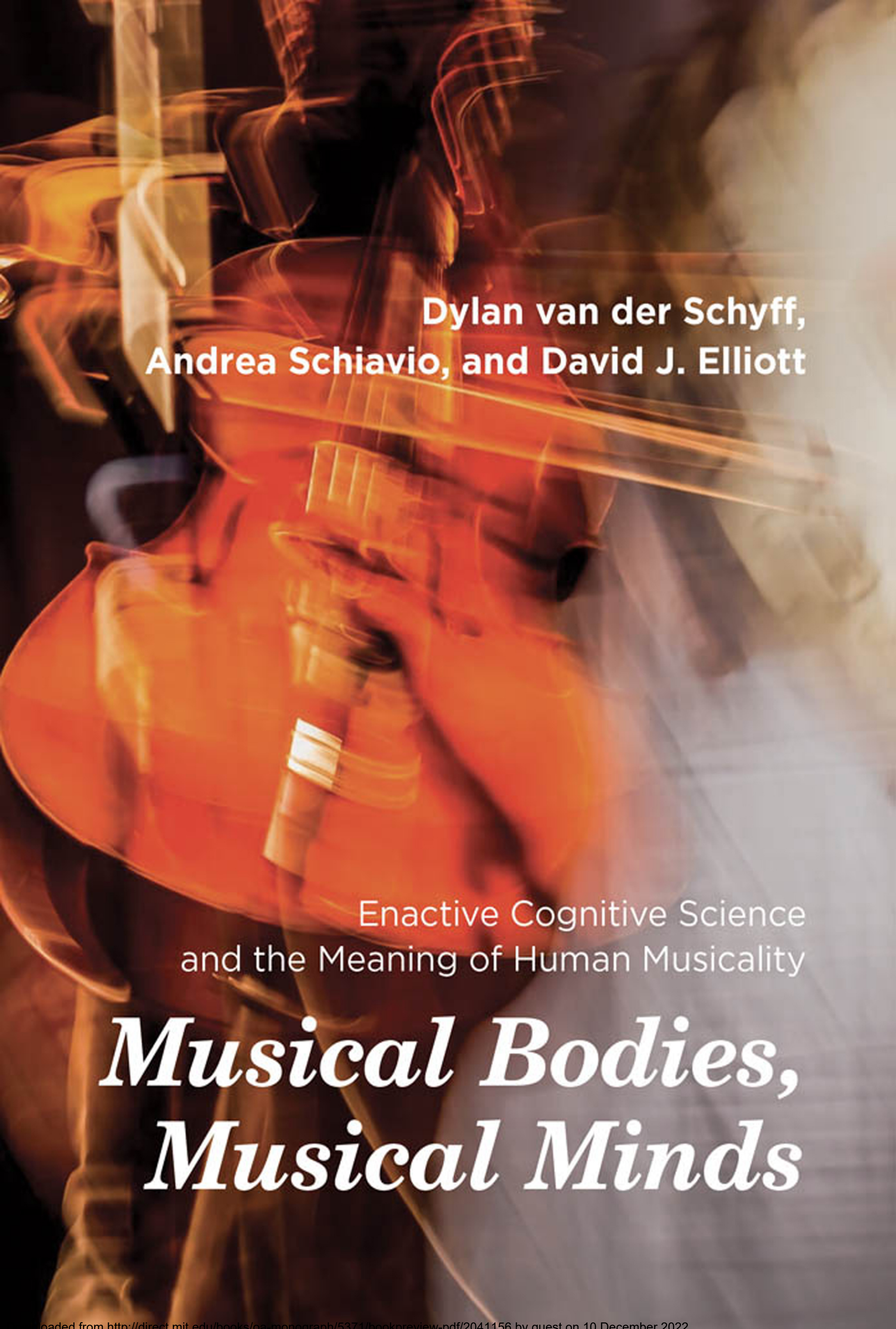

Dylan van der Schyff,
Andrea Schiavio, and David J. Elliott

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and the Meaning of Human Musicality

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Contents

Acknowledgments

The collection of ideas, arguments, and insights contained in *Musical Bodies, Musical Minds* is the result of almost a decade's collaboration between its three authors. The book reflects our backgrounds as musical performers and music educators, as well as our interests as scholars. As such, *Musical Bodies, Musical Minds* develops a perspective on human musicality that integrates knowledge from across a range of domains, including the cognitive and biological sciences, developmental studies, pedagogical theory, affective science, philosophical traditions, various branches of music research, and more. In line with this, we hope that *Musical Bodies, Musical Minds* will contribute to the interdisciplinary orientation that characterizes current musicology and especially to scholarship that explores the "embodied" and "ecological" dimensions of musical perception, cognition, and practice. This research area has produced a number of inspiring books, including Eric Clarke's *Ways of Listening* (2005), David Borgo's *Sync or Swarm* (2005), Marc Leman's *Embodied Music Cognition* (2007), Arnie Cox's *Music and Embodied Cognition* (2016), Jonathan De Souza's *Music at Hand* (2017), Simon Høffding's *A Phenomenology of Musical Absorption* (2018), Mariuz Kozak's *Enacting Musical Time* (2019), and Mark Reybrouck's *Musical Sense-Making* (2020). These texts connect in various ways with the account we offer in *Musical Bodies, Musical Minds*. However, to our knowledge, *Musical Bodies, Musical Minds* is the first monograph fully dedicated to developing a comprehensive enactive/4E view of human musicality.

In addition to the authors just mentioned, we would also like to acknowledge that many of the chapters that comprise *Musical Bodies, Musical Minds* began as research articles, some of which involved additional collaborators who contributed in important ways to the ideas presented in this book.

Chapter 5, “Music and Emotion,” is based on an article authored by Schiavio and van der Schyff in collaboration with Julian Cespedes-Guevara and Mark Reybrouck (Schiavio et al., 2017). We thank Julian and Mark for their contribution to that article and for their suggestions on the present chapter. Thanks also to Mark for his comments on chapter 1. Chapter 6, “The Empathic Connection,” is based on an article by van der Schyff and Joel Krueger (2019). Thanks to Joel for reading and commenting on this chapter. Chapter 8, “Teleomusicality,” develops sections that originally appeared in an article coauthored by Schiavio, van der Schyff, Silke Kruse-Weber, and Renee Timmers (2017). Thanks to Renee and Silke for reading and commenting on this revised version. Chapter 9, “Creative Musical Bodies,” is based on an article written with Valerio Velardo, Ashley Walton, and Anthony Chemero (van der Schyff et al., 2018). We thank Valerio, Ashley, and Anthony for their contributions to the ideas presented in this chapter.

In the first endnote of each chapter, we indicate our previously published articles that contribute to the discussion in *Musical Bodies, Musical Minds*. We thank the journal editors and the many anonymous reviewers from whom we received important critical feedback that helped us sharpen our arguments. We would also like to express our appreciation to Ezequiel Di Paolo, who commented on chapter 2; to Tiger Roholt, who commented on chapters 1 and 3; to Luca Barlassina, who commented on an early version of chapter 3; to Tom Froese, who commented on a previous draft of chapter 7; and to Mathias Benedek, who commented on chapter 9.

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1 Getting Situated

Every known human society, past and present, engages in activities that can be described as "musical." These activities involve singing, drumming, dancing, listening, and a range of other expressive behaviors and coordinated actions that take place in lived contexts associated with work, play, worship, ritual, entertainment, and more (Cross, 2012; Elliott, 1995; Small, 1998; Tomlinson, 2015). Songs, melodies, rhythms, and musical styles are used to reinforce feelings of belonging and identity in social groups, cultures, and communities (Blacking, 1995). Our day-to-day experiences of the world also involve all kinds of sounds, movements, and relationships that we can perceive as musical—from the noises and rhythms of the city to the sounds and movements of nature (Schafer, 1994). Music affords forms of emotional regulation and nonverbal communication, and is often employed as a therapeutic aid in both clinical and everyday contexts (DeNora, 2000; Sacks, 2007). Since the earliest days of our species, we have used music to enhance and give meaning to the various places we inhabit, from singing and dancing around a campfire or in a place of worship to the use of personal listening devices while exercising, or when traveling on buses, trains, and planes (Bull, 2000; Fritz et al., 2013; Mithen, 2005; Skånland, 2013). Music plays an important role in how we develop cultural understandings; it drives the complex and powerfully transformative experiences associated with different (e.g., religious) ceremonies, symphonic performances, or rock concerts. But it also involves more mundane phenomena we may hardly notice—like tapping one's foot to the beat of a tune on the radio and the subtle shift in mood that may occur as one does so.

In all, the activities, perceptions, and meanings associated with the word "music" span an impressive range of what humans experience. Whatever else we are, we are also musical. Human minds are therefore also musical minds. But why and how is this so? What is meant by "musical mind"? Why did musicality[1] evolve in the human phenotype? What is the relevance of music for human survival and well-being? How does music bring meaning to our social and cultural environments? And how might our responses to such questions inform how we think about, use, and experience music in contexts such as education, therapy, performance, composition, musicological research, and everyday life?

Over the last few decades, researchers have shown a growing interest in exploring these kinds of questions. As a result, music scholarship has developed into a fascinating interdisciplinary field that looks beyond its traditional interests in historical and compositional analysis, drawing on knowledge across the sciences and humanities to examine the psychological, biological, developmental, social, and cultural dimensions of musical experience (see Parncutt, 2007). Additionally, current music research is offering new insights into the nature of the human mind more generally and is therefore becoming an important area of interest for researchers working in the cognitive sciences. This book aims to contribute to this interdisciplinary orientation by offering a novel approach to the musical mind that is based on the enactive approach to cognition (Thompson, 2007; Varela et al., 1991). Where traditional models of mind often equate cognition with information processing confined to the brain (the "mind-as-computer" model), the enactive perspective traces a deep continuity between biological, corporeal, and mental processes, highlighting the central role of the active, situated, living body for cognition. As such, it closely integrates body, brain, and the environment as different aspects of the same evolving system, offering a holistic and nonreductive view of what cognition entails.

In the chapters that follow, we explore questions like those posed previously by extending the enactive perspective into areas such as musical consciousness, musical emotion and empathy, music and human evolution, musical development in infancy, musical creativity, and music pedagogy. In doing so, we develop connections between a diverse array of ideas and knowledge drawn from neuroscience, theoretical biology, psychology, affective science, archeology, developmental studies, social cognition, education, different philosophical traditions, and more. We should note at the outset that some of the enactivist concepts we develop may seem radical to some readers—for example, the ideas that cognition is not grounded in representational processes or that minds extend beyond the brains and bodies of individuals. While we will support such claims in various ways, we should make it clear that the chief aim of this book is not to defend the enactive orientation from its detractors. Prominent philosophers and cognitive scientists have already provided eloquent responses to critics, and we see no need to rehearse these arguments again in detail.[2] Instead, our focus will be on showing how an enactive perspective can provide ways of thinking about the nature and meaning of human musicality that have useful applications for theory, research, and musical practice and for how we conceive of the meaning(s) of music in everyday life.

In a nutshell, our take is that in being *enactive*, (musical) cognition is necessarily *embodied*, *embedded*, and *extended*. By this light, musical minds are explored as active musical bodies that are embedded within, and that extend into, the social, material, and cultural ecologies they inhabit and actively shape or "enact." This orientation—often referred to as the "4E" approach—is currently being developed, discussed, and applied across a range of research areas (Newen et al., 2018). We should note that, because of its interdisciplinary reach, the 4E approach is not always understood in precisely the same way. There are different varieties of extended (and externalist) proposals (Hurley, 2010; Menary, 2010a); competing approaches to embodiment and embeddedness have been offered (Gallagher, 2011); and differing conceptions of enactivism itself populate the discourse (see, e.g., Hutto & Myin, 2012). Nevertheless, there are good reasons to consider an approach to musical cognition based on enactivist and 4E principles. Indeed, because this orientation considers the mind as something that goes beyond the brain, it provides levels of description that are not available from other perspectives (Barrett, 2011). In chapter 2, we outline the main principles of enactive cognitive science and discuss its connections to ecological psychology, dynamical systems theory, and theoretical biology. Here, we explore in more detail the "embodied," "embedded," and "extended" dimensions that are fundamental to enactivist thinking. In doing so, we will attempt to alleviate some of the concerns just mentioned.

In this opening chapter, we provide a few historical perspectives on musical cognition in conjunction with concurrent trends in philosophy of mind and cognitive science. This will help to situate subsequent chapters by highlighting the possible origins of certain assumptions that have tended to guide our understanding of what mind and music entail. It will also aid in tracing some antecedents to the embodied and "biological" perspective we develop further on in association with the enactivist approach. Before we do this, we should note that the discussion that follows is not intended as a history of philosophy and music. This would go well beyond the scope of the present book. Instead, we offer a selective view of what is in fact a wide swath of writings that originate in antiquity; we do this from a certain perspective and with specific theoretical goals in mind. The aim here is simply to introduce some of the ideas, themes, and critical concerns that motivate the approach we develop in subsequent chapters.

Perspectives on the Musical Mind

Humans have been fascinated with music's relationship to thought, feeling, and action since antiquity and probably well into prehistoric times. The archaeological record shows evidence of human musical activity dating back to the Upper Paleolithic period—in the form of bone flutes that were fabricated 40,000 years ago (figure 1.1). But it seems very likely that music would have been present in human life long before this. Indeed, researchers have speculated that music-like behaviors played an important role in the lives of our prehuman ancestors—for example, for social bonding, child rearing, and more generally because it allowed for embodied and

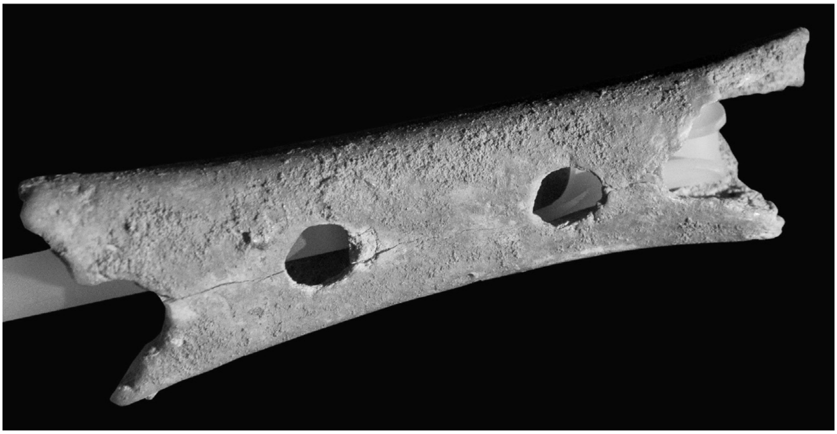

Figure 1.1
A surviving fragment of the Divje Babe Flute (sometimes referred to as the "Neanderthal Flute"). It was discovered in 1995 at the Divje Babe archeological park in northwestern Slovenia. It is made from the femur of a juvenile cave bear and is dated at 43,000 (± 700) years old. (Courtesy of the National Museum of Slovenia, Ljubljana. Photo license: CC BY 2.0.)

emotional forms of communication in prelinguistic societies (Dissanayake, 1995; Mithen, 2005; Tomlinson, 2015).

Some of the earliest writings involving music are found in Ancient Greek texts (Barker, 1989). Here, music is inspired by a divine Olympian source—the Muses, the daughters of Zeus. The influence of music, however, spans the world of plants and animals, the domain of humans and heroes, as well as the eternal realm of the gods. Consider, for example, the Homeric Hymn to Hermes, in which the young god fashions the first lyre (the *chelys*) using a tortoise shell as a resonator and the entrails of cattle as strings (figure 1.2).

Figure 1.2
This image comes from a fifth-century BCE drinking cup found in the tomb of a Delphic priest. It depicts Apollo pouring a libation with his right hand while holding the tortoise shell chelys lyre in his left hand. (Courtesy of the Archaeological Museum of Delphi, Inv. 8140, room XII. Photo license: CC BY-SA 2.0 DE.)

Hermes uses the instrument to soothe the anger of his half-bother Apollo, who becomes so enamored with it that he gives a golden lyre to his son, Orpheus. Orpheus is trained by the Muses and becomes the greatest musician and poet, capable of charming gods, humans, animals, plants, and even rocks with his beautiful singing and playing.

Notably, these ancient stories reveal a conception of music that traverses an *ontologically extended psyche*—one that includes the biological, the material-technological (the fashioning of tools and instruments), and the spiritual or divine. Orpheus himself was a quasi-sacred figure for the Greeks, conceived of variably as a god, a human, or a demigod hero; and the Orphic cults that emerged in the Archaic period (700–480 BCE) exerted considerable influence over Greek society until well into the Hellenistic era (323–31 BCE). In all, the Greeks saw music (along with dance and poetry) as a driving force in the emergence of their people and culture, and as essential to their relationship with the gods who guided their fates. Music was therefore omnipresent in their everyday lives—in their athletic events, religious ceremonies, medicine, theatre, and leisure activities (Anderson, 1994; Bundrick, 2005; Comotti, 1989).

In the sixth century BCE, Pythagoras (570–495 BCE), a reformer of the Orphic tradition, initiated the study of harmonics based on his calculations of vibrating strings and the overtones they produce (Barker, 2007). This led him to discover musical-acoustical laws based on mathematical principles and to instantiate a musical ethos for the use of intervals and modes that would align the human mind with eternal truth (the "Music of the Spheres"). This Pythagorean rational mysticism had a profound influence on the thought of Plato—a pivotal figure in the history of philosophy. Most famously, Plato abstracted the realm of "mind" from the changing world of biological and material reality. He aligned it instead with the eternal and unchanging realm of the "forms"—a transcendental, quasi-mathematical reality that is (partially) revealed in the material world by geometry. Importantly, Plato also recognized the power of music, extolling both its virtues and dangers for the soul and society.[3] He thus claimed that our musical lives should not be guided by our senses—by what appeals to the ear—but by the mathematical principles that govern the rules of musical relationships. It is an understanding of these laws, and not the bodily sense of what is pleasurable, that guides virtuous music making (Anderson, 1966).

Plato's abstract conceptions of mind and ethics were rejected by his most famous student, Aristotle. As a proto-biologist, Aristotle argued that mind and knowledge do not originate in some ideal non-material realm, but here in the world as we experience it—most notably in the transformations of matter and form as things and beings come into and go out of existence. This view is worth expanding upon briefly because it prefigures certain key insights associated with the enactive orientation.

One way to understand Aristotle's perspective is to first consider the distinction he makes between the ontological status of natural and artificial entities, or the "living" and the "made" (in *Physics II* lines 192b8–32; see McKeon, 2001). For him, living beings are not created as such. Instead, their coming-into-existence involves an innate principle of change special to the living organism itself—living creatures are essentially *self-moving* and *self-making* entities that actively "reach out" to the world as they strive to maintain a flourishing life.[4] For example, we see the egg become a tadpole, and the tadpole become a frog; we observe the seed become a sapling, and the sapling become a tree. Each has within it its own self-making principle (*archê*), and each moves seamlessly toward its actuality or purpose (*télos*) (i.e., biological flourishing). A made entity, by contrast, carries no such principle of change or movement within it. A table, a house, a ship, or a computer has its principle of motion and being outside of itself—humans bring these objects into existence through craft (*techné*) and give them the attributes that make them what they are, both in the physical and abstract sense. The purpose, form, and coming-into-being of artificial objects are not self-actualizing; they are wholly dependent on human need, desire, and *techné*. Put another way, artificial entities have their ontological footing outside of themselves: trees beget trees, but tables do not beget tables. In line with this, Aristotle adopts a tripartite theory of mind that is continuous with processes of organic movement, which include growth, bodily action, reproduction, and thought. In various stages of biological complexity, then, the manifestations of mind (*psuché*) emerge respectively as nutritive (e.g., plants), locomotive (insects and animals), and, indeed, "rational" (human). Accordingly, Aristotle not only asserts that natural entities—not just humans—are intrinsically purposeful but also that all living things have minds.[5]

As we will see, there is a sense in which these contrasting notions of mind—on one hand as a discrete, abstract, and rational category (Plato) or, on the other, as a biologically continuous phenomenon (Aristotle)—are echoed by current debates between traditional information-processing or "computational" approaches to cognition and the embodied, biological, or "life-based" orientation associated with the enactive perspective. For now, it is instructive to consider the view of musical perception provided by Aristotle's pupil, Aristoxenus, who departs from Pythagorean-Platonic musical theory in several ways. Most importantly, Aristoxenus argues that musical understandings emerge first from the senses: "The nature of melody is best discovered by the perception of sense . . . there is no other way of arriving at the knowledge of music . . . for just as it is not necessary for him who writes an Iambic to attend to the arithmetical proportions of the feet of which it is composed, so it is not necessary for him who writes a Phrygian song to attend to the ratios of the sounds proper thereto" (see Hawkins, 1868, p. 67). He also notes: "we must bear in mind that musical cognition implies the simultaneous cognition of a permanent and of a changeable element, and that this applies without limitation or qualification to every branch of music. We shall be sure to miss the truth unless we place the supreme and ultimate [(the ruling principle or *archê*)], not in the thing determined, but in the *activity that determines*" (see Stunk 1950, p. 31; also Bamberger, 2006). Aristoxenus appears to claim that, although aspects of music can be described in terms of abstract mathematical ratios, music cannot be reduced to them, nor are these aspects required for musical phenomena to be perceived, understood, and judged. Rather, it is the situated, active, and sensory aspects of music-making that form the basis of musical experience and knowledge.

It was, however, the abstract Pythagorean-Platonic model of music that remained most influential throughout the early Christian and the medieval periods, where it was adopted to support a devotional and increasingly rule-driven conception of music that mediated between the earthy domain and a heavenly God. It was also during this time that musical notation began to emerge as a central aspect of Western music. Among other things, notation provided a way of fixing musical practices within the liturgy, ensuring that they adhered to the ideals of the church. By the eleventh century, three important developments had emerged that paved the way for the period of Common Practice (roughly 1650–1900), which encompasses the evolution of Baroque, Classical, and Romantic styles. These include the growing use of polyphony, the development of principles of musical form, and the establishment of the composition and the composer as the central components in the production of Western art music.

In the Renaissance, Western thinkers began to return to the original Greek philosophical and musicological sources. Accounts from this period become less concerned with adapting ancient thought to meet religious ideals and show more interest in understanding music's ability to transform biological and psychological states—reflecting a growing fascination with the discoveries of science. As musicologist Bernardo Fantini (2014) notes, interesting examples of this can be found in musicological work of the late Renaissance and early Baroque periods, which demonstrate commonalities in "forms of thought between music and science" (p. 264). More specifically, this entails the development of two models of life that played influential roles in the music theory of the seventeenth and eighteenth centuries. The first model involves the Baroque "theory of fibers," which relates the power of music not to abstract mathematical relationships, but to vibration, movement, muscular (fibral) actions, and bodily resonances. This is paralleled aesthetically in the autonomous yet intertwining contrapuntal lines of a Bach fugue. The second model entails the eighteenth-century interest in elementary organisms or "cells." This is paralleled in how music was understood and constructed in the Classical period, where the focus shifted to distinct formal components (e.g., sonata form). These developments reveal an interesting alignment between how musical and biological processes were understood in these periods—the appositional, interchangeable, and sinuous approach of the Baroque biological-musical view came to be replaced with a cellular, hierarchical, and autonomous perspective in the Classical era.

This orientation resonates with the enactive perspective on the musical mind, which draws on current trends in theoretical biology to examine the deep relationship between music, mind, and the fundamental processes of life. We should add, however, that although embodied-biological approaches are currently (re)gaining influence in Western musicology and the sciences of mind, they were marginalized in both domains for most of the nineteenth and twentieth centuries. This is due, in part, to prevailing philosophical notions of knowledge, aesthetics, and mind received from Enlightenment thinking. An important influence on these ways of thinking is found in the mind-body "dualism" associated with the seventeenth-century philosopher René Descartes, who (like Plato) argued that the mind and body (i.e., the living body and the "extended" material world of things and objects more generally) were in fact two distinct ontological categories or "substances." He claimed that the former, nonmaterial domain must be the proper locus of knowledge and thought.

This notion of a detached rational mind had a significant effect on emerging aesthetic theories in the eighteenth and nineteenth centuries. Notably, the philosopher Immanuel Kant rejected the value of emotion and sensuous qualities for aesthetic experience, emphasizing instead the purely formal properties of music and art more generally. To be clear, the Kantian claim is not that musical experiences do not involve bodily engagements, emotional episodes, and experiences of movement and space; such an argument would be in direct violation of experience. But, by this light, bodily and emotional episodes—or feelings—are subjective, nonrational dimensions that have no bearing on an understanding of "beauty" from a philosophical point of view. This perspective is expressed by nineteenth-century music critic and theorist Eduard Hanslick (1891), who writes that "theorists who ground the beautiful in music on the feelings it excites build upon a most uncertain foundation, scientifically speaking . . . and can therefore, at best, only indulge in speculations and flights of fancy. An interpretation of music based on the feelings cannot be acceptable either to art or science" (p. 120). Following Kant, Hanslick sees the aesthetic experience of music as an entirely intellectual phenomenon: musical beauty emerges from formal characteristics of the musical work and exists independently of the listener; any emotional response is merely a by-product of the listener's subjective experience. It should be noted that several writers in the first half of the twentieth century became interested in addressing the question of emotional expression for musical aesthetics. But here too, the locus of music's (emotionally) expressive content was generally understood to be found in the formal qualities of the composed work itself—whatever music expresses is "in the music" a priori (Kivy, 1990, 2002; see also Meyer, 1956).

We will consider these perspectives in more detail in chapters 5 and 6, where we explore musical emotions and empathy. For now, we can say that, although the strong versions of "aesthetic formalism" associated with Kant and Hanslick are now discussed mostly for their historical relevance, they nevertheless played an important role in driving the more general and long-lasting assumption that a proper aesthetic understanding of a musical work has little to do with the actual lives of individual listeners. What does matter is the possession of the appropriate mental apparatus (and training) to correctly perceive, understand, and reproduce the supposedly objective structural relationships encoded in the score by the composer.[6]

While the composer and the score do continue to hold privileged places in the Western musical discourse, this perspective has been seriously questioned by a new generation of critical musicologists who have traced such attitudes to cultural developments in the late nineteenth and early twentieth centuries (see also Cook, 2006, 2013). These developments include the establishment of the Classical canon and the concert hall as a cultural and entrepreneurial strategy, the "cult" of the elite (white, male, and often dead) composer genius, the emergence of a bureaucratic "culturally administered" bourgeois society, and the mechanical reproduction of printed and recorded music (De Nora, 1986, 2000; Goehr, 1992; Nettl, 1974). These factors are now understood to have played important roles in promoting the notion of the transcendent musical object or "work," as well as the growing commodification of music more generally.[7] In brief, the assumption that the locus of musical expressivity and meaning (whether emotional or intellectual in nature) should be "possessed by" the formal structural relationships of the "music itself" is now increasingly problematized as a historical construction (Bohlman, 1999; Elliott, 1989, 1995; Small, 1998), and many current musicologists offer much broader and more inclusive perspectives on musical ontology and value.

Later, we examine the implications these changing attitudes have had for musical aesthetics and pedagogy—including the so-called "praxial" approach to music education that draws on enactivist theory (Elliott & Silverman, 2015; Silverman, 2012). For the moment, we address an important point raised by musicologist Ian Cross (2010), who reminds us that what we know of music in philosophical and scientific terms "is constrained by a conception of music that is narrowly shaped by historical and cultural notions of what constitutes 'music'" (p. 2). Indeed, the same aesthetic and cultural assumptions just considered also influenced early work in music cognition, where research tended to be focused on measuring psychophysical and cognitive responses to various musical stimuli, with the goal of articulating the rules that govern how the mind extracts and processes the information present in the score and performance thereof (Seashore, 1938; Sloboda, 1985).[8] Here, the basic assumption was that musical cognition is realized by a kind of input-output or stimulus-response schema, whereby objective properties intrinsic to the formal structure of the music (intervallic relationships, harmonic cadences, and so on) cause relevant reactions in listeners. Researchers naturally drew on the accepted scientific theories of day to explain such processes, and by the mid-twentieth century studies were increasingly framed and interpreted largely in terms of post-behaviorist, information-processing models of cognition.[9]

Music and the Computational Mind

Very generally, the information-processing approach conceives of cognition as confined to the individual, and it involves the assumption that all mental processes are essentially computational and representational.[10] The senses receive stimuli from the external world. This information is then transduced into symbols—instantiated by patterns of neural firing—that are manipulated as representations of the sensory data according to the rules (the "language" or "syntax") of the system. This proceeds in a hierarchical manner leading to the production of increasingly complex internal constructs (representations) that generate appropriate behavioral outputs (e.g., experiences, emotions, actions). The main tenets of this orientation are captured in the following passage by Bechtel and colleagues (1998): "To be a cognizer is to possess a system of syntactically structured symbols-in-the-head (mind/brain), which undergo processing that is sensitive to that structure. Cognition, in all its forms, from the simplest perception of a stimulus to the most complex judgment concerning the grammaticality of an utterance consists of manipulating symbols in the head in accord with that syntax. The system of primitive, innate symbols-in-the-head and their syntactic, sentence-like structures is sometimes called 'mentalese'" (pp. 63–64).

To account for the incredible computing capabilities of the human mind, it was also posited that such processing takes place in discrete "modules," each adapted by natural selection to perform a specific cognitive task.[11] Moreover, the processing in these modules is understood to take place at the preconscious or "subpersonal" level, meaning that we have no direct access to the world: all of our experience is located in the brain, which creates virtual, internal representations of relevant aspects the environment.

A consequence of this approach is that the body plays no substantial role in cognition as such: it merely provides the biological scaffolding to support a properly cognizing brain. In line with this, it has been argued that, although the classic substance dualism associated with Descartes is (in most cases) a nonstarter in current debates (as it raises seemingly intractable problems associated with how a nonmaterial mind might communicate with a material brain),[12] traces of it nevertheless remain at the core of the computational approach to mind. As the neuroscientist Antonio Damasio (1994) points out, the dominant idea is that "mind and brain are related but only in the sense that the mind is the software run in a piece of computer hardware called the brain; or that the brain and body are related but only in the sense that the former cannot survive without the life support of the latter" (pp. 247–248). Importantly, this information-processing, or "mind-as-computer," approach relies upon two general assumptions. The first is that cognition—conceived of as a hierarchical and quasi-linguistic (or rule-based) computational process—is necessarily an abstract and "rational" phenomenon. In line with this, the second assumption involves a disembodied, "internalist" view that sees the mind as contained strictly within the skull. The first of these assumptions, as we saw, has philosophical antecedents going back at least to Plato—it has been weakened considerably in recent years in music cognition studies, philosophy of mind, and cognitive (neuro) science. The second assumption, however, remains remarkably resilient.

We consider problems associated with this perspective in more detail in later chapters. For now, it is sufficient to say that researchers in music cognition have traditionally endorsed an information-processing orientation, albeit with varying degrees of specificity. Consider, for example, the following passage on pitch perception by the music psychologist Diana Deutsch (1999): "We shall examine the ways in which pitch combinations are abstracted by the perceptual system. First, we shall inquire into the types of abstraction [(representation)] that give rise to the perception of local features, such as intervals, chords, and pitch classes. . . . We shall then examine how higher-level abstractions [(representations)] are themselves combined according to various rules" (p. 349).

Additionally, the idea that musical cognition should be most fundamentally a hierarchical and rule-based process has also prompted much research into the relationship between music and language as cognitive systems. As we have just seen, the computational approach to the mind understands cognition as proceeding according to a kind of unconscious "language of thought" or "mentalese" (Fodor, 1983). This process is thought to have a kind of conscious correlate in spoken and written language, which functions via the organization of symbolic representations into hierarchical structures according to syntactic rules (Chomsky, 1975, 1980; Pinker, 1997). Furthermore, because language is understood to be the crowning adaptation of the human species, the evolutionary origin and functioning of the musical mind has traditionally been examined largely in terms of comparisons to language—with the assumption often being that musicality is not a proper adaptation; it is dependent on information-processing mechanisms (modules) that evolved to support language and other related functions (Patel, 2008; Pinker, 1997) (more on this in chapter 7). Accordingly, music is discussed in terms of its relationship to language at structural, perceptual, neurobiological, and evolutionary levels (Patel, 2008; Rebuschat et al., 2012), and a “music-as-language” analogy often pervades common understandings of musical experience (see Johnson, 2007).

Language and the Rules of Musical Perception

Perhaps the most well-known attempt to understand the relationship between music and language involves the apparent similarities between the Schenkerian approach[13] to musical analysis and Chomsky’s universal grammar theory (Chomsky, 1980).[14] This was developed most famously by Fred Lerdahl and Ray Jackendoff (1983), who posited a “generative theory” for tonal music, in which a given musical work is parsed into hierarchies of pitch, grouping, and meter according to a quasi-syntactic schema. This led some prominent researchers to posit that musical cognition depends on linguistic capacities. As the cognitive psychologist and linguist Steven Pinker (1997) puts it, “Music may borrow some of the mental software for language. And just as the world’s languages conform to an abstract Universal Grammar, the world’s musical idioms conform to an abstract Universal Musical Grammar” (p. 529; see also Sloboda, 1985, 1988).

Research into music’s relationship to language has also been greatly expanded by recent technological developments, most notably in the areas of computer modeling (Wiggins, 2012) and neural imaging (Grahn, 2012). Among other things, studies in the latter area have suggested an overlap between brain areas associated with linguistic syntax and those thought to be involved with the processing of tonal music (Koelsch, 2005, 2012; Koelsch et al., 2002; Patel, 2003, 2008). Interestingly, the results of such studies appear to contrast with research in neuropsychology involving patients diagnosed with *amusia* and *aphasia* (Peretz, 1993, 2006, 2012). Amusia refers to the inability to recognize or produce musical tones—it can be congenital or acquired through injury. Aphasia is a symptom of brain damage that involves impairments in expressing oneself through speech or writing (expressive aphasia) and/or difficulties in understanding written and spoken language (receptive aphasia). Amusia and aphasia can take different forms and exhibit degrees of severity depending on the extent of damage to the brain areas involved. However, studies have shown that the loss of ability in one domain does not necessarily lead to losses in the other. This research suggests, in other words, that there may in fact be dissociations between brain areas thought to process pitch and those related to language (see Van Orden et al., 2001). This apparent discrepancy has been countered by theorists who posit a cognitive "resource-sharing framework" for tonal music and language based on the idea that linguistic and musical cognition employ domain-specific representations that may be shared when necessary (Koelsch, 2012; Patel, 2012). Put simply, this theory argues that the cognitive processing of both music and language requires the ability to compute mental representations of structural hierarchies between sequential elements (Koelsch, 2012; Krumhansl & Kessler, 1982). As such, in music cognition, the representational outputs from the domain of pitch processing are thought to be shared with those from language at higher levels of processing. In this way, the perception of musical sounds (e.g., sequences of pitches, simultaneously occurring pitches) is understood to be transferred into a "cognitive representation of the location of tones and chords within the tonal hierarchy of a key" (Koelsch, 2012, p. 226; see also Krumhansl & Toiviainen, 2001).

Along similar lines, substantial attention has also been placed on theorizing about how structural variations built into a composition may set up and break musical rules and how this creates tension-resolution patterns that allow for emotions to be perceived as a property of the music and to be felt by listeners themselves (Koelsch et al., 2008; Steinbeis & Koelsch, 2008; Steinbeis et al., 2006). This research has resulted in several models in which musical emotions are explained in terms of the computational outputs of neural components (e.g., those adapted to process statistical responses associated with the satisfaction and violation of expectation) (Huron, 2006; Meyer, 1956; Scherer & Zentner, 2001).

Embodied Music Cognition

The research just discussed has produced a wealth of fascinating data and some compelling theories. However, it also views the perception and cognition of music (and language) almost wholly in terms of abstract representational processes that play out in the brain, which, again, paints a rather disembodied, skull-bound picture of the musical mind. The field of "embodied music cognition" has recently made considerable steps toward addressing this concern. As the name suggests, this orientation aims to illuminate the central role played by the body in constituting musical phenomena (Iyer, 2002, 2004; Leman, 2007; Leman & Maes, 2014; Leman et al., 2018; Maes et al., 2014; Reybrouck, 2005a, 2006a, 2017a). Important early work in this area can be found in the studies by music psychologist Jane Davidson and colleagues (e.g., 1993, 2005, 2012; Clarke & Davidson, 1998; Davidson & Correia, 2001), who examined the effects of bodily movement on the perception of emotional expression and meaning in musical performance.[15] More recently, scholars have explored how, and to what degree, the motor system influences the perception and experience of musical events, suggesting that musical stimuli are processed in the brain as representations that are action relevant and corporeally based (see D'Ausilio, 2007, 2009; Novembre et al., 2012, 2013).

While this approach appears to maintain the "internalist" perspective discussed previously (i.e., that cognition is restricted the brain, although shaped by various resources distributed across the rest of the body[16]), theorists in this field have traded the traditional modular hierarchy for a more plastic perspective on the mind-brain relationship that explains how neural connections arise, strengthen, and rewire when necessary through experience. It should be noted that this so-called "connectionist" approach is well received beyond the musical research. For many cognitive neuroscientists (see Pollack, 1989), it provides a model of the brain that better highlights its adaptive and creative capacities, offering a revised and arguably more parsimonious conception of what mental representation entails (more on this later).

While the implications of "connectionism" have been considered in a variety of ways, perhaps the most compelling suggestion is that the mental content that guides most behavior need not be understood first in terms of a language of thought and the complex unconscious mental gymnastics that this would entail.[17] Instead, the formation of neural networks and the representations they produce are thought to be guided largely by the agent's developmental history within a sociomaterial environment. This implies a conception of cognition and representation that, while still essentially brain-bound, is far less abstract and more grounded in the enactment of (action-relevant) patterns of behavior between neural and bodily components. For example, instead of framing musical cognition first in terms of the adherence to or violation of quasi-syntactic rules, embodied music cognition posits that it can be approached in terms of body-based predictive processing, whereby musically relevant "movements" (visual-sonic-tactile) are anticipated in the brain and where unexpected variations are adapted to in real time (see, e.g., Herholz et al., 2008; Zatorre & Salimpoor, 2013; Zatorre et al., 2007). These adaptive processes involve the negotiation of dynamical patterns of interference and coherence, of entropy and stability, between various neural networks through the constant feedback/feedforward interactions of "bottom-up" and "top-down" processing. In all, embodied music cognition offers a welcome new perspective as it places more emphasis on examining how the body mediates musical interactions within specific environments. As we discuss in chapter 6, this approach is also beginning to offer accounts of the social dimensions of musical experience in terms of how agents internally simulate the musical sounds, movements, and intentions of others via the mirror neuron mechanism.[18]

Interdisciplinary Musicology and Enactive Music Cognition

In addition to the growing interest in the embodied nature of music cognition, a range of new sociocultural, philosophical, and scientific perspectives are being integrated in musicological research. This interdisciplinary orientation is revealing a much wider range of possibilities for understanding what human musicality involves. Consider, for example, the work of sociologist Tia DeNora (2000, 2011), who draws on studies in musical development, music therapy, and the uses of music in everyday life. Notably, DeNora develops an approach to musical meaning as a process that plays out in various ways within the evolving sociocultural and personally enacted contexts of lived experience—music as action, as a therapeutic "force for bio-cognitive organization," and as part of an enacted aesthetic environment through which cultural and individual identities may be constructed and deconstructed. Music is thus a "resource for meaning-making."[19]

Relatedly, Elliott (1995) has argued that music should be conceptualized as a verb: “Fundamentally, music is something that people do” (p. 39). He uses the term “musicing” in the collective sense to mean the actions and the personal, social, and cultural values that emerge from performing, listening, improvising, composing, arranging, and conducting, as well as from “musicing” and dancing, music and worshipping, music and celebrating, and so forth, in their specific sociocultural contexts (p. 129). He adds that because music is an “open” global reality (p. 128), not a unitary entity, it is appropriate to replace the conventional term “music” with “Musics” (p. 43).

The cultural theorist and ethnomusicologist Christopher Small (1998) agrees that music is best understood as a verb rather than a noun. His theory of “musicking” considers human musicality as a multifaceted activity: “The fundamental nature and meaning of music lies not in objects, not in musical works at all, but in action, in what people say and do. . . . To music is to take part, in any capacity in a musical performance, whether by performing, by listening, by rehearsing or practicing, by providing material for the performance (what is called composing), or by dancing” (p. 9). Likewise, the inclusion of non-Western and other traditionally marginalized perspectives has decentered the traditional focus on the relationship between composed form and expression (Elliott, 1989, 1995; Lewis, 2007, 2009; Nettl, 1974; Nettl & Russell, 1988). This research highlights the active, interpersonal-communal, and creative nature of human musicality and the unique meanings that are generated by music-making in specific contexts. Additionally, comparative studies of musical (or music-like) activity in nonhuman animals (Bannan, 2016; Fitch, 2006; Merchant et al., 2015; Patel & Iversen, 2014) have revealed interesting possibilities for understanding the relevance of musicality for our prehuman ancestors and, more generally, for the development and flourishing of the living systems that engage in such forms of behavior.

This expanding view of what musicality involves poses new challenges to traditional thinking and research in music cognition—which, as we have seen, has tended to restrict itself to explaining the stimulus-response mechanisms and the abstract forms of information processing that musical perception is thought to entail. As we also considered, research and theory in embodied music cognition have contributed to these developments by offering an important new perspective that bases musical cognition in the outputs of motor-based processing in the brain, highlighting the relevance of bodily engagement for musical perception (whether actual or simulated internally). However, another "embodied" approach is emerging that is based in recent developments in cognitive science and theoretical biology associated with the increasingly influential enactive approach to cognition. "Enactive music cognition" offers a view of the musical mind that, although consistent with certain aspects of embodied music cognition, integrates body, brain, and environment in a more direct way. It does so by drawing out fundamental continuities between mental and biological processes, tracing the origins of mind to the primordial manifestations of life. Put simply, where embodied music cognition may understand the musical mind in terms of representations of musically relevant movements—or corporally based simulations—that play out in a cognizing brain, the enactive approach explores the environmentally situated body as a cognitive domain in its own right.

The enactive approach takes the interactive, creative, or "world-making" nature of living embodied minds as foundational for cognition. In doing so, it casts the musical mind in a more ecological and "radically embodied" (Chemero, 2009) light as it seeks to overcome the lingering internalist assumptions that often permeate the embodied cognition orientation. From an enactive perspective, musicality is explored as a manifestation of human sense-making—as continuous with (but not simply reducible to) the forms of adaptive interactivity that characterize how even very simple life forms enact survival-relevant relationships within the sociomaterial environments they inhabit (Reybrouck, 2005b, 2006b). In all, the enactive approach aims to form an understanding of the mind that trades an abstract computational analogy for a biological reality. Accordingly, enactive music cognition takes the living, sensing, moving, affective-emotional, and environmentally situated body as the starting point for understanding the musical mind. As is evident in the chapters to come, this perspective has important implications in many areas of interest to current musicology. Indeed, enactivist approaches are currently being applied across a range of domains in the sciences and humanities. As a theoretical framework, it is well suited to engage with the interdisciplinary orientation that characterizes current musicological research.

We outline the main principles of the enactive perspective in detail in the next chapter. Before we do this, however, we would like to note that an enactive approach to the music mind has some important antecedents. This includes the musicologist Eric Clarke's (2005) influential monograph, *Ways of Listening: An Ecological Approach to the Perception of Musical Meaning*. Clarke argues that the (often-tacit) acceptance of the information-processing approach has tended to reduce musical experience to a kind of abstract "reasoning or problem-solving process," in which "perception is treated as a kind of disinterested contemplation with no connection to action—which bears little relationship to the essentially exploratory function of perception in the life of an organism" (p. 15). He further questions the validity of this approach as it appears to contradict direct experience. As he notes, we tend to understand music first in terms of its meaning in our lives and how it makes us feel, and only subsequently in terms of its constituent structural elements—an activity that often requires difficult (and conscious) analysis, as well as sustained training. In response to these concerns, Clarke offers a perspective based in connectionist neuroscience, ecological psychology, and first-person experience. In the process, he develops an approach that highlights the active, creative, embodied, and environmentally situated nature of the musical mind. And indeed, the final section of *Ways of Listening* is entitled "The Affordances of Music and the Enactment of Musical Meaning." On the penultimate page he writes, "This book should be no more than a part of a larger project on the *enactment* of musical meaning" (p. 205, italics in original). In recent years Clarke has offered a number of articles that develop enactivist and 4E models (e.g., Linson & Clarke, 2017).

Similarly, the ethnomusicologist David Borgo's (2005) *Sync or Swarm: Improvising Music in a Complex Age* draws on enactivist theory, ecological psychology, and complex systems theory to analyze the performances of collaborating improvisers. In doing so, he explores a practice (free improvisation) that has traditionally been marginalized in Western musicology, revealing the dynamics of musical interaction as it unfolds in real time.

A third important precedent can be found in the work of musicologist Mark Reybrouck (2001, 2005a,b, 2006, 2010, 2012, 2015a,b, 2016, 2017a,b, 2020), who draws on enactivist principles, ecological psychology, and biosemiotics (among other areas) to explore musical sense-making as continuous with processes of niche construction and adaptive behavior in the context of a real-time lived experience. Philosopher Joel Krueger (2009, 2011a,b,c, 2013, 2014, 2015, 2018a,b) has also contributed a number of important papers and chapters that develop phenomenological, enactivist, and 4E perspectives, with a special emphasis on the social aspects of musical experience. Additionally, theorists such as Marissa Silverman (2012, 2020; Elliott

& Silverman, 2015) and Wayne Bowman (2004) have drawn on enactivist and related phenomenological models to develop ethical frameworks for music education. We consider pedagogical perspectives in more detail toward the end of the book.

Looking Ahead

Let us now outline what's to come in the chapters of this book. In chapter 2, we introduce the main features of the enactive approach to mind. Here we consider enactivism's relationship with ecological psychology and distinguish it from other embodied approaches to cognition. Following the seminal work by Francisco Varela, Evan Thompson, and Eleanor Rosch (1991), as well as more recent contributions (e.g., Di Paolo et al., 2017; Thompson, 2007), we then identify three main principles central to the enactive position: autopoiesis, autonomy, and sense-making. In doing so, we explore the enactivist claim that cognition is not best understood first in terms of computations and representational content confined to brains; and we begin to consider the implications of the enactivist conception of mind as primarily rooted in the processes of sense-making that arise between living bodies and the sociomaterial environments in which they are embedded. To conclude, we draw connections with supporting fields such as dynamical systems theory, and we outline the 4E framework (embodied, embedded, extended, and enactive) that will help to guide our musical discussion in subsequent chapters.

In chapter 3, we tackle the tricky subject of music and consciousness. We first consider the ways the issue of consciousness has traditionally been approached from an information-processing orientation. Here we place a special focus on two important perspectives—those of philosophers Daniel Dennett (1988, 1991) and Diana Raffman (1993), respectively. We choose these examples because, for us, they represent two of the most compelling computational accounts of the experiencing mind. Moreover, Raffman offers a fascinating critical extension of Dennett's position, using musical nuance as a paradigmatic example of where their approaches diverge. Drawing on thinkers associated with the phenomenological tradition (Merleau-Ponty, 1945; Roholt, 2014), we argue that Raffman and Dennett maintain disembodied and internalist assumptions that prevent them from engaging fully with what the experience of music entails. We then begin to develop a perspective that highlights the primacy of the situated living body for musical consciousness.

Chapter 4 develops this embodied approach further, outlining the importance of the "phenomenological attitude" for enactive music cognition. Here, we introduce some examples intended to engage readers in phenomenological inquiry. These involve the exploration of multi-stable visual and musical phenomena (i.e., Ghanaian polyrhythm). As we show, these experience-based examples reveal observations that align closely with the enactive approach and the 4E framework—most notably that musical cognition requires an active embodied, embedded, and extended engagement with a social and material environment. Following this, we outline an embodied perspective on musical experience. Here we draw on complementary accounts from phenomenological philosophy (Johnson, 2007) and neuroscience (Ramachandran, 2011) to examine how our "metaphorical" ability to enact cross-modal, embodied, affective-emotional relationships forms the basis for what it means to be an experiencing (musical) being.

In chapters 5 and 6, we explore the emotional and empathic aspects of musical experience, respectively. We review some prominent philosophical and psychological approaches, as well as relevant work in embodied music cognition. We then offer an alternative perspective based in the emerging work on emotion and social cognition associated with enactivism (Colombetti, 2014; Gallagher, 2020). This approach trades the focus on neurally instantiated affect programs, internal representations, and simulations for more dynamical interpretations that encompass the contingent moment-to-moment engagements of living systems across multiple time scales. As we argue, this perspective appears to better address the experience of music as a relational phenomenon that involves direct, embodied forms of interactivity between musical agents and their environments. To conclude, we begin to develop a 4E approach to musical empathy and emotion by exploring the ecological concepts of "musical scaffolding" and "empathic space" (Krueger, 2011a,b; Krueger & Szanto, 2016).

In chapter 7, we consider what an enactive approach may reveal about the origins of musicality in the human phenotype. The field of evolutionary musicology has tended to divide into two main positions: those who argue that music should be understood as a naturally selected adaptation and those who claim that music is a product of culture with little or no relevance for the survival of the species. In light of this, we consider a recent "biocultural" proposal that appears to offer a way though this apparent dichotomy as it posits a more integrated model that sees biological and cultural dimensions as aspects of the same evolving system (Tomlinson, 2015). Here we make connections between the biocultural approach and the enactive perspective, exploring possibilities for how a 4E framework can help us think about the ways (proto)musical behavior could have emerged within the material environments and social spaces that were inhabited and shaped by our prehuman ancestors.

In chapter 8, we discuss musical development in infancy and childhood. In doing so, we examine the central role played by the active sense-making body—highlighting the ways in which infants and children actively pursue developing relationships between manipulated objects and the forms of sound making they afford and how this develops into patterns of behavior that become meaningful over time. In chapter 9, these insights are developed toward an enactive approach to musical creativity. Here we consider how dynamical processes of adaptive body-brain-environment interactivity drive musical creativity across a range of contexts, leading to a 4E perspective that extends the idea of "musical creativity" beyond the personal (inner) domain of musical agents and out into the material and social worlds they inhabit and influence.

Chapter 10 concludes with an exploration of the practical and ethical implications of an enactive approach to the musical mind. Here we explore how musicality, understood as human manifestation of the biological processes of autopoiesis, autonomy, and sense-making, can reveal important aspects of human being and knowing that are often lost or obscured in the modern, technologically driven world. This, we argue, may have profound implications for thought and action in the areas of music education and community music, music therapy, and for the ways we engage with music in everyday life.

In all, we hope that this book will help spark conversations and inspire new approaches to research in academic environments. But equally we hope that the ideas offered here are useful to those who wish to reflect on their own relationship with music and what it means to them in the context of their daily lives. Indeed, our intention is not to provide the final word on the musical mind, nor to debunk or supplant the other perspectives we discuss. Rather, we wish to introduce a compelling new way of thinking about the nature and meaning of human musicality that aligns closely with the actual experience of music in human life. We hope, then, that the ideas and possibilities offered in this book will be interesting and provocative; that they will inspire critical feedback and future refinements; and that this will lead to richer understandings of the complex range of action, thought, and experience we associate with the words "music" and "mind." We should also note that many of the chapters that make up this volume began as academic journal articles. So, in addition to our collaborative efforts, the discussion that follows owes a great deal to the many peer reviewers who helped us sharpen our arguments, to the colleagues and friends who read and commented on chapter drafts, and to other coauthors who provided ideas that influenced our thinking. These contributions are indicated in the first end note of each chapter (and in the acknowledgment). We can now move on to explore the basic concepts associated with the enactive approach to mind.

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