscience with linguistics to explain cognition and has wide-reaching potential in understanding other systems similar to language.

Before turning to how music and metaphor intersect in terms of cognitive science, it will be helpful to briefly describe Lakoff and Johnson's understanding of the conceptual system. In a co-authored *Cognitive Science* article, they argue that the "system is fundamentally metaphorical in character. That is, it contains metaphorical as well as nonmetaphorical concepts…" (Lakoff and Johnson 1980b, 195). Put another way, the conceptual system necessarily uses both metaphorical and nonmetaphorical concepts (e.g., physical, spatial, experiential) but still is fundamentally metaphorical: such ability to cross between such states or domains is what they call cross-domain mapping. The distinction between metaphorical and nonmetaphorical concepts is primarily in how they relate to themselves. For example, a metaphorical concept typically is used to explain or understand some concept other than the metaphor itself, while a nonmetaphorical concept is something literal and self-referential. Expanding on the latter, Lakoff and Johnson give three sample nonmetaphorical concept categories: spatial orientations, ontological concepts, and structured experiences and activities. For each of those categories a metaphorical concept can be attached.

To support these claims, Lakoff and Johnson provide examples of everyday language and idioms that demonstrate the metaphorical nature of the conceptual system. Orientational metaphors explain concepts in relation to space, such as "fuel prices continue to *rise*" or "the number of records produced *fell* this year." In this metaphorical schema, a nonmetaphorical entity (fuel prices, number of records) moves through a metaphorical space to express a linear change in value. While they seem obvious in context, when taken apart to understand their function cognitively, conceptual metaphors become telling of the deep connection language has to our physical world. The second category, what Lakoff and Johnson call ontological metaphors, puts a status inherent to one concept onto another one that does not assume that status normally (e.g., the metaphor of the mind as a machine that works or runs). This reinforces the physical connection language makes to express effort or exertion, for example. Finally, structural metaphors link different types of experiences or activities, such as the idea of "seeing" to imply understanding (1980b, 195–97). With these basic principles, Lakoff and Johnson posit that cognition can be understood through metaphorical concepts and are "necessary for understanding most of what goes on in our world" (1980b, 207).

Semiotics, Topics, and Gesture

The application of the linguistic conceptual metaphor theory to a wide range of fields has been ongoing since Lakoff and Johnson's first pioneering book, including with their own subsequent scholarship (1999; Johnson 1987). Music notably shares many of the characteristics that Lakoff and Johnson pointed out about language. Music can be understood semiotically as "written" (committed to signs and recorded) in some way and more discretely in the greater signification of music's constituent parts. In other words, music can operate in similar ways to language when expressing meaning structurally and fundamentally. V. Kofi Agawu's work on semiotics and signs in music overlaps in some ways with Lakoff and Johnson. In *Playing with Signs* (1991), Agawu argues for an understanding of music as having meaning through two forms of semiosis, which simply is the act of signifying. The first is introversive semiosis: musical features within a work like notes on a page, harmonic material, and so on. The second is extroversive, which refers to signifying by different styles or extramusical features, which Agawu further explains through topics. Principally, topics are musical or extramusical concepts that create meaning as signs, whether aesthetic, rhetorical, structural, et cetera. More specifically defined, Agawu writes:

> Topics are musical signs. They consist of a signifier (a certain disposition of musical dimensions) and a signified (a conventional stylistic unit, often but not always referential in quality). Signifiers are identified as a relational unit within the dimensions of melody, harmony, meter, rhythm, and so on, while the signified is designated by conventional labels drawn mostly from eighteenth-century historiography (Sturm and Drang, fanfare, learned style, sensibility, and so on). (49)

Agawu, like Leonard Ratner before him (1980), argues that composers of the Classical period (here, Agawu is referring to the years 1770–1830) were aware of and used topics in creating music and that listeners were also well-versed in such topics. This necessarily brings up another issue of how modern listeners understand topics without that cumulative or contextual understanding. Nevertheless, while Agawu is not specifically concerned with how metaphorical concepts structure music's semiology, his arguments support Lakoff and Johnson's theory that those concepts influence much of our understanding and can also apply to music.

The semiotic approach to musical meaning proposed by Agawu focuses thoroughly on the idea of the topic, but other music theorists have expanded principles of semiotics to other forms of expression and understanding. Among many interpretive additions to the discourse, Robert S. Hatten's work on gesture (1994, 2017) links semiotics with movement. Gesture, as Hatten points out in his book *Interpreting Musical Gestures, Topics, and Tropes* (2017), is a multidimensional term. For example, gestures can be purely musical (either sonically or written in a score), performed, or some combination. Hatten ponders: "how can one claim that gesture is implied by, or encoded within the fabric of a score? To begin with, the dynamic environment in which we experience our bodies and their gestures has its virtual counterpoint in music" (2017, 115). Essentially, gestures are intrinsic to music and when recorded on a score dictate gestures that the listener and/or performer experience. If Hatten's theory on gesture on the surface appears to be a step in the opposite direction to Agawu's use of topics, he is actually offering a broader method of understanding music semiotically through movement.

Embodied Cognition

Hatten is also interested in devising a system of understanding movement and gesture through embodiment. As a part of the greater subfield of embodiment, Hatten is concerned with analysis and how gesture can be understood structurally mainly through motion. For Hatten, the score and notation are inherently gestural as are the performances realized from it (Hatten 2017, 123). David Lidov's scholarship on gesture (1987, 2005) in part emphasizes physiology as a critical component of music's gestural nature. Instead of taking Hatten's argument that embodied gesture is part of music's meaning, Lidov considers movement (as a component of gesture) to be intrinsic to music (Lidov 2005, 146). Both Hatten and Lidov acknowledge that music engages with the body fundamentally but disagree about if or how embodiment creates meaning in music. This is partially because both are trying to create a semiotic approach to gesture. Where semiotics and gesture divide, the subfield of embodied cognition offers another method that helps integrate them.

Scholars, including some already mentioned, have offered many approaches to embodied cognition and performance. While I focus primarily on two who integrate the theory of conceptual metaphor, some important studies on embodied music cognition deserve mention. One of the pioneers in music psychology and later of embodied cognition was Manfred Clynes. Clynes is perhaps best known for his theory of sentics, which proposes a physiological link to emotions through physical touch and rhythmic pulse (1977). In subsequent studies, Clynes—a musician himself—and Janice Walker proposed that embodiment through pulse is experienced by the performer but was also experienced by composers and that their individual pulses carry through the composers' music (1986). In a similar vein, Marc Leman's book *Embodied Music Cognition and Mediation Technology* (2008) offers an interpretation of embodied cognition through action, primarily focusing on the way mediation (i.e., the use of instruments and technology) can connect perception and physicality (see esp. chapter 6).

The work of Lawrence Zbikowski and more recently Arnie Cox turns in varying degrees to embodied cognition as it interplays with the idea of the conceptual metaphor. In his book *Conceptualizing Music* (2002), Zbikowski like Hatten identifies ways that music imitates language, focusing on how categorization and coherence through syntactical (i.e., motivic) structure. In the second chapter, Zbikowski draws on Lakoff and Johnson's cross-domain mapping and Johnson's image schema (Zbikowski 2002, 65–70; Johnson 1987). With the latter, Zbikowski highlights perhaps the most obvious cross-domain mapping in music: the concept of pitch existing within vertical space. An image schema is essentially a representation ("like the abstract structure of an image") of a common trait linkable between different experiences (Zbikowski 2002, 68). The schemata are important in explaining the potential transmutability of the conceptual metaphor, or more simply put how they can be consistently applied in various situations. Taking the verticality schema as an example, Zbikowski notes that the schema allows for "low" and "high" orientations but also "small" and "large" (69). Zbikowski acknowledges that while the verticality schema designating "low" and "high" pitch might seem intuitive from say a Western musical notation perspective, it may be presented through different models in other cultures (71).

Another one of Zbikowski's arguments is the problem of music theory and analysis. He observes that theories devised to explain musical organization fit naturally into a system of cross-domain mapping (74–76). Zbikowski writes:

> Theorizing about music requires that we bring order, even if of a tenuous sort, to an ephemeral and often intangible domain. Cross-domain mapping aids this process by bringing systems of relationships to bear on the musical domain and by correlating rich, if at times complicated, images of essential musical concepts. (76)

In short, conceptualizing music from a theoretical perspective is fundamentally a process of cross-domain mapping and categorization. Theory provides systems that infer musical meaning through structure and a framework that permits (if not encourages) understanding by physical principles or "concepts derived from everyday experience" (Zbikowski 2002, 76). One such system logically emerges when the body's somatic interaction with music is used to derive meaning.

Arnie Cox describes a system that attends to both music cognition and embodied cognition in his book *Music and Embodiment* (2016). The central thesis of Cox's book is that embodied action (what we do with our bodies and the neurological structures that accomplish that) is at least in part mimetically determined and consists of mimetic behaviors: that is, bodily movement is the result of hardwired imitation. Cox calls this principle the mimetic hypothesis (2001, 2011, 2016). Two general mimetic components make up mimetic behavior: mimetic motor action and mimetic motor imagery. The former is overt behavior such as physical movement, while the latter is covert in that it is imagined or a mental representation (12). The mimetic hypothesis also asserts that music is comprehended "by imitating, covertly or overtly, the observed sound-producing actions of performers" (12). The third chapter of Cox's book considers the mimetic hypothesis as a corollary of the conceptual metaphor. Here Cox draws on Lakoff and Johnson in a similar way to Zbikowski but offers more depth to embodiment's physical and physiological features.

Since the mimetic hypothesis relies on imitation, conceptual metaphors are especially useful for explaining musical interaction as both a listener and a performer. Cox observes that many of Johnson's image schemata work multidimensionally with music. The leap schema, for instance, can describe "locomotive leaps [that include] a starting point, end point, space in between, and trajectory" (66). It also can be compared to other kinds of schemata like the exertion and path schema. An important point of the former regarding performance is that exertion naturally tends to be inferred by musical leaps (i.e., a musical leap can make a listener or performer experience exertion) through the conceptual metaphor/image schema (65–66).

Instrumental Performance

It is clear that there are many different approaches to music cognition and embodiment. Until now I have focused this review mainly on broad concepts and systems. I now turn to scholarship that deals more directly with movement and instrumental performance. The first is Rolf Inge Godøy's 2018 article that evaluates the connection between physical action, the creation of sound, and how they are experienced. Godøy suggests that body motion in music making is continuous and determines (or even creates constraints for) how performers interact with instruments (Godøy 2018, [1.4]). Such constraints, Godøy notes, could be deemed detrimental to the value of the music that by its own merit enforces them ([1.5]). That is not to say that music can ignore its motor constraints, but rather in considering them the performer may achieve agency in music making. Motor constraints, in other words, open the door for musicians to reimagine how to execute performance. Motion functions in different capacities according to Godøy: excitatory, modulatory, ancillary, and communicative. To summarize, the first two are motions that are responsible for the direct activation of an instrument where the last two are additional motions that inflect meaning but are not critical to producing sound ([2.4]).

Another aspect of Godøy's argument draws from linguistics with applying coarticulation. In brief, coarticulation is the preparation of motion with respect to what precedes and follows the motion ([5.2–5.4]). An example of coarticulation in performance might be when a pianist spreads their fingers to prepare to play a chord or when a string player goes from one left-hand position to another using a prepared and fluid motion. Godøy also proposes that a musical work can function as a sort of "script of music-related body motion, motion that then would be re-created in our minds when listening or merely imagining by so-called musical imagery" ([8.3]). Though these points may seem implicit and intuitive, they also tease out an important question. How do we retain agency through embodied performance when much, if not all, our performative motion is predetermined? One potential answer is to apply analysis as a vehicle for agency and a new method of interpretive understanding.

The field of performance and analysis is another multi-faceted one that much of the scholarship already mentioned relates to. Particularly in the 1980s through the '90s, performance and analysis garnered interest as a possible means to enhance performance quality and musical meaning. Scholars such as Wallace Berry, Eugene Narmour, Nicholas Cook, and John Rink made significant contributions expanding the field during those decades and in more recent times (see Berry 1989; Narmour 1990; Cook 1999, 2013; Rink 1995, 1999, 2002). Alexandra Pierce's book *Deepening Musical Performance through Movement* (2007) approaches performance and analysis practically. As a pianist, teacher, theorist, and composer, Pierce's interest in movement's structural nature in performance draws on her experience in each application. Chapters five and six of her book propose using structural analysis as an interpretive tool, which she suggests can be achieved through her concept of the "Schenkerian Sound" (Pierce 2007, 84). While I will go into detail about this later, Pierce's dedication to pragmatic analysis (i.e., done through and by movement) offers a valuable addition to the topic.

One book about cello technique that anticipated some of Godøy's and Pierce's principles is Gerhard Mantel's *Cello Technique* (1975). Mantel addresses both physiology and cognition, though the subfield of embodied cognition did not exist at the time. A central theme of his book is goal-directed movement. Though with this topic he is mainly concerned with physical movement and coordination of the left hand, the idea that cellists and performers can integrate an abstract concept with a physical act is noteworthy. I will discuss Mantel's book in more detail in the next chapter.

Agency and Connection Through the Score

Making interpretive decisions in performance requires agency in some form and amount. In Western classical music where there is a score (and perhaps also an unwritten interpretive score created through performance editions, passed down from teachers, or derived from recorded media) the performer might appear to have less agency than, say, a jazz musician improvising. Needless to say, the notion that classical musicians are any less able to interpret is a fallacy that persists in part due to a long-standing desire to be faithful to the "work" and the composer: what is sometimes called *Werktreue*. Edward Klorman (2018) critiques the idea of *Werktreue* despite his training as a violist that instilled in him a respect for the "work." He writes: "the traditional separation between what we call composition and performance is ultimately untenable since every performance necessarily includes some musical elements contributed by the performer, which vary from performance to performance and are often unnotated or unnotatable" (Klorman 2018, [1.6]). To paraphrase, the performer's agency, while perhaps not notated, is encoded as a necessary part of the performance and realization of a piece of music. To that end Klorman notes that when a performer who uses a notated score still "plays a creative role determining many aspects of the music, including the exact tempo, use of rubato, and other aspects of timing; choices of pedaling, voicing, and timbre" ([3.2]).

In some respects, performing liberates the musician from the confines of the score. On the other hand, it necessarily links the performer to the composer. Elisabeth Le Guin's book *Boccherini's Body* (2006) explores the notion of an embodied connection to a composer through their music: what she has named "carnal musicology." Chapter one includes observations about technical problems encountered in the first movement of a Boccherini cello sonata. Implicit in Boccherini's cello music as a kind of choreography is his own expertise in playing the cello, which Le Guin suggests allows modern-day cellists to connect physiologically to the composer (Le Guin 2006, 18–24). Le Guin's approach, in a different way to Klorman, proposes that a musical "work" is realized when performed physically. But within the embodied act it also becomes possible to imagine what a composer felt or imagine an alternative. Agency is thus prescribed by the composer and the score in the embodied experience of performance yet liberatory as the performer inflects their own embodied reaction.

Concerning Musical Forces

Steve Larson's background in Schenkerian analysis fundamentally shaped his theory of musical forces. Like Heinrich Schenker, many of Larson's analytical examples come from the late Classical and early-to-mid Romantic period music of Germany and Austria. I wish to acknowledge that in the past few decades, Schenker's theoretical and socio-political beliefs have been scrutinized for being explicitly and sometimes insidiously racist (Ewell 2020). Though this document explores the same repertoire, I do not wish to repeat, reinforce, or endorse any of the overt and/or covert racist or nationalist aspects of Schenker's life or theoretical output. My interpretation of Larson's theory and particularly how it relates with performance relies on its open-ended potential. In other words, I am interested in interrogating how Larson's broader observations about musical forces can influence performance rather than espousing any authoritative interpretation or structural hierarchy. I see Larson's theory as a valuable addition to the large order of scholarship that I have outlined above and particularly applicable to cello performance practice.

CHAPTER TWO

MUSICAL FORCES, PHYSICAL FORCES, AND CELLO

At some point in my early childhood, I learned to the old nursery rhyme "Ring Around the Rosie (or Ring a Ring o' Roses)" and the accompanying circle dance. Anyone familiar with this common playground activity can probably recall that at the end of the rhyme ("we all fall down") everyone drops onto the ground. At the same time, the tune usually drops as everyone sings "down" usually by a descending fifth ($\hat{5}$ to $\hat{1}$) in a kind of musical text painting. The movement is almost instinctual in response to the words "fall down," and the music seems integral to the experience of falling too. In this outwardly simple and commonplace kind of play, there is something that speaks to how connected our physical interaction with the world can be in music. What tells us that as we drop to the ground the music should also drop?

For Steve Larson, such an activity illustrates a fundamental element in Western classical music: that laws of the physical world are encoded metaphorically within music. Larson's theory of musical forces proposes that experiences with the physical world inform how we experience music. More specifically, he writes,

> our experience of physical motion shapes our experience of musical motion in specific and quantifiable ways – so that we not only *speak* about music as if it were shaped by musical analogs of physical gravity, magnetism, and inertia, but we actually *experience* it in terms of "musical forces." (Larson 2012, 1–2)

I am interested in exploring the potential that those forces shape not only how we hear music on the cello as embodied acts, but also how we may shape music using similar physical analogs. This chapter explores Larson's concepts about musical motion and how they correlate to cello technique. By observing some common performance practices, I hope to offer alternative ways to conceptualize cello performance under Larson's terms.

Gravity as Physical, Musical, and Melodic Force

The musical force of gravity posits the idea that music has characteristics analogous with the effects of physical gravity. According to Larson, the experience of musical gravity is inherent to melody, harmony, and rhythm. Gravity "pulls" melody and harmony to a point of stability and serves as a fundamental part to the experience of motion going through music. To begin discussing how we experience musical gravity first requires looking at how we experience musical meaning. The concept of musical gravity and all musical forces are foremost metaphorical. These concepts suggest the composer, performer, and listener occupy a common virtual space that is influenced by our experience of the physical world (Larson 2012, 73). As with physical gravity, musical gravity is something experienced with varying levels of awareness based on different factors of perception and effort. For example, standing up from a seated position on a chair versus standing up from a position lying on the ground. Awareness of physical gravity is often experienced referentially through motion and the perceived effort that movement requires (Larson 2012, 83; Gallagher et al, 2021). Musical gravity can also be experienced this way in reference to its effect on motion.

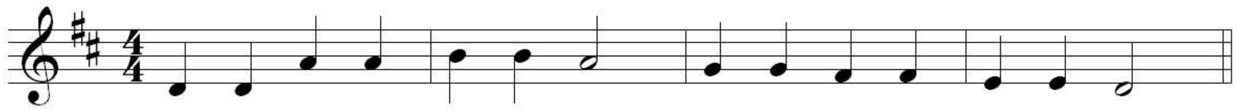
In Larson's theory of musical forces, melodic gravity is defined simply as "the tendency of a note (heard as 'above a stable platform') to descend" (Larson 2012, 85). While melodic gravity is not a novel concept outright (Larson points out the work of several scholars and pedagogues who have written about the use of melodic gravity), a fundamental aspect of its use for Larson is experiential. He suggests "if listeners make sense of musical motions by mapping them onto their own experience of physical motion, then musical gravity will play a role in the way the interpret melodic ascent and descent" (Larson 2012, 85). This serves as an impetus to evaluate the relative function of performing music as a physical act. Regarding performing or practicing on the cello we might be led to ask how does my bow arm/left hand/location on the instrument relate to melodic *and* physical gravity? Whether it is done consciously or not, playing an instrument has the potential to engage with both physical and musical gravity.

Gravity as a physical metaphor in cello playing has congruencies and contradictions when reconciled with the idea of musical gravity. Since a cellist plays seated, their body remains in a position of relative stasis regarding gravity, which Gerhard Mantel calls equilibrium (Mantel 1975, 19). An exception to this is in the movement forward that is sometimes needed when accessing upper positions, which has been described as a shift in the body's center of gravity (Mantel 1975, 20). Without such compensation, a cellist might develop physical tension or potentially reduce their accuracy in upper positions in addition to not having adequate leverage. Mantel also points out that lateral motion (shifting weight) can disrupt equilibrium while rotation (of the spine) does not (Mantel 1975, 20). Mantel reasons that equilibrium can be maintained when disturbed by shifting the center of gravity or using stabilizing muscles. In effect, equilibrium is the desired physical state of the cellist but that does not necessarily mean the cellist always remains in equilibrium. Gravity is a fundamental part of physically engaging with the cello and finding equilibrium, and technical choices made by cellists can support (go with) or disrupt (go against) it.

The equilibrium inherent to playing the cello can be reconciled with the concept of a stable platform from Larson's definition of melodic gravity. A common practical iteration of this is in the way that positions are taught and learned systematically from low to high. Many pedagogues point out accurately that higher positions are not fundamentally more difficult than lower ones. Nevertheless, the lower positions are typically the most familiar for cellists and considerably more stable at least in the beginning and intermediate stages. But musical stability and the tendency to descend to a point of stability do not require that the point be only a low note and thus a low position. Musical stability is something that can be experienced in a variety of musical contexts and therefore is capable of being felt that way on an instrument. Much like how Mantel describes equilibrium and the ways to physically manage gravity, musical gravity is also not an absolute. Musical gravity and physical gravity both become more marked when there is some form of disturbance, for example an inertial impulse or the application of force working against or tangentially to the effect of gravity. In the physical sense, this could be realized when performing a large shift from the lowest position to a very high position (or vice versa). Musically, gravity can similarly be experienced when a leap takes the music away from the stable platform. Both forms of gravity overlap at times, which has the potential to add expressive depth for the performer and the listener.

An example that Larson gives to illustrate the effect of melodic gravity is with "Twinkle, Twinkle, Little Star" (Larson 2012, 82–4). Larson explains that "Twinkle, Twinkle, Little Star" has a "prototypical shape" marked by an initial leap from the tonic to the fifth scale degree, an ascending step to the sixth scale degree, and a stepwise descent back to the tonic. It also establishes a broad arching shape accentuated by its metric layout. The leap at the beginning of the melody is inherently stable because it goes from one stable pitch (the root) to another (the fifth scale degree) and in Larson's view evokes a sense of ease. To hear this melody and to look at it notated certainly corroborate many of Larson's observations, at least in consideration of the theories he is building from, like Schenkerian analysis. How would a performer experience melodic gravity in such an example?

Example 2.1 “Twinkle, Twinkle, Little Star” first phrase.



Incidentally, along with adhering to both ideas of pitch stability and the tendency of melodies to descend, the melody is one commonly taught to beginning cellists, namely through Shinichi Suzuki’s method. “Twinkle” and several variations is often one of the earliest pieces that cellists (and many string students) encounter when learning under the Suzuki Method. The whole unit of “Twinkle” variations serves as a sort of primer of bow control, bow strokes, familiarization with first position, and coordination of string crossings. The theme is included after the variations and requires competency in controlling the speed of the bow and maintaining consistent contact with the string. The first phrase of the theme establishes a consistent alternation of down bows and up bows. Editorial markings also indicate that the quarter notes should be played staccato and marcato. As a pedagogical tool this is just as good a solution as any, but if we consider Larson’s proposals about melodic gravity, we might have questions. How does playing the bowing “as it comes” influence the experience of gravity? Is the “athletic quality” and ease of the leap enhanced by playing the in an easy part of the bow (the lower half)? What is the musical benefit or effect of playing the notated articulations and style?

Examining the implicit musical effects of technical choices in this simple example will offer some useful insight into possible applications of Larson’s theory. To begin, the issue of the physical distality of the bow at its extremes must be addressed. The closer one plays to the frog, the more centered is their center of gravity and therefore they can apply more of the weight of the arm (Mantel 1975, 19–20 and 39–40). For example, playing a down bow at the frog is a common technique used to play loudly or to accent notes when called for. Conversely, playing at the tip requires some modifications to the player's physiology to attempt to maintain equilibrium. For most pedagogues, the solution to the lack of leverage at the tip is to pronate the right hand inward which means applying rotational effort or force (Krall 1923, 20). The physiology of bowing and the bow's natural balance of weight toward the frog encourage the notion that gravity is easier to experience at the frog. This principle also corresponds with the so-called "rule of down bow," which developed in string playing as early as the seventeenth century and suggests that the perception of ease playing at the frog is a long-standing idea (Walden 1998, 146).

Despite the natural tendencies of the bow, modern cellos and bows allow cellists to apply weight with relative ease in all parts of the bow. William Pleeth notes,

> because the down-bow has an immediate sense of brute force (and therefore gives the illusion of power), people often get side-tracked into believing it is stronger than the up-bow… the up-bow can often have the same sharpness and strength of attack, plus the added advantage of a sense of thrust and movement forward. (Pleeth 1982, 47)

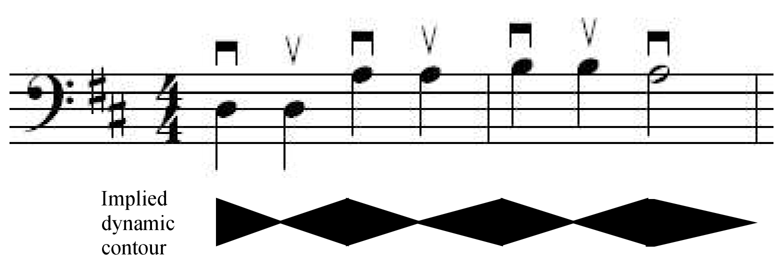
The down bow in the seventeenth and eighteenth centuries was extremely prevalent but was so because of musical needs (e.g., to be used for dance rhythms) and physical limitations of the instruments. On modern instruments and playing repertoire from later periods, down-bow hierarchy is not as rigid. Pleeth continues by describing the up bow:

> The up-bow on the other hand has an almost built-in balance between the force of the attack and the subsequent movement forward, because it starts at a point *away* from the hand and arm and plays into that weight.... I personally find the up-bow a most marvellous gesture forward, like threading something into something. It gives the most wonderful sensation of pent-up power. (47)

Pleeth's point may be in part to open cellists' eyes to the possibility of alternative bowings, but the language he uses to describe these techniques also speaks to the fundamentally expressive function of the bow and how a performer uses it. He says an up bow evokes momentum and great potential energy, both similar metaphors to musical forces.

Musical gravity and the inferred experience of gravity through the bow share in common the fundamental function of music to move. Larson argues that musical gravity is not a direct experience of gravity but a musical sense of “falling” (2012, 83). In his discussion of “Twinkle, Twinkle, Little Star,” Larson suggested that the initial leap of a fifth is stable because it is going from tonic to the next-most-stable pitch. Nevertheless, leaps draw a listener’s attention to the vertical relationship between the first and second note. If a cellist were to play the version of “Twinkle, Twinkle, Little Star” in Example 2.1 using the standard down-up (“as it comes”) bowing, the sense of stability the first and third note of m.1 is emphasized. Alternatively, if the passage was played with hooked bows (down-down up-up) the leap becomes transitional: leading to the note after not unlike what Pleeth described. If the bow’s natural dynamic characteristics are accounted for, the first two measures of the first version might look something like Example 2.2.

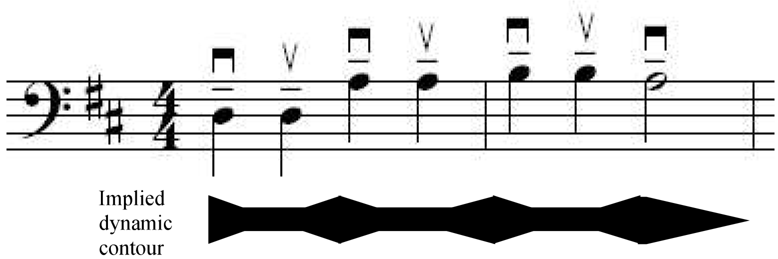
Example 2.2 “Twinkle, Twinkle, Little Star” mm. 1–2, down-up bowings and dynamic contour.



The diagram below the excerpt shows an exaggerated and simplified representation of the bow’s natural behavior. This would be a logical solution and rendition if performed. Each of the down-bow strokes falls on a strong beat and every up bow leads to the next down bow. In terms of musical forces, the stability that Larson suggests characterizes the "prototypical leap" from C to G is reinforced by this bowing.

Most of the time, however, string players find ways to minimize these effects of the bow by applying various techniques that encourage smoothness and regularity. If a cellist were to play the same version with a very smooth and even sound, while the down bows would still naturally have dynamic and metrical emphasis, the up bow would lose some of the propulsive quality.

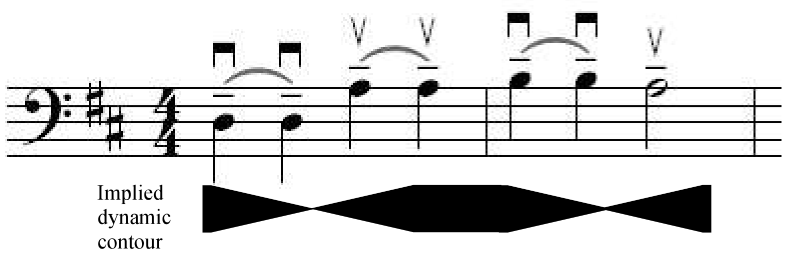
Example 2.3 "Twinkle, Twinkle, Little Star" mm. 1–2 with smoothed dynamics.



Playing with maximally even tone (and tangentially, dynamics) also modifies the experience of musical gravity. Instead of the leap highlighting movement from one stable pitch to another analogous to the physical world, the leap might become smoothed over and lose some of its expressive power.

Using hooked bows as noted above may offer another method to express musical gravity. In Example 2.4 musical gravity is expressed gesturally by the physical effort it demands. As the bow moves from frog to tip over the first two notes, weight has to be applied primarily by pronating the hand. When the bow changes direction to the up bow, the effect of gravity as both a musical gesture and how it is experienced through technical demands converges.

Example 2.4 Twinkle, Twinkle, Little Star mm. 1–2 with hooked bows and dynamic contour.



As noted in the previous example, playing with a smooth and even sound is a common practice. This bowing (or in reverse up-up down-down) works against that principle, challenging the cellist by requiring more effort to maintain the sound farther out in the bow. In this way there are a couple observations worth mentioning. First, the notion of a continuous smooth sound is not totally natural (i.e., making adaptations to counteract the bow's natural behavior sometimes requires significant effort). Second, technical decisions are not only technical but work with or against musical forces and impart musical meaning. To summarize these points using the example above, changes to the contour of the phrase are softened by minimizing the natural effects of bow. Making smoother connections between notes might create a sense of linear direction, but it also reconfigures the passage to be horizontally oriented and potentially less effected by gravity's vertical tendencies. Such observations are on the one hand obvious and on the other reveals the drawbacks of idiomatic technical performance. Some hard-wired technical principles at the very least set a musician on a particular interpretive path.

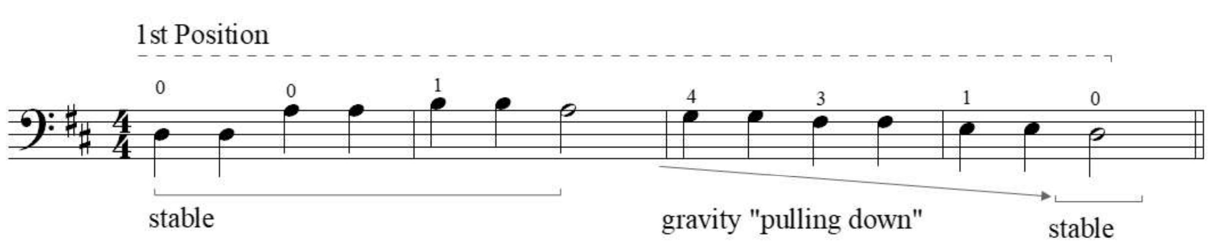
Gravity Experienced in the Left Hand

The somatic experience of musical gravity is also expressed in the left hand's movement on the string. Leaps that occur on one string involve shifting from one secure position to another. Many factors can go into deciding how to shift technically: the best position considering the notes after the shift, what finger is active before and after the shift, how fast the shift needs to be according to the rhythmic notation or physical distance covered. Of note, because there are so many nuances to shifts, here I am only addressing the connection between technical shifts and musical leaps through some basic principles. When considering musical reasons to shift, new and more nuanced decisions can be made: if the shift will include any portamento, will the shift start and end on the same finger (sometimes called a "Romantic" or "Russian" shift) or on a different finger ("Classical" or "French"), how will the dynamics affect the sonic quality of the shift. To get back to the principle that leaps are transitional, shifts can intertwine a technical problem and solution with the musical experience of a leap. That said, shifts are inherently destabilizing and sometimes avoided if other solutions exist like using an adjacent string.

In the first measure of "Twinkle, Twinkle, Little Star" shifting from the tonic to the fifth seems overly complicated. Afterall, crossing to the next string requires changing only the right hand and arm. There is also pedagogical sense behind using open strings, allowing a student to focus on the mechanics of moving between strings. But if the second part of the measure (on the cello, A) was instead played on the same string in a higher position, how would it be different aside from more difficult? The left hand and arm's movement becomes a visual and kinesthetic measure of the musical leap. With the open string notes in the first half and shift into a higher position in the second half, there is a more physical sense of musical gravity: the hand and body has to track along the string, which requires effort. Here it is worth noting that Mantel's goal-directed movement also highlights the potential to experience musical forces physiologically. It is also important that both solutions I have just described interact with musical gravity: there is no correct way to experience musical gravity. If one decides to stay in first position and cross from the D to A string or if they choose to play in a higher position does not negate musical gravity, rather it reconfigures the physical experience into two distinct versions.

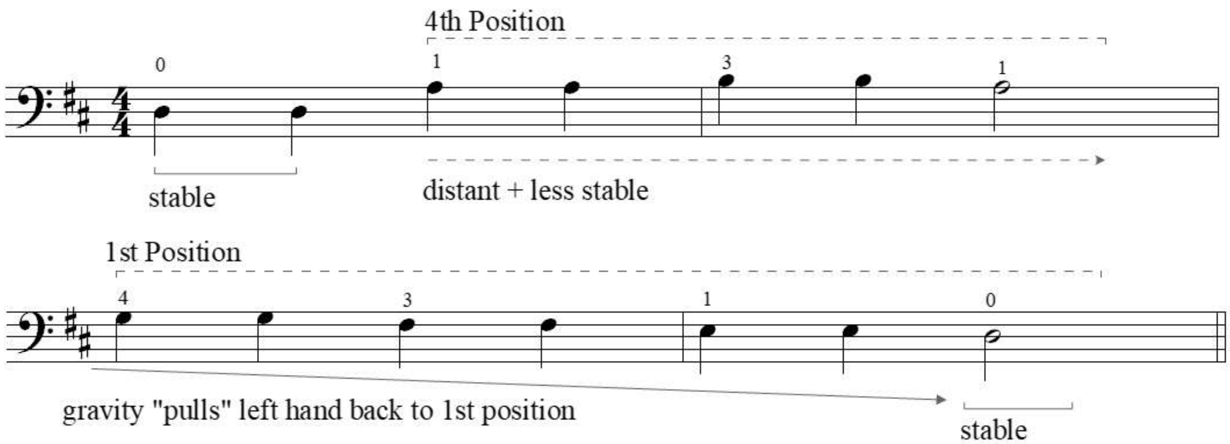
Perhaps the most obvious part of "Twinkle, Twinkle, Little Star" that shows the effect of musical gravity is the pattern seen in mm. 3–4. The descending tetrachord (G–F♯–E–D and also A–G–F♯–E in mm. 5–6) is another prototypical gesture of "falling" as Larson suggests. According to the nature of melodic gravity, the sense of falling stems from notes moving toward an established stable pitch. In this case, the tonic D feels and sounds stable. The step-wise motion of the descending tetrachord follows a logical path back to the tonic, "pulled down" by musical gravity. This quality is present in both potential versions of mm. 1–2, whether staying in the same position and changing strings or shifting back from a higher position to the lower one. In case of the former shown in Example 2.5, the experience of musical gravity outweighs the experience of physical gravity: using open strings makes D and A relatively equal as stable pitches (and, as Larson points out, are the two most stable notes diatonically) (Larson 2012, 83).

Example 2.5 "Twinkle, Twinkle, Little Star" mm. 1–4 in first position.



Example 2.6 shows the latter version, which suggests "falling" because it requires movement going from distant to close: in this case, musical and physical gravity overlap more obviously.

Example 2.6 "Twinkle, Twinkle, Little Star" mm. 1–4 using fourth position.

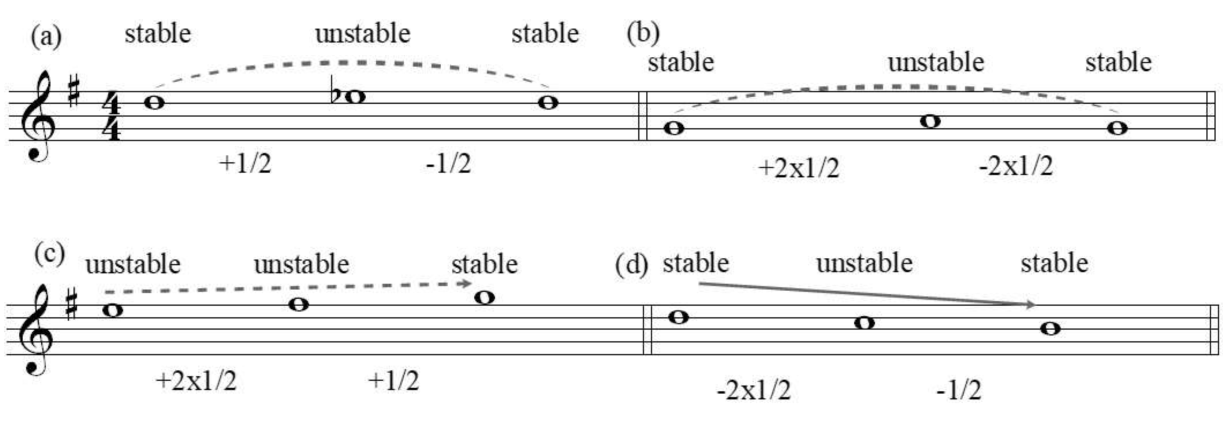


Larson explains that "if listeners make sense of musical motions by mapping them onto their own experience of physical motion, then musical gravity will play a role in the way they interpret melodic ascent and descent" (2012, 85). Listeners and especially performers can experience musical gravity physically as metaphor or literally by embodied performance. However, Larson's proposed way of listening is not prescriptive: musical gravity can be felt in different ways and invites performers to discover how it may be used as an interpretive and technical tool. It is also worth mentioning that the discussion of musical gravity points to a possible way to retool pedagogical exercises. Taking "Twinkle, Twinkle, Little Star" as an example, the musical experience of the tune becomes predetermined in pedagogical settings like in the Suzuki method by prioritizing one technical outcome. Though exactly when students should be introduced to matters of interpretation is primed for a longer discussion, exercises that allow students to begin understanding musical structure by physical means is promising. In such a case I imagine students learning musical features like stability and gravity by experiencing them on the instrument. If a student learns to play many versions of “Twinkle, Twinkle, Little Star,” I suspect they would have a richer understanding of its musical expression and musical forces could be a tangible way to model them.

Magnetism

Like gravity, melodic magnetism is contingent on a sense of stability. Larson’s theory suggests that stable pitches (for example, the notes of a tonic triad) draw unstable pitches to them based on proximity (Larson 2012, 89). Larson defines melodic magnetism as “the tendency of an unstable note to move to the closest stable pitch, a tendency that grows stronger as we get closer to that goal” (2012, 88). This is the same principle as the leading tone’s natural resolution to the tonic, but accounts for larger intervals too. Notes that are close together like by half or whole steps are inherently more affected by musical magnetism than distant ones. Example 2.7 shows some basic ways that magnetism can be expressed and when it interacts with musical gravity.

Example 2.7 Magnetism in melodic segments.

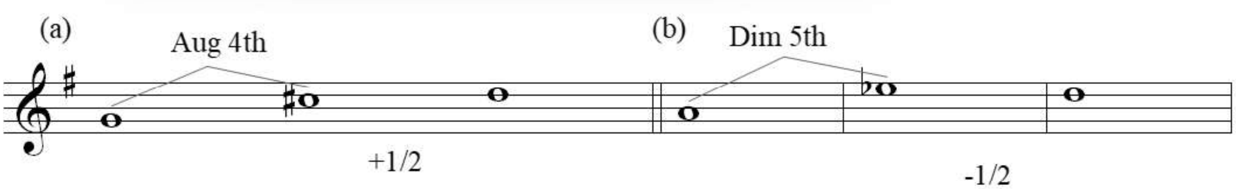


In section (a), the movement from D to E♭ demonstrates a very strong magnetic pull: in the key of G major, D is very stable while E♭ is non-diatonic and only a half step from its lower neighbor.

The same kind of magnetic pull to a stable pitch is seen in section (b), where the neighbor tone A is drawn back to the tonic G showing that magnetism and gravity can work together. An alternative in the (b) example would be to continue to the B above A, which Larson explains "give[s] into inertia" since the B is also a relatively stable note (Larson 2012, 88–89). Inertia, which I will describe in more detail in the next section, can oppose gravity's effects and particularly so when combined with magnetism. The example in (c) demonstrates how the descending nature of gravity is not the dominant force in the $\hat{6}$–$\hat{7}$–$\hat{8}$ gesture. Instead, the line is pushed up to the tonic by continuing to climb from an unstable note through another that leads magnetically to the tonic. But magnetism can also work with or confirm gravity's effects by pulling notes closer to a lower stable platform. The descent from D to B in section (d) shows that an unstable note like the intermediate C might tend to fall with gravity because of the magnetic pull of the half step.

Larson makes clear that these are not absolute functions or rules. Many times, a melody might defy musical forces, but in so doing marks an important expressive detail worth considering. Returning to magnetism, I examine an especially illustrative gesture that shows magnetism working in two different ways with gravity. As we see in Example 2.8, two treatments of an ascending leap by a tritone require resolution in opposite directions. Section (a) shows that leaping up by a tritone from the tonic G to C♯ naturally continues its trajectory by a half step to the stable D. The second example in section (b) shows the exact same leap starting on pitch A, which resolves down from E♭ to D. These seem logical, of course, because they follow standard rules of conventional voice leading in Western tonal classical music. At the same time, they more surreptitiously confirm Larson's hypothesis that musical forces shape how we hear and conceive of music. If the final note in (a) was rewritten as C♮ the sense of tonal stability would be compromised even if we could potentially hear the resolution the same way we hear (b). The same could be said about example (b) if the final note was rewritten as E♮, in which case the sense of tonal center on G would be subverted (i.e., the A – Eb/D♯ – E would not feel as unstable as the original since it follows the same pattern centered on A).

Example 2.8 Magnetism's effect on leaps.



Physically, magnetism is not something encountered in daily life for most, at least, in an embodied sense. Magnetism's effect on objects is typically the most common realization of its force. Does magnetic attraction inform embodied performance as a string player? The relative strength of each finger is a matter discussed in Mantel's treatise *Cello Technique* (1975). He writes, "it is of no importance for the pitch which finger in which position presses down the string to get a certain tone on the only possible spot" (Mantel 1975, 66). Here he simply means that the choice of fingering is inconsequential to the absolute musical outcome (the reproduction of a particular pitch). Implicit, however, is that the performer then has free will to decide how to play a particular note. He goes on to provide some important guidelines regarding the physiology of the left hand:

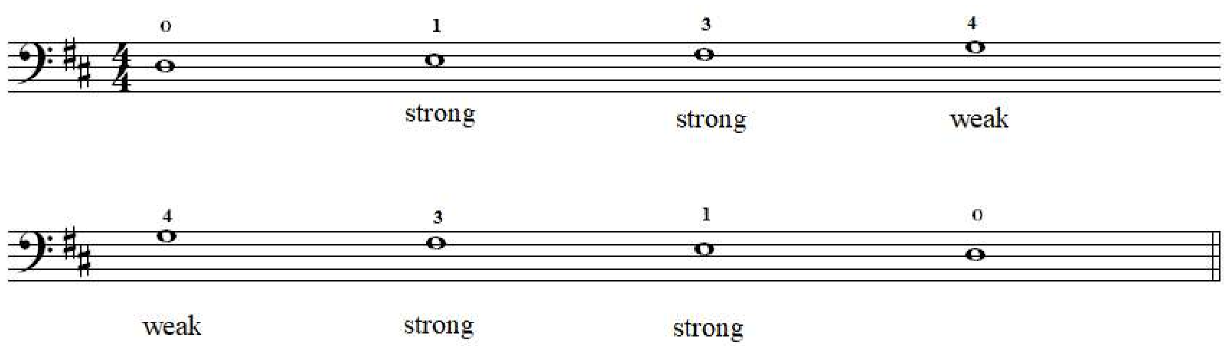
> if the hand corresponded to the typical image of the position [a determinate function to optimally reproduce pitches] its function could be described in a few sentences. The four fingers would be of even strength and even length, would be placed at chromatic distances from one another, and would all have the same functions.... Such a mechanical image, … does not depict the real conditions of the hand.... Instead of trying to prescribe a mechanical scheme for the hand and thereby accept several disadvantages, it seems

> more sensible to examine which finger, hand, and arm position allow for the best conditions of pressure and movement for each of the fingers. (66–67)

Mantel acknowledges that physical limitations potentially impact how a player chooses to play technically. How exactly the left hand's physiology determines musical decisions is perhaps secondary to Mantel's description of efficient movement at the cello. However, those limitations can be considered as integral to interpretation, even if done so only instinctively.

Adapting musical forces as a metaphor for musical and physical motion can elucidate how fingering choices impact a cellist's performance. Musical magnetism posits that unstable notes move to more stable ones with proximal preference. Since magnetism is strongest in close relationships like half and whole steps, evaluating relative stability between fingers reveals a similar tendency. Considering an ascending and descending tetrachord as shown in Example 2.9 there is an obvious commonplace intersection of the two.

Example 2.9 Tetrachord with fingerings and relative finger strength.



This is a pattern found in countless works for cello, to say nothing of the technical exercises like scales. Aside from articulating that the fourth finger is the weakest finger of the left hand (Mantel 1975, 66), it also has expressive significance. In this tetrachord in D major the G ($\hat{4}$ and fourth finger) leads to F♯ ($\hat{3}$ and third finger), coinciding with voice leading rules and melodic magnetism.

Naturally, not every fingering application can or will overlap with an expression of musical magnetism. Taking the same example but transposing it into G major, the tetrachord outlines the last four notes of a major scale ($\hat{5}$–$\hat{6}$–$\hat{7}$–$\hat{8}$). Magnetism no longer pulls the G back to F♯ but rather the F♯ leads to G, since the tonic is the stable pitch. This contradicts the natural characteristics of the third and fourth finger being stronger and weaker respectively. Despite this, taking into account musical magnetism still uniquely expresses something musically: the resolution of $\hat{7}$ to $\hat{8}$ can embrace the contradictory effect if the fourth finger is allowed to be "weak" or it can instigate the performer to modify their technique to reinforce the fourth finger (or even more likely, to shift to a different position). Like musical gravity, magnetism is a force that offers a metaphor for different modes of expression relatable to the physical world. They both call attention to the possibility that performance can present different modes of enactment in sync with or running counter to physiological and musical forces.

Inertia

Where gravity and magnetism attend primarily to vertical stability, Larson's inertia focuses on horizontal motion and "the tendency of a pattern of motion to continue in the same fashion, where the meaning of 'same' depends on how that pattern is represented in musical memory" (Larson 2012, 96). As a physical force, inertia asserts that objects in motion continue moving in the same direction unless acted upon by another physical force. Musical inertia simulates the physical form through things like melodic expectation, hypermeter, and rhythm. Several theorists have written on the idea of inertia, which Larson surveys (see Larson 2012, 98–100). Larson is most interested in inertia's influence on melody as a fundamentally physical metaphor. He argues that inertia has the potential to overcome the forces of gravity and magnetism, and as an effect it produces the capacity to "carry musical motions beyond the stable positions that serve as goals for other forces" (Larson 2012, 100). Though Larson puts inertia in conversation with the other musical forces, it is capable of long-range and higher-level structural influence.

Musical inertia can help describe the following example. In the Sarabande of J.S. Bach's *Suite for Unaccompanied Cello No. 5 in C minor*, a similar melodic pattern is played at the beginning of each of the first four measures. The pattern is marked by a distinctive set of leaps outlining a chord with a chromatic inflection interspersed. There are two primary ways this passage illustrates inertia. First, the pattern has a memorable rhythmic structure of four eighth notes with a quarter note that seems to propel each measure to its last beat. Second, the outlined harmony creates inertia across the phrase because it follows a prototypical tonic-predominant-dominant-tonic schema. The rhythm and melodic shape of each measure falls in line with Larson and others about the effects of inertia. That is, both qualities are regular enough to build momentum in the listener's ear through repetition, yet each measure is unique.

Example 2.10 Bach, Sarabande from Suite for Unaccompanied Cello No. 5 in C minor.

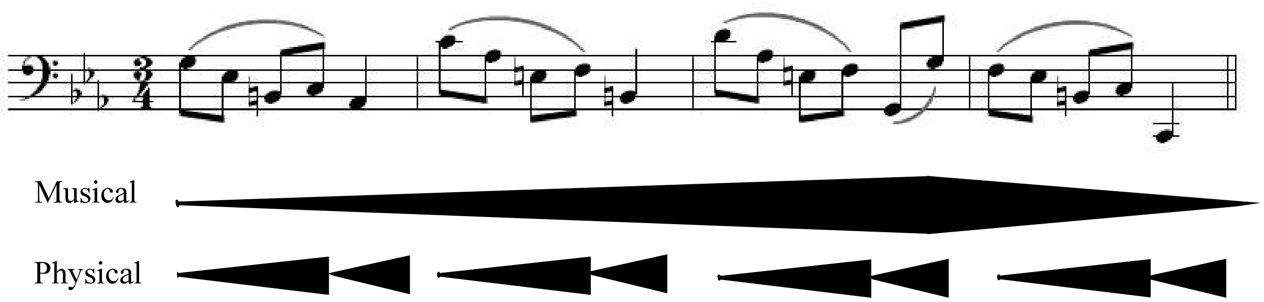
c:	i	(VI)	iv	(vii°)	ii°	V	i
Function:	T	PD				D	T

Technical and interpretive challenges in the Bach suites are magnified by the inconsistent phrasing and bowing marks passed down through various copies and editions. The markings shown in Example 2.10 are a common version based on the Anna Magdalena Bach copy, but several others appear. For the purposes of this discussion, I will consider only the version above, though any other version can be considered within a musical forces context. Instinctually, a cellist would start a phrase like this on a down bow. The "rule of down bow" certainly makes sense by providing strength to the first beat of each bar. Meanwhile, the indicated bowing would make the third beat feel the weakest physiologically and musically, something that is characteristic of the sarabande. However, slurring across four notes obscures the second beat, which is also customarily emphasized in the dance.

Because inertia in its simplest sense is a force that affects objects by relative motion irrespective of other forces, it is not something experienced intuitively in the human body. Though musical inertia seems to be the most salient and potent musical force, the physical effects of gravity seem more relatable to the human body. Repeating a motion physically (in the same sense that musical inertia builds momentum by repetitive motion) ultimately makes the body succumb to gravity. Playing a stringed instrument also complicates motion because physical and equipment constraints of the bow require frequent directional changes in force. In short, inertia as a force in performance is regulated by the limitations set by the instrument, which ultimately require that a resisting force be applied. Though inertia certainly influences motion on a stringed instrument, it is always mediated by the relatively limited dimensions of the length of the bow and the size of the left hand. Undoubtedly, many skilled performers have learned to smooth-over the limitations, but that point only highlights the potential tension between musical forces and technical application.

In the Bach example, musical and physical inertial forces are not always aligned. Musical inertia extends over the whole phrase while physical inertia interrupts its momentum with changes in bow direction. I have represented this visually in Example 2.11 with the shapes below the excerpt. Bow strokes are inherently inertial: they begin from a state of low inertia and continue until the bow "runs out" or changes direction. Each time the bow changes direction, force must be applied to counteract inertia and shift it in the opposite direction.

Example 2.11 Bach, Sarabande mm. 1–4 with inertia representations.



Though this is an oversimplification in performance practice, the potential is that there are many small inertial gestures creating a phrase that is disjunct. Mitigating these small-scale inertial restarts is possible with bow speed control. Slowing the bow speed over the four eighth notes in each bar helps avoid creeping closer to the tip and a fast stroke on the third beat. It also allows the shape of the phrase to develop, as a performer could speed up the bow as the phrase becomes more excited musically and by inertia. For advanced players, this skill is common sense, but it stands that physical inertia and musical inertia sometimes (if not frequently) need to be adapted to one another.

CHAPTER THREE

BEETHOVEN CELLO SONATA IN A MAJOR

The final chapter of this document is an application of musical forces in two specific examples in the first movement of Beethoven's Cello Sonata in A Major. Within these passages, I explore ways that interpretation can be expanded by utilizing theories like Larson's: musically and technically.

Primary Theme: the Musical Forces

The movement opens with the cello presenting the primary theme. This movement is written in cut time with a tempo marking of "Allegro ma non tanto." As a side note, it is worth pointing out that in the only surviving manuscript of the movement the meter is common time, which along with the tempo indication might imply a moderate pulse. There are a mixture of specific and vague directions given on how to interpret the first phrase. Beethoven's markings appear detailed when it comes to slurs but dynamically it is only marked with piano. The expression marking *dolce* is the only other indication that Beethoven gives for the cellist (or the pianist, for that matter) to work with.

Example 3.1 Beethoven Cello Sonata in A Major, first eight measures.

One notable feature of the primary theme is its obvious arch-like shape. Following the model of the prototypical gesture mentioned in Chapter Two, the first three notes create a shape very similar to “Twinkle, Twinkle, Little Star.” The first note on A establishes the tonic as a stable platform from which the melody leaps to E. Such gestures in terms of musical forces can either evoke effort or be something done with ease, and both interpretations can be interpreted through musical gravity. In the version attending to effort, the rise from A to E might feel like the leap is precipitated suddenly: the tonic has clearly been established as a stable platform and moving away from it so quickly requires more effort than expected. The other version would then take the first two notes as part of a larger gesture that hints at the stable platform on A but only reveals it later in the phrase.

The phrase continues to F♯ in m. 2, which in both gravitational phrase models is an expressive moment highlighted by its extra-long duration. Using the gravity metaphor, the F♯ becomes the apex of a trajectory that will lead back to a stable platform. Without the sense that F♯ is a significant point in the line and that it relates to the initial A, we might imagine that the line could continue upward or take on a different shape altogether. The point here is that either experience of the first phrase is valid and can be conceived within musical gravity’s framework. Perhaps more obvious is the effect of musical gravity after the peak. The C♯ immediately after the F♯ is a potent note, since it naturally points toward D. Instead of immediately resolving to D, however, the line jumps back up to E. This is a common way of “circling” a resolution note, but here it also adds to the sense of pulling downward by precipitating the line’s descent.

Inertia is also affecting this phrase, though it is also influenced by the effects of musical gravity. As already mentioned, the first three notes suggest a half-note rhythmic pulse that is disrupted by the lengthening of the third. Musical inertia typically involves repetition of patterns that lead to a logical point. Here, any sense of a pattern and inertia's upward push is stalled by interference from musical gravity. The second half of the phrase is dominated by gravity's pull, but it also has an inertial element. As the melody turns around to descend in m. 2, the rhythm speeds up: moving by quarter notes and eventually eighth notes by the end of m. 3. Here stepwise inertia is also at play. Paul von Hippel (2002), building off a large body of scholarship about melodic expectation including the work of Leonard Meyer (1973) and his own co-authored work with David Huron (2000), suggested that steps tend to continue in the same direction as a kind of "step inertia" (see Larson 2012, 99). The steady and mainly stepwise motion of the line toward the stable platform on A, therefore, shows both musical forces working together.

So far, the first four measures have already provided several musical clues about musical forces. What happens next in the phrase complements the concepts of gravity and inertia in an entirely different way. First, the arrival on the stable platform of A in m. 4 is not the conclusion of the phrase and its continuation leads to the E in m. 6. It is important to remember that stability is not absolute. While stability might be gravity's ultimate goal, stable notes other than the tonic exist. In this case, as the phrase proceeds the seeming arrival at A gives into both gravity and inertia. Since m. 5 is a modified version of m. 3, the repetition reveals a stronger sense of inertia moving the melody past A in m. 4 and leading to the E. The piano takes over the theme starting in m. 6 and starts a dramatic climb in register.

Because of the D♯ at the end of m.4, the harmony is now naturally centered around E major, or more precisely it is emphasizing the dominant in preparation for a half cadence. Nevertheless, the theme continuously alternates between A major and E major harmony from m. 6 until m. 12. If we accept that either A or E can be stable platforms, I suggest that what is happening in this section is that the "real" center of gravity between them is not yet settled. With that in mind, the figure in m. 7 and m. 9 seem like effortful gestures fighting the strong pull of gravity set up on E in m. 6. Inertia still helps move the theme higher by this repetition. The eventual arrival on the half cadence in m. 12 and the almost humorous *Eingang* that cascades to the low E at the end of the bar seems to reconfirm the E's gravitational pull.

Example 3.2 Entire primary theme full score.

Eytan Agmon (1998) argues that the first phrase generates almost all of the material for the movement by its distinct and intrinsic motives. Such an interpretation creates a satisfying and coherent structural understanding in the Schenkerian sense but arguably skims over the possibility of the physical experience it offers. The first phrase presents a typical musical question that sonata form articulates, develops, and resolves: the opposition of tonic and dominant. Since I am interested in possible physical correlations and effects, I argue that these key areas can be conceived in terms of musical forces. In that way and through cross-domain mapping, performance might simultaneously enact a structurally integrated and embodied realization of the process.

First Phrase: Physical considerations

A common convention in performing this opening is to play the first three measures on the G string. An early example of this interpretation comes from Josef Werner's *Die Kunst der Bogenführung* (the Art of Bowing)*, Op. 43* (1894) shown in Example 3.3.

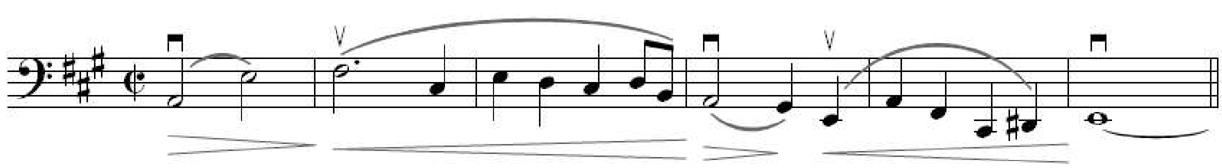
Example 3.3 Opening passage of Beethoven Sonata as edited by Josef Werner.

Playing the passage on the G string on one hand achieves a uniform tone perhaps to create a *dolce* sound. On the other, it means travelling a greater distance than simply staying in position and crossing strings. The leap up a fifth is an expressive gesture because musical gravity suggests the application of effort to depart from the stable A. Shifting thus emulates a physical leap that also potentially articulates musical gravity. The fingering that Werner suggests also emphasizes the arrival on A in m. 4 with a strong second finger, adding expressive weight.

Werner's edition suggests dynamics at the end of the phrase that are normal in performances of the work. This is especially true about the arrival on E in m. 6, which is typically played quietly. But some details point to another possible interpretation: that the E is an important arrival harmonically and under musical forces. Because E is tonicized in mm. 5–6, D♯ is pulled magnetically to the E in m.6. As mentioned in the previous section, musical inertia is also influencing the phrases direction pointing toward the E. That the dominant is emphasized so early in this movement also has rhetorical significance in the form. In the end, there are credible reasons to assert either A or E as the more important note of the first phrase. Depending on what way a cellist chooses to interpret the passage has major implications on how to execute the performance.

In an interpretation masterclass posted on YouTube in December 2022, conductor Benjamin Zander coached cellist Andrés Sanchez on the exposition of the first movement. Discussing the opening, he was intrigued by the fact that Sanchez started the piece on an up bow and offered an alternative. He asserted that the phrase's hypermeter determines how to bow the phrase and that Beethoven already suggested the optimal bowing with the notated slurs if the player starts on a down bow. Zander, once a cellist himself, offered a perfectly reasonable solution for interpreting the opening phrase: simply follow what is on the page and the "rule of down bow". He emphasized that m. 1 must be strong and mm. 2–3 lead to another strong arrival on A in m. 4, with m. 5 serving to lead into the second part of the theme. Zander's rationale was that the first phrase is five measures long (I believe he actually means six measures) and that to start the piece on an up bow creates the sense that the first measure is a hypermetric upbeat.

Example 3.4 Opening with Benjamin Zander's suggested bowing and phrasing.

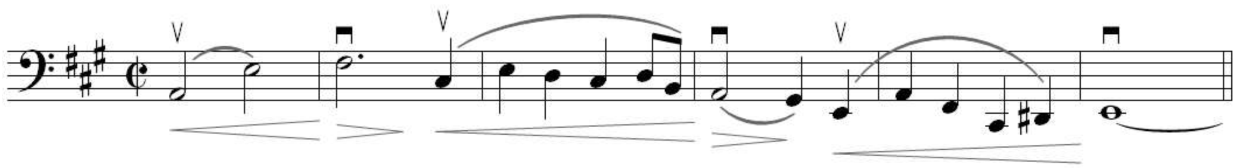


Zander's interpretation obviously treats bow direction as critical to shaping the phrase and suggests tangentially that bowing interconnects musical and physical movement. Musical forces has the ability to reveal possible interpretive schemata like Zander's treatment of hypermeter, but arguably with more flexibility. Hypermeter deals namely with assigning a hierarchy of strong and weak hypermetric beats (i.e., measures or groups of measures) akin to how a measure is divided into strong and weak beats. Following Beethoven's slurs as bowings and reconciling it with hypermeter, the hypermetric phrase from mm. 1–6 becomes strong-weak-weak-strong-weak-strong. Applying musical forces, on the other hand, does not require a hierarchical scheme in the same sense. Instead, points of stability typically serve as phrase goals, and forces like magnetism and inertia help lead to them. To be clear, I believe Zander's general interpretive approach is in line with much of what musical forces can explain in this work. Musical forces encourages multiple readings and most importantly offers a salient metaphorical and physical link.

Considering musical forces with the bowing suggested in Example 3.4 creates a specific model of the phrase. The most obvious force that the bowing interacts with is gravity. Starting the phrase with emphasis on the A demarcates the tonic as a strong and stable platform. The phrase therefore returns to the A in m. 4 naturally arriving at a resting point. As the phrase continues, the musical question is emphasized by the bowing because the E in m. 6 becomes a point of arrival too. But how the phrase develops around these strong points also has expressive importance. In m. 1, for example, the leap from A to E is made by becoming lighter in the bow and the arrival on m. 2 is the lightest point in the phrase. To make an analogy, the phrase is a ball bounced onto a surface at m. 1 and it rises to its apex in m. 2, as its inertia and gravity's pulling force equalize.

Starting the phrase on an up bow as shown in Example 3.5 provides a different experience of musical forces. Musical gravity in this model still plays a major role. The arrivals in mm. 4 and 6 can still be emphasized with one modification to the slurs.

Example 3.5 Alternative bowing with resulting dynamics.



But what becomes very clear is the experience of gravity as something cellists must use effort to oppose. Playing closer to the tip inevitably requires more work (i.e., uses more muscles or demands more control) to produce a sound with good tone on the cello. If real or perceived effort can articulate the body's resistance to gravity's physical effects, starting up bow takes on new expressive significance as the cellist "rises" above the stable platform implied by musical gravity.

Secondary Theme

The primary theme presented a linear musical idea that drew attention to the possible stable platforms on the tonic and dominant. In whatever way the performer interprets the primary theme, it appears that the theme serves as a good example of musical forces—especially musical gravity—in action. The secondary theme unfolds as an opposition of the two instrumental parts with one giving into gravity and the other inertia.

In m.37, the piano part begins the secondary theme. It starts with a three-note lead-in followed by a descending major arpeggio highlighting the new E major key area. Notably, the rhythm of the first four bars (except the lead-in) is almost identical to that of the primary theme (Agmon 1998, 399; Lockwood 1992). When the theme moves lower by arpeggio in the same harmony, musical gravity becomes less pronounced. I would argue this is because any one note of the first two bars could be stable. It is only once the pattern changes in m. 40 that the theme becomes more clearly oriented toward a particular gravitational platform.

Example 3.6 Secondary theme full score, mm. 35–50.

It is in fact the arrival on the dominant in m. 41 that is the first clear goal in terms of musical gravity in the piano part. Already in the primary theme the fourth bar was a decisive arrival point, and it is the same in the secondary theme. But instead of the gravitational pull to the tonic then the dominant, here it is reversed with the dominant in m. 41 and tonic four bars later. Before the arrival on the dominant, in m. 40 there is a turnaround in the bass line that goes below the eventual target. Aside from the harmonic reasons detailed earlier, there is also another influence affecting the phrase and the expression of musical gravity: the cello part.

The cello part is interacting with all three types of musical forces in an interesting way. First, in m. 36–37 the chromatic triplet figuration emphasizes B by magnetism which eventually reinforces the cello's arrival on the gravitational stable platform of E in m. 38. Momentum and inertia built by a long steady scale helps the cello climb from the low E through mm. 38–39. The momentum eventually pushes the cello toward an arrival in m. 41 on D♯. However, like in the left hand in m. 40, the cello part seems to overshoot the target note. One possible way to justify both the cello and the left hand is to consider their effect on each other.

Just by looking at the score, the crossing paths the lines create are evident. But between the parts there is also interplay of musical forces. The cello, which starts at a low point of gravitational stability and moves increasingly higher because of inertia, is "reigned in" by the left hand part arriving at a stable point in m. 41. Meanwhile, the left hand begins at the top of a long downward drop but all within one harmony—something Larson explains can be a feature of inertia—eventually finding stability at the cadence (Larson 2012, 99). I should also mention that the right hand helps steer the phrase toward m. 41: its imitation of the left hand is shortened and therefore seems to home in on the cadence (i.e., the point of gravitational stability) quicker.

Secondary Theme in Performance

For a cellist, the secondary theme offers comparatively fewer choices for interpretation than the primary theme. The printed slurs for the long ascending scale, for example, are a completely logical and expressive solution that accentuates the arrival at the end. In Werner's edition there is even a crescendo marked in the middle of the passage, which only reiterates how cellists often perform it. Werner does not give explicit information on whether to start up bow or down bow, which is perhaps indicative that he did not find such determinations important (earlier in his treatise he suggests exercises that make crescendos on down bows and decrescendos on up bows, for example).

Example 3.7 Josef Werner's version at the secondary theme.

Let's assume that it begins on a down bow for the purposes of this discussion. Since the beginning of m. 38 can be justified as a point of stability under musical gravity, this seems a satisfactory way for musical and physical gravity to converge. As the phrase continues, playing one note per bar does help make a crescendo in the next measure, but also counterintuitively means arriving on an up bow in m. 41. From there, the analogous material in the phrase's second half—if bowed the same way as the first half—poses a new problem as the cello part elides with the theme's second half in m. 45. Landing on an up bow at the start of m. 45 means the pickup notes into m. 46 would be on a down bow and the arrivals on the downbeat of each of the next three bars would be on an up bow. This result, judging by many performances of the passage that I have viewed, is apparently dissatisfactory since there are all sorts of creative bowings used in m. 44 to land on a down bow in the next bar.

Example 3.8 Leonard Rose's bowing in performance with Glenn Gould, mm. 44–46.

If the cellist starts the passage on an up bow, the problem of arriving in m. 41 and mm. 45–47 on an up bow is solved, but the phrase loses its grounding on the low E in m. 38 and B in m. 42.

As was observed in the primary theme, gravity's physical effects need not only be expressed by reinforcing them physically. Another reason to start the secondary theme on an up bow is that the ascent is arduous at first, giving into inertia later in the phrase. This would make it similar to the reading of the primary theme starting with an up bow. The effect not only imparts coherence considering musical forces, but motivically too: for example, Agmon argues that the cello part in the secondary theme relates to the rising fifth motive in m. 1 (Agmon 1998, 401–2). Put another way, the themes can be interconnected by musical forces or opposed, and that ultimately can help guide interpretation.

Conclusion

At the beginning of this chapter, I suggested that this sonata poses many interpretive challenges to the performer. Beethoven did not give substantial details about how to play the work, but the work is full of expressive gestures that carry integrated physiological and musical meaning. A conceptual metaphor like Larson's musical forces has the potential to connect the real experience of motion with the theoretical motion that a piece of notated music infers. It also allows for different ways that motion can be experienced. Larson's theory when taken broadly as a model does not suggest there is one way to understand or interpret music; it argues that music and motion are corollaries of movement in our daily lives and together they have expressive meaning. Cello performance and all forms of embodied performance have the potential to experience motion as musically meaningful. The more we can do to articulate that in discourse and performance, the richer our relationship with music can be.

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