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MUSIC AND THE SPECTACLE OF ARTIFICIAL LIFE

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ABSTRACT

"Music and the Spectacle of Artificial Life" examines how mechanical experiments since the Enlightenment have used music to explain, affirm, and challenge the relationship between the material body and immaterial mind. Since Descartes, natural philosophers and scientists have imagined the human body and mind in mechanical terms, creating machines that attempted to simulate, and thereby reveal, a material origin for human life. These experiments were often conceived in musical terms, leading to automata, androids, toys, computers, artificial intelligences and neural networks that reproduced the actions of musical subjects. I analyze the reception of these machines to show how many philosophers, engineers, and critics heard mechanical music not only prove a machine's capacity mimic the bodily affordances enabling music (the fingers of the instrumentalist, the voice of the singer, and even the brain of the composer) but simulate the mind's embodied experience of interpreting, performing and feeling music. The spectacle of music enacted a spectacle of cognition.

In case studies dealing with inventions by Jacques de Vaucanson and David Cope, I show how materialist models of cognition and consciousness were contingent on the aesthetic actions of machines, presenting mechanical minds that listeners could hear and evaluate musically. Chapter One investigates the spectacle of Vaucanson's automaton flutist (1737), a machine that provoked philosophers like Denis Diderot, Julien Offray de la Mettrie, and Étienne Bonnot de Condillac to imagine a mechanical model for the origin of language—a prelapsarian utterance that these thinkers associated with the first

emergence of human intelligence. Chapter Two follows Vaucanson's machine into the nineteenth century when the automaton's then-outdated technologies—which represented unerring reproducibility, internal self-regulation, and even uncanny action—were heard as potent tools for reimagining both human subjects and their subjectivity in post-Revolutionary Europe. Finally, Chapter Three examines the "musical intelligence" of Cope's AI-powered composition software, Experiments in Musical Intelligence ("EMI"). Though many commentators considered EMI a radical break from Romantic subjectivity, I argue that it showcased the continuities between nineteenth-century idealism and twentieth-century computational materialism.

By listening to the intersection of music and artificial life, this dissertation complicates a conception of Enlightenment ideology that celebrates the unwavering progress made by the sciences towards perfect materialist understanding. Instead, by taking the musical spectacles of artificial life seriously, I illuminate a history of cognitive science that was often unscientific, rife with contradictory claims from audiences who observed one thing and heard another. By embracing these aesthetic contradictions rather than dismissing them, this dissertation functions less as a scientific history of music and more as a musical history of science—a history that accepts listening itself as a viable site for understanding body and mind together.

INTRODUCTION

ANDROID MUSICOLOGY

> Olympia played the harpsichord with great dexterity, and sang a virtuoso piece, with a voice like the sound of a glass bell, clear and almost piercing. Nathaniel was quite enraptured…he saw with what a longing glance she gazed towards him, and how every note of her song plainly sprang from that loving glance, whose fire penetrated his inmost soul.[1]
>
> E. T. A. Hoffmann, "The Sandman" (1816)

In a famous scene from E. T. A. Hoffmann's short story "The Sandman" (1816), the automaton Olympia stages a seeming conflict between automatic action and sensuous perception when she uses her brilliant keyboard and singing skills to seduce a man, Nathaniel. On the one hand, Hoffmann's machine reflects the goals of eighteenth-century automata design. Its musical actions were conceived as complements to the biological sciences, enabling a physiology that was thought to explain the mechanisms of human music-making. Simulation, in this context, constituted a form of knowing, making the Enlightenment automaton part of a utopian quest to recreate, and thus understand, the human. On the other hand, Hoffmann presents Olympia's musical simulations as a

[1] E. T. A. Hoffmann, "The Sandman," in Selected Writings of E. T. A. Hoffmann, trans. Leonard J. Kent and Elizabeth C. Knight (Chicago: University of Chicago Press, 1969), 12.

transgression of what can and cannot be reproduced by a machine. Nathaniel does not disinterestedly observe the music performed by Olympia's harpsichord-playing fingers or aria-singing voice, but is "enraptured" by it, perceiving "in every note" a song sprung from "that loving glance, whose fire penetrated his inmost soul." Music enables Nathaniel to imagine a mind that went beyond the automaton's physical body. From these mechanical melodies, Nathaniel believes that he senses a soul capable of autonomously thinking, acting, and reciprocating his love.

Hoffmann's fantasy reminds us that music has long been a potent tool for explaining, affirming, and complicating relationships between matter and spirit—what contemporary philosophers call the "mind-body problem." The mind-body problem arises from a crisis of observation: What is the relationship between the unobservable mind and observable body? How are seemingly immaterial thoughts, beliefs, ideas, intelligence, and consciousness enabled by and enacted through bodily processes? Is there a connection between the subjective experiences we feel ourselves and the embodied actions we observe in others? Can the immortal soul or immaterial mind be materialized? "The Sandman" addresses these problems of mind and body through mechanically-made music. To Nathaniel, Olympia's melodies are not merely beautiful but personal. The automaton enacts a sentimentality and soulfulness that seemed inseparable from its interiority, a "sonic self," says Naomi Cumming, that seamlessly connects embodied actions to mindful intentions.[2] Yet, as Cumming notes, the sonic self is also a

[2] Naomi Cumming, *The Sonic Self: Musical Subjectivity and Signification* (Bloomington: Indiana University Press, 2000).

performative fiction. It arises from a self-conscious effort to enact one's presence through cultural and social forms, a self-expression exemplified by the instrumentalist who endlessly drills a phrase until their musicality is instinctive, or the singer who trains their vibrato to waver on the knife's edge of automaticity (too mechanical) and schmaltz (too sentimental). The sonic self, then, is a fantasy of a body that transcends itself musically, transmuting the limitations and affordance of matter into pure, immediate spirit.

Olympia rebuked and participated in the fantasy of the sonic self. Like all machines, its actions are governed by material gears and mechanisms, yet the mechanical reproducibility of its music seemed neither mechanical nor reproducible to Nathaniel. Olympia's music and automaticity are at cross purposes, enabling an irreconcilable assemblage of machine and spirit that defies simple explanation. Hoffmann only resolved this paradox in Nathaniel's final encounter with the automaton, after its mechanical body is broken, and its eyes violently removed. As if visually confirming the subjectivity he first heard musically, Nathaniel peers into the automaton's head through its gaping eye socket, but he sees nothing. No interiority, no consciousness, no sonic self—only darkness. Witnessing firsthand the irreconcilability of Olympia's mechanical body and nonexistent mind, Nathaniel goes insane.

Android Musicology

This dissertation is about listeners' relationships with artificial lives like Olympia, the machines both real and imagined that addressed the mind-body problem by simulating the actions of musical subjects: playing instruments, singing songs, and even composing

symphonies. Since at least the eighteenth century, music has inspired inventors, natural philosophers, and computer programmers to not merely imagine the mechanisms of music, but also theorize the broader mechanisms of thought.[3] The result was an impulse I call *android musicology*, a scientific inquiry into the human founded on musical criticism of the nonhuman. Android musicology refers to an informal cluster of practices that thinkers used to blur the distinction between humanistic criticism, technological engineering, and scientific observation. I argue that the musical machines discussed in this dissertation were conceived as experiments in android musicology. They simulated a humanity co-constitutive of mechanism and music, enabling a critical apparatus for relating the staunch materialism of the android to the mind-body dualism of music criticism.

Of course, the methods cultivated by practitioners of android musicology little resemble modern conceptions of musicology and androids. The term "android" today denotes an object of science fiction—those mechanical beings who occupied the fantasy worlds of Philip K. Dick and George Lucas—but its modern use originated during the Enlightenment to describe automata that imitate the appearance and actions of humans.[4]

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[3] It is important to note that mechanical music and musical automata were unique to neither the Enlightenment nor the Western world. Nearly a millennium before Hoffmann described Olympia, the ninth-century Persian scholars, the Banū Mūsā brothers, illustrated a variety of mechanical instruments in their *Book of Ingenious Devices*, including an automatic flute player that is thought to be the first reprogrammable machine. Similarly, the twelfth-century Muslim polymath, Badīʿ az-Zaman Abu l-ʿIzz ibn Ismāʿīl ibn ar-Razāz al-Jazarī wrote *The Book of Knowledge of Ingenious Mechanical Devices,* which describes one hundred mechanical devices, including an automatic musical band with two harpists, a flutist, and a drummer.

[4] The term dates back to Ephraim Chamber's 1728 *Cyclopaedia*, where it describes the talking head allegedly created by the Dominican friar Albertus Magnus in the thirteenth century. The term was reproduced forty years later in the first volume of Diderot and D'Alembert's *Encyclopédie*. Their article defines the *androide* as "an automaton with a human form that, with certain well-designed mechanical means and other functions, will mimic the exterior functioning of man." Although Diderot and D'Alembert discuss Albertus Magnus's brazen head, they devote most of their article to Jacques

As historians like Minsoo Kang and Catherine Liu have noted, the android was a pivotal agent of humans' self-knowledge during this period, acting as a mechanical proxy for humans' first steps towards anatomical and cognitive understanding.[5] Although this dissertation expands beyond a narrow definition of the android as a subset of the automaton, I retain a central feature of the eighteenth-century definition by focusing on mechanical imitation, expanding the ideals of the Enlightenment android to encompass three hundred years of evolving technologies for mimicking human music-making. These experiments, then, included not only traditional androids and automata, but also musical instruments, toys, computers, symbolic artificial intelligences, and neural networks—mechanical music-makers that I unite under the broad category of "artificial life."

Modern historians of science have long studied these artificial life experiments, but they often neglect the role music played on such machines. Instead, their scholarship tacitly imagines these musical technologies as mute, severing the mechanisms of the machine from the aesthetics observed and judged by spectators. This disregard for mechanical music has not only contributed to a widespread misperception that practitioners of artificial life (A-life) were uninterested in aesthetics, but also severed aesthetic concerns from scientific models of life, artificial or otherwise. In actuality, the history of artificial life reveals a vibrant conversation between music aesthetics and the

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de Vaucanson's automaton flautist. See Denis Diderot and Jean Le Rond D'Alembert, "Androide [Méchanique]," in *Encyclopédie ou Dictionnaire raisonné des sciences, des arts et des métiers.*, ed. Denis Diderot and Jean Le Rond D'Alembert (Paris: Chez Briasson, 1765).

[5] Minsoo Kang, *Sublime Dreams of Living Machines: The Automaton in the European Imagination* (Cambridge, MA.: Harvard University Press, 2011); Catherine Liu, *Copying Machines: Taking Notes for the Automaton* (Minneapolis: University of Minnesota Press, 2000).

life sciences. At great effort, expense, and ingenuity, these thinkers, like the eighteenth-century French inventor Jacques de Vaucanson (who constructed the first modern android) and the contemporary composer and programmer David Cope, built performative subjectivities that brought the nonhuman into conversation with human biologies and cultures,. In this regard, my research should be read as part of a larger intervention in the humanities to take seriously how mechanical models of art influenced scientific models of life.[6] Artistic expression was conceived of as self-expression. Listeners were encouraged to identify with these objects, hearing in mechanical music a shared cultural, embodied, and emotional vocabulary that they recognized as intimately connected to the self.

A-life creators, I argue, were the first android musicologists. They voiced theories about humanity via analytic methods germane to their conceptions of music criticism. Here, musicology is defined broadly, pertaining less to the origins of the German *Musikwissenschaft* or Anglo-American musicology as disciplines of historical scholarship and humanistic inquiry taught at modern research universities. Instead, the anachronisms of android musicology illuminate a larger transhistorical yearning to

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[6] For just a small sample of this work, see **[music]** Deirdre Loughridge, "Science, Technology, and Love in Late Eighteenth-Century Opera," in *Nineteenth-Century Opera and the Scientific Imagination*, ed. David Trippett and Benjamin Walton (Cambridge, UK: Cambridge University Press, 2019), 175–98; James Q. Davies, *Romantic Anatomies of Performance* (Berkeley: University of California Press, 2014); Jennifer Iverson, *Electronic Inspirations: Technologies of the Cold War Musical Avant-Garde*, The New Cultural History of Music (New York, NY: Oxford University Press, 2019). **[English literature]:** Robert Mitchell, *Experimental Life: Vitalism in Romantic Science and Literature* (Baltimore: The Johns Hopkins University Press, 2013); Mark Coeckelbergh, *New Romantic Cyborgs: Romanticism, Information Technology, and the End of the Machine* (Cambridge, MA: The MIT Press, 2017); Patrick Jagoda, *Network Aesthetics* (Chicago: University of Chicago Press, 2016); Avery Slater, "CRYPTO-MONOLINGUALISM," *Amodern* (blog), January 2018, http://amodern.net/article/crypto-monolingualism/. **[Visual arts]:** Marcus Du Sautoy, *The Creativity Code: Art and Innovation in the Age of AI* (Cambridge, MA: Harvard University Press, 2020); Roald Hoffmann and Iain Boyd Whyte, *Beyond the Finite: The Sublime in Art and Science* (New York: Oxford University Press, 2011).

understand the human by thinking critically and scientifically about mechanical music—an impulse articulated by musicians, natural philosophers, and engineers long before musicology was institutionalized by the academy. Note that I am not suggesting that these engineers were consistently *good* musicologists, or that their analyses were unbiased or even consistent. Neither am I suggesting that music was always the best avenue for studying the human. Indeed, music criticism has led many otherwise responsible researchers to surprising (and easily disproven) assumptions about humanity.[7] Instead, by depicting A-life as a musicological practice, I show that the ongoing quest to mechanically engineer human life was bounded by many of the same contingencies as Cumming's sonic self—a subjectivity transcended and embodied, an emergent self that is enabled by artistic successes and ruined by artistic failure. Thus, while materialists of both past and present explained these experiments by breaking mechanical actions down into their constituent parts, my attention to android musicology rejects this atomism so as to embrace the complexity of diverse musical experiences. The result, I show, was a more delicate negotiation of observation and inference, an aesthetic experience that was not merely heard autonomously but felt, understood, and embodied relationally, allowing even the machine to participate in the cultural practices that unite all music makers.

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[7] Perhaps nowhere is the legacy of Western music more problematic than in collisions between musical aesthetics and biological theories of otherness. This includes musical orientalism, primitivism, negrophilia, and other discourses of musical difference in which so-called unnatural sounds are taken as evidence of cognitive or bodily shortcoming. These misperceptions are best encapsulated in Holly Watkins gloss on Hanslick's distrust of the body and affect; "If you wish to be civilized, ignore your body when listening to music, shut down the affective mechanisms responsible for transforming musical sound into subjective feeling. Such an achievement, if that is what it is, depends on channeling physical sensations into the safer territory of appraising intellect." Holly Watkins, *Musical Vitalities: Ventures in a Biotic Aesthetics of Music* (Chicago: The University of Chicago Press, 2018), 120.

At the heart of the musicological treatment of artificial life is a radically different way of organizing the modern mind-body problem where music acts as a tool for engaging what David Chalmers has called "the hard problem" of consciousness. Chalmers describes a "Great Divide" in studies of mind and consciousness, a split between "easy" solutions, which portray consciousness as an effect of brain chemistry, and the "hard problem" that takes personal, conscious experiences seriously. The former involves objective brain scans and computer models of *other* minds; the latter is subjective, borne of intuition and introspection of the self. As Chalmers explains:

> Conscious experience is at once the most familiar thing in the world and the most mysterious. There is nothing we know about more directly than consciousness, but it is far from clear how to reconcile it with everything else we know…We know consciousness far more intimately than we know the rest of the world, but we understand the rest of the world far better than we understand consciousness.[8]

The great divide of consciousness research, admits Chalmers, spans the border of science and philosophy. While the everyday experience of mind demands scientific investigation, the mind simultaneously thwarts traditional scientific methods.[9]

In the remainder of this introduction, I explain how musical performances of artificial life were imagined to offer an escape from this conundrum. For diverse thinkers since the Enlightenment and across the Western world, scientific observation and

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[8] David John Chalmers, *The Conscious Mind: In Search of a Fundamental Theory* (New York: Oxford University Press, 1996), 3.

[9] Chalmers explains that "The problem of consciousness lies uneasily at the border of science and philosophy. I would say that it is properly a scientific subject matter: it is a natural phenomenon like motion, life, and cognition, and calls out for explanation in the way that these do. But it is not open to investigation by the usual scientific methods. Everyday scientific methodology has trouble getting a grip on it, not least because of the difficulties in observing the phenomenon. Ibid., xix.

aesthetic criticism were two sides of the same coin, with musical ears augmenting scientific eyes. For some, like Hoffmann's Olympia, music renegotiated the divide between matter and spirit. Indeed, Nathaniel becomes insane when he finally realized that both the automaton and its music were deceptive—that they originated from unfeeling mechanisms rather than vibrant, feeling matter. Hoffmann, as author and music critic, was not denying all music the capacity to enrapture or ensorcel a listener—for his take on music-as-spirit, look no further than his vaunted review of Beethoven's Fifth Symphony. Instead, he moralized the automaton's musical communication as a pale imitation of human activity, demonizing its sound as a form of unnatural necromancy that he elsewhere called a "living-dead."[10] For others, music revealed the parity (or at least the similarities) between human and nonhuman. Diverse artists, like the nineteenth-century writer Achim von Arnim and the twenty-first-century filmmaker Spike Jonze, imagined dualistic machines that signaled their human-equivalent consciousnesses through music.[11] Other intellectuals—like the French *philosophe* Denis Diderot and his contemporary, the physician Julien Offray de la Mettrie as well as the American cognitive scientist Douglas Hofstadter—heard mechanical music demonstrate the opposite: there is no consciousness or mind; it is matter all the way down.

Whether mechanical music verifies the hard problem of consciousness or easy solution of cognitive science, android musicology offers a compelling model of the mind

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[10] Katherine Maree Hirt, *When Machines Play Chopin: Musical Spirit and Automation in Nineteenth-Century German Literature*, (Berlin: Walter de Gruyter, 2010), 47.

[11] Through song, subjects like Jonze's Samantha and Arnim's flute-playing automaton gave voice to complex emotions like love and lament, desire and depression, acts of melody-making that strengthened their relationship with listeners.

because it *feels* intuitive. It relies on an aesthetic sensibility that listeners have cultivated in their everyday listening. When we listen to a Bach prelude or a Charlie Parker solo, for example, we identify with these music-makers because their music seems to arise from a subjective well that feels intimately familiar—even as the recording or performance leaves an objective impression on the world.[12] While we might scoff at Hoffmann's Nathaniel for failing to notice Olympia's deception, Nathaniel's error is one that even the most attentive listener makes from time to time—especially in today's increasingly digital world. By acknowledging that we too can be seduced by the humanity of mechanical music, this dissertation considers what musical misperception says about *our* subjecthood. Does mechanical music evince the machine's being? Does it validate or disprove our own? Or is the machine's melody nothing more than a mechanical trifle, one categorically different from human-produced artworks? In asking these questions of our mechanical encounters, we too become android musicologists.

Modernity and the Mind-Body Problem

In his 1993 monograph, *We Have Never Been Modern*, the cultural anthropologist Bruno Latour complicates what is generally imagined to be a clean separation between the pre-modern and modern eras. The pre-modern world before 1700 upheld the fundamental dualism between matter and spirit, the former being mundane, understandable, and

[12] Steven Smith unpacks this musical identification in blues music, describing it in clear terms; "We are riveted by the presented experience, but we do not just suffer from it; it is formed in such a way that we can hold and handle it, that is, it has objectivity, and so is checkable and shareable. Since it carries objectivity (a showing) and conviction (a licence) both, we 'know' it. We know that we are our bodies and also some fearing-and-hoping other thing." Steven G. Smith, "Blues and Our Mind-Body Problem," *Popular Music* 11, no. 1 (1992): 50.

eminently knowable, while the latter was magical, mysterious, and beyond human comprehension. Consider, for example the fifteenth-century French chanson, *Le Pèlerinage de Charlemagne* (The Voyage of Charlemagne), which describes a fictional encounter between the King Charlemagne and a series of automata. As the medievalist E. R. Truitt has written, Charlemagne and his knights receive the uncanny machines as evidence of an otherworldly force that appeared to outstrip the knowable certainty of the mechanisms.[13] This very otherworldliness, notes the historian Jessica Riskin, led many automata before the seventeenth century to assume a prominent place in the Church, where machines were used to stage for parishioners a variety of sacred and occult magics from Christian liturgy: church clocks that re-enacted miracles from the bible and organs affixed with mechanical angels that simulated the playing of horns, drums, and carillons. As Riskin explains, these premodern machines reconciled the modern world's seemingly irreconcilable tension between knowable mechanics and unfathomable divinity: "Mechanization is often taken as an index of modernization. But the automaton icons had a medieval impetus in a tradition of imagery in which the tangible, visible, earthly

[13] E. R. Truitt, *Medieval Robots: Mechanism, Magic, Nature, and Art*, *Medieval Robots* (PLACE: University of Pennsylvania Press, 2015), 53, https://penn-degruyter-com.proxy.uchicago.edu/view/title/510660. Truitt cites the following passage from the chanson: "The palace was vaulted with a dome on top: / It was built with great care and put up with art; / Its central column was inlaid with silver; / One hundred pillars of solid marble stand there, / Each one inlaid with fine gold in front. / Two brass and metal children flank it, / Each holding in his mouth a horn of white ivory. / If there blow from the sea nor'westerlies, northerlies or other winds / Which strike the palace on its western side, / They make it turn as swift and continuous / As the wheel of a vehicle going downhill. / These horns then resound and bellow and boom / Like drums or thunder or great hanging bells; / Then [the statues] face each other and laugh / So that you would think they were alive." *The Voyage of Charlemagne* quoted and translated in Michael J. T. Lewis, "The Greeks and the Early Windmill," in *History of Technology*, ed. Graham Hollister-Short and Frank James, vol. 15 (London: Bloomsbury Publishing, 1993).

representations of Christian lore and doctrine were pushed even farther. The icons were representations in motion, inspirited statues."[14]

For Latour the eventual split between mechanization and divinity was a modern innovation in which spirit was purged from matter in an enlightened bid to profligate rationalism, scientific observation, and objective truth. The problem with modernity, notes Latour, is that its celebration of Enlightened, objective observation—what Thomas Nagel called the "view from nowhere"—draws too sharp a distinction between natural and social phenomena.[15] Modern sciences like biology and chemistry conceive of a natural world reducible to the movement and modification of matter. And at the same time, those very sciences largely neglect the social world, relegating its cultural and discursive immaterialities to the domains of the arts, humanities, religion, and social sciences.[16] In doing away with the matter-spirit dualism of the pre-modern period, modernism robbed us of our capacity to recognize how natural phenomena inform the social, and how social phenomena inform the natural.[17]

The mind-body problem offers perhaps the clearest example of modern science's propensity to materialize the natural and ignore the social. The origin of the modern

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[14] These enchantments could have both negative and positive valences. The divine music of automaton angels was joined by countless instances of mechanical devils, beasts, and other simulacra of hell. Riskin describes machines, like one organ in Barcelona, fitted with the mechanical head of a moor hung by its turban. When the music was played softly, it "made mild facial expressions" which soon became more tortured ("it rolled its eyes and grimaced as though in pain") as the instrument played louder. Jessica Riskin, "Machines in the Garden," *Republics of Letters* 1, no. 2 (February 2010): 27.
[15] Thomas Nagel, *The View From Nowhere* (New York: Oxford University Press, 1989).
[16] There are notable exceptions to this dichotomy, like the psychological practices of Freudian psychoanalysis, which fixate on the immaterial actions of the unconscious. Freud and his students, however, are often the exception that proves the rule: much of psychology, from William James' work on experimental psychology, B.F. Skinner's behaviorism, and modern cognitive psychology have sought to dismiss the immaterial dimensions of soul or unconscious from psychological practice.
[17] Bruno Latour, *We Have Never Been Modern* (Cambridge, MA: Harvard University Press, 1993).

mind-body problem comes from the French philosopher René Descartes, who reduced the bodies and actions of humankind to a set of mechanical principals. Although Descartes is today known for upholding a decidedly pre-modern separation of body and soul, historians like Jessica Riskin, George Makari, and Gaby Wood each explain how the philosopher laid the groundwork for the eradication of that soul over the next three centuries.[18] Makari, for instance, describes how Descartes' metaphor of the machine-man allowed contemporaries to reconceive human agency as a mechanical process housed within the body rather than an external process governed by God's intervention. Human behaviors could now be understood as a biological response: needing energy, humans eat; having thirst, they drink; feeling pain and pleasure, they avoid pain and gravitate towards pleasure. While Descartes is oft-criticized today for denying the soul to animals, dismissing them as mere automata, Makari portrays him as a progenitor of a materialism that would eventually deny all souls, thereby conflating humans, animals, and machines—an intellectual lineage connecting him to Hobbes, Locke, Rousseau, Lamarck, Darwin, and Turing.

Descartes's philosophy helped precipitate a shift in the debate about mind and body, transforming it from a theological conversation about souls to a scientific inquiry about minds.[19] Thus, although Descartes today is portrayed as the founder of rationalism,

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[18] Jessica Riskin, *The Restless Clock: A History of the Centuries-Long Argument over What Makes Living Things Tick* (Chicago: The University of Chicago Press, 2016); George Makari, *Soul Machine: The Invention of the Modern Mind*, First edition. (New York, NY: W. W. Norton & Company, Inc., 2015).; Gaby Wood, *Edison's Eve: A Magical History of the Quest for Mechanical Life* (New York: Alfred A. Knopf, 2002).

[19] For the French philosopher, the body and mind are connected, yet separate. They are connected because Cartesian philosophy demands the soul's intervention over the body's short-term impulses and passions. Nevertheless, the pair are separate because they are comprised of two opposing substances: a soul of purely mental *res cogitans*, and a material

he enabled a science of the soul grounded in empiricism.[20] After all, it was in his first meditation that he discovered his soul by objectifying his own subjective thoughts: *Cogito ergo sum*—I think, therefore I am. Descartes's famous phrase will become a leitmotif throughout this dissertation, but not always in the dualistic context most famously proposed by the philosopher in 1637. Instead, when later philosophers were forced to resolve the mind-body problem opened by Cartesian philosophy, they often mutated the phrase to imagine *cogito* in more material terms, as something that one could observe, manipulate, or even rebuild. "I think therefore I sum," claimed the cognitive scientist Douglas Hofstadter, as he compared the cognitive processes of the brain to the algorithmic processes of a computer. "I sense, therefore I am," wrote science writer Michael Cross in a 1998 article documenting the quest to program an AI to appreciate subjective qualia. Or, in the bastardized Latin pun that presciently encapsulates the materialist worldview, "Cogito eggo sum"—I think, therefore I'm a waffle.[21]

Still, perhaps the most thought-provoking riff on Descartes' "I think…" came early on from a 1774 invention by father and son watchmakers, Pierre and Henri-Louis Jaquet-Droz, who created an automaton that could hold a pen and write sentences of up to forty

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body of *res extensa*. Descartes struggled throughout his life to convincingly explain how *res extensa* and *res cogitans* could be connected in concrete terms.

[20] The incompatibility of mind and body has not only defined the terms of the modern mind-body debate, but it upset the balance between matter and spirit for the sciences as a whole. As Latour explains, "Descartes' mind requires an artificial life support if it is to keep beating all the way through. Only a mind put in the strangest position, looking at a world *from the inside out* and linked to the outside by nothing but the tenuous connection of the *gaze*, will throb in the constant fear of losing reality; only such a bodiless observer will desperately look for some absolute life-supporting survival kit." Bruno Latour, *Pandora's Hope: Essays on the Reality of Science Studies* (Cambridge, MA: Harvard University Press, 1999), 4.

[21] Douglas R. Hofstadter, *Gödel, Escher, Bach: An Eternal Golden Braid* (New York: Basic Books, 1979), 340; Michael Cross, "I Sense Therefore I Am," New Scientist, accessed May 7, 2020, https://www.newscientist.com/article/mg16021626-500-i-sense-therefore-i-am/.

characters long. Although the machine has written many messages in its almost two-hundred-and-fifty-year existence, the most well-known takes a subtle dig at Descartes's legacy: "Je pense, donc je suis"—I think, therefore I am. The irony of the automaton's message, of course, was its explicit lack of cognition. Unlike the opaque interiority of the Cartesian *cogito*, the Jaquet-Droz writer showcased a subjective mind, an "I," that could be observed, both indirectly from the written utterances on the page, and directly from the internal mechanisms powering its writing. Onlookers could witness its "I-ness" unfold in real-time. They could open it up, disassemble it, reprogram it, and even rebuild it from scratch, as if its immaterial mind were easily materialized and manipulated by gears and cogs.

Figure 0.1: : Pierre and Henri-Louis Jaquet-Droz, L'Écrivain, Neuchâtel, 1774. SOURCE Musée d'Art et d'Histoire de Neuchâtel "Détail," Mahn, accessed June 12, 2020, https://www.mahn.ch/collections/detail/collection/horlogerie-et-orfevrerie/.

Figure 0.2: A close-up of **Pierre and Henri-Louis Jaquet-Droz,** *L'Écrivain writing the phrase "Jaquet Droz Enchanted Journey à moi" SOURCE Screenshot from "The Writer By Pierre Jaquet Droz," Jaquet Droz, accessed June 12, 2020, https://www.jaquet-droz.tv/video/9308963/the-writer-by-pierre-jaquet-droz.*

In this era of ubiquitous mechanical reproduction and cybernetic simulation, Jaquet-Droz's writer may seem quaint—a bygone science fiction that we have since overtaken, like the *Voyages extraordinaires* of Jules Verne, or the communicator of *Star Trek*. Nevertheless, by mechanically reproducing Descartes's immortal phrase, the machine's joke exposed a problem at the heart of the modern mind-body relationship: how do thoughts relate to actions? In everyday life, the relationship between thoughts and actions is often perceived to be immediate. Likely, you are reading my text and unconsciously imagining these words to have organically originated from my mind. The entire exchange likely seems immediate, a "mind-mind game," says musicologist Suzanne

Cusick, in which the thoughts in my head are beamed right into your head.[22] Still, as the Jaquet-Droz writer illuminates, the immediacy of this mind-mind transference is more a "polite convention" than an objective fact.[23] In actuality, you cannot directly perceive the content of my immaterial mind. I could be lying, tricking you into believing I think these things. I could be an artificial intelligence, or an automaton like the Jaquet-Droz scribe, a robotic writer whose words are mechanically produced. Or even more profoundly, I could be tricking myself, communicating as if I were a self-possessed thinking subject.

I fixate on these scenarios to showcase how Jaquet-Droz's eighteenth-century automaton problematized the distance between thought and action as a problem of mind and body, staging a gulf between the first-person "I" that Descartes used to prove his soul and the third-person "I" the automaton scrawled on the page. The automaton's joke was to make Descartes, the vaunted progenitor of the mind-body split, seem like an automaton himself, a being of pure body tricked into believing the fantasy of the *cogito*. And at the same time, by borrowing the Cartesian motto, the automaton made itself seem a little more like Descartes, not merely parroting the French philosopher's writings but posing, through its very existence, the questions Descartes dedicated his life to answering: Are immaterial thoughts and material actions two sides of the same coin? Does the machine's simulation of Descartes's writing recreate Descartes's mind? And how

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[22] Suzanne G. Cusick, "Feminist Theory, Music Theory, and the Mind/Body Problem," *Perspectives of New Music* 32, no. 1 (1994): 8–27, https://doi.org/10.2307/833149.

[23] Alan Turing uses the phrase "polite convention" in the context of what he calls the solipsist point of view addressing attacks against his imitation game, the test he proposed to evaluate artificial intelligence. He explains, "It may be the most logical view to hold but it makes communication of ideas difficult. A is liable to believe 'A thinks but B does not' whilst B believes 'B thinks but A does not'. Instead of arguing continually over this point it is usual to *have the polite convention* that everyone thinks." Alan Turing, "Computing Machinery and Intelligence," in *The Philosophy of Artificial Intelligence*, ed. Margaret A. Boden (Oxford, UK: Oxford University Press, 1950), 446.

is Descartes's mind (the human mind) created in the first place? Could a better machine (with more complex mechanisms or more convincing actions) better enable the Cartesian consciousness? Or is the gulf between thought and action unbridgeable? Jaquet-Droz's automaton even asked these questions for itself, scrawling in one of its lesser-known notes: "I do not think, do I not therefore exist?"[24]

Artificial Life and Music

The relationship between Jaquet-Droz's writer and Cartesian philosophy demonstrates how technology became a central site for conversations about the mind-body relationship after Descartes. This impulse resulted in a desire to make life-like machines, "artificial life." "Artificial life" first emerged as an academic field in the 1980s by the theoretical biologist Christopher Langton who configured it to broadly study "the synthetic approach to biology: rather than take things apart, Artificial Life attempts to put living things together."[25] Langton avoids narrowly defining "life" in concrete terms, but the field traditionally focuses on the living processes enacted by nonhuman and nonintelligent systems. These experiments include everything from computer simulations of biological processes like cell division, mathematical equations for predicting the migratory patterns of animals, bioengineered chemicals that synthesize cellular systems, and mechanical hardware to robotize moving bodies. Given the breadth of this research, A-Life practitioners often distinguish their work from the narrower study of artificial

[24] Quoted in Gaby Wood, *Edison's Eve: A Magical History of the Quest for Mechanical Life*, 8.
[25] Christopher Langton, "Artificial Life," in *The Philosophy of Artificial Life*, ed. Margaret A. Boden (Oxford, UK: Oxford University Press, 1996), 40.

intelligence, focusing on simulating unconscious, biological processes rather than conscious, intelligent behaviors.

I take a more holistic view of artificial life, repurposing the term to encompass the cultural impulses across history to create life in all of its forms, spanning the gamut from inventions like the earliest androids to the most advanced neural networks. Artificial life motivates our earliest myths, as in the Old Testament story of Eve emerging from Adam's rib, the creation of the golem in Jewish folklore, and Pygmalion's sculpting of Galatea in Ovid's *Metamorphoses*. The first sciences, too, were influenced by a yearning to understand and remake life, with early medieval alchemy texts giving detailed (and often horrifying) instructions for making homunculi—miniature, home-brewed humans.[26] Artificial life also has parlance in early modern conversations about mind-body philosophy, as when Descartes's contemporary, Thomas Hobbes, wrote in *Leviathan*, "For seeing life is but a motion of Limbs, the beginning whereof is in some principall part within; why may we not say, that all Automata (Engines that move themselves by springs and wheeles as doth a watch) have an artificiall life?"[27] Even Descartes became entwined with fantasies of artificial life—although there is no record of him using that precise term.

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[26] In *Unnatural: The Heretical Idea of Making People*, Philip Ball describes one such recipe from a treatise called *The Book of the Cow*, which gives detail instruction of how to create an artificial cow. "A cow is killed and beheaded, the head reattached, and the orifices sewn shut. Then the body is beaten with a large dog's penis until all the bones are broken…a 'marrow-like' substance is extracted from the body, ground up with herbs, and left to putrefy while being occasionally sprinkled with powdered bees. If this process is conducted in reverse, a living cow can be regenerated." (41)

[27] Notably, Hobbes's notion of the Leviathan—the metaphor of the state—is itself portrayed as a form of artificial life. "For by Art is created that great Leviathan called a Common-wealth, or State…which is but an Artificiall Man; though of greater stature and strength than the Naturall, for whose protection and defence it was intended; and in which the Soveraignty is an Artifiall Soul, as giving life and motion to the whole body…" Thomas Hobbes, *Leviathan: Or, The Matter, Forme & Power of a Commonwealth, Ecclesiasticall and Civill*, ed. A.R. Waller (Cambridge: Cambridge University Press, 1904), xviii.

As early as 1699, stories began circulating about Descartes's "daughter," a mechanical doll allegedly named after his real daughter, Francine, who had passed away from scarlet fever when she was just five years old. During his final journey to Sweden by sea, Descartes informed the sailors that he was traveling with Francine, but they never saw her. Driven by curiosity, the sailors stole into Descartes's cabin and found no girl but a mysterious box containing a life-sized android, one that Descartes had supposedly built to "move and behave exactly like a human."[28] Sadly, the machine, if it ever existed, is now lost: the horrified sailors threw it overboard.

The term artificial life may seem expressly modern, conjuring *Blade Runner*-like images of futuristic replicants, android societies, and electric sheep—a materialistic world in which Descartes could mechanically resurrect his deceased daughter. Nevertheless, I argue that these imaginings are accompanied by equally longstanding yearnings to provoke the immaterial dimensions of life, recapturing (however contingently) the magic of consciousness, soul, reason, and passion. While modern technologies are often imagined to be essentially passive, with each mechanism dispassionately driving the next like clockwork, A-Life was often imagined exhibiting irrational and expressly nonmechanical drives.

For starters, these experiments often shirk the kinds of productive labor privileged by technologies in the age of modern capitalism—although productive labor was

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[28] Descartes would profess to friends that Francine's death was the "greatest sorrow of his life," lending the story of the mechanical daughter an enticing marriage of Cartesian rationality and Romantic feeling. The story itself seems to have originated from a 1699 work entitled *Mélanges d'histoire et de littérature* by the writer Bonaventure de Vigneul-Marville. For more, see Minsoo Kang, "The Mechanical Daughter of Rene Descartes: The Origin and History of an Intellectual Fable," *Modern Intellectual History* 14, no. 3 (November 2017): 633–60, https://doi.org/10.1017/S147924431600024X.

sometimes a crucial side effect. As the eighteenth-century Enlightenment gave way to the nineteenth-century Industrial Revolution (a period that Peter Jones calls the "industrial Enlightenment"), the perception of technology was transforming from a thing for *showing* to a thing for *doing*.[29] Nevertheless, despite this mechanical transition, the technology of A-Life stubbornly resisted this capitalistic drive, and accordingly, detractors denigrated them as wanton or irrelevant to modern sensibilities. Consider, for instance, Jacques de Vaucanson's automaton flutist from 1737, which I discuss in detail in Chapters One and Two. To make his instrumentalist, Vaucanson repurposed technologies like the camshaft (a rotating pinned cylinder) and weighted bellows to simulate the bodily actions of a human flute player. He subdivided the camshaft to coordinate different aspects of the machine's body, like its mechanical fingers, lips, lungs, and tongue, while the bellows allowed the machine to channel breath-like air into its instrument. While camshafts and bellows served a myriad of productive functions before and after Vaucanson (driving everything from the manufacturing of textiles to the complicated clockwork of timepieces), the flutist's use of these technologies was not "productive" in the modern sense of transforming raw materials into material goods. Instead, at great expense and effort, Vaucanson engineered a mere spectacle, an automaton designed to produce nothing but mechanical music: twelve tunes on an unaltered German flute.

[29] Jones describes this transition as one in which "bodies of useful knowledge were generated and fashioned into effective technologies," largely borne from increased partnerships between the public intellectuals and artisans. Peter Jones, *Industrial Enlightenment: Science, Technology and Culture in Birmingham and the West Midlands, 1760-1820* (Manchester, UK: Manchester University Press, 2008), 111–12.

By many accounts, even Vaucanson was disappointed by the financial gains of his automata. After only a few years, he sold them to an impresario and leveraged his newfound fame to win a lucrative appointment as the master of silk in Lyon. This position allowed him to redirect his knowledge of the camshaft and bellows towards a more material good: a reprogrammable silk loom that allegedly inspired Jacquard's loom. At the same time, modern commentators have mostly ignored the musical automaton. Musicologists historically disregard Vaucanson's flute-player (although that gap in the literature is starting to fill), while historians of science, who have long championed Vaucanson's legacy, neglect the machine's aesthetic dimensions.[30] Vaucanson and his machines are routinely praised for their contributions to robotics, prosthetics, and iatromechanics, but their music too often falls on unhearing ears.[31]

However, if Vaucanson's experiments were strictly iatromechanical endeavors, then why did he expend such efforts on their music? What could technologies like camshafts and weighted bellows reveal about the human body in the first place? I ask these questions not to denigrate the mechanics of A-Life but to challenge a strict materialist conception of such machines. For almost two hundred years, the automaton's music was cited by philosophers, scientists, and musicians eager to understand how

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[30] For a small sample of musicological studies of Vaucanson, see David Gaynor Yearsley, "Bach as Machine," in *Bach and the Meanings of Counterpoint* (Cambridge, UK: Cambridge University Press, 2002), 173–208; Annette Richards, "Automatic Genius: Mozart and the Mechanical Sublime," *Music & Letters* 80, no. 3 (1999): 366–89; Nicholas Mathew and Mary Ann Smart, "Elephants in the Music Room: The Future of Quirk Historicism," *Representations* 132, no. 1 (November 1, 2015): 61–78, https://doi.org/10.1525/rep.2015.132.1.61; Jonathan De Souza, *Music at Hand: Instruments, Bodies, and Cognition*, Oxford Studies in Music Theory (New York, NY: Oxford University Press, 2017).

[31] For a small sample of this musical neglect, see Liu, *Copying Machines*; Kang, *Sublime Dreams of Living Machines*; Riskin, *The Restless Clock*; Daniel Cottom, "The Work of Art in the Age of Mechanical Digestion," *Representations* 66 (April 1, 1999): 52–74.

utterances perpetrated by mechanical organs could be received and understood in musical terms by listeners. While these technologies passively enabled it to make sounds, one senses that their iatromechanical subtleties were less important than the aesthetic actions that listeners heard. Indeed, the spectacle of the automaton's musical body prompted diverse thinkers like la Mettrie, Diderot, and the writer Johann Wolfgang von Goethe to question the origins of sensation, reason, affect, and language.

Throughout this dissertation, I will focus on two distinct boundaries blurred by examples of musical artificial life. On the one hand, the music produced by machines like Vaucanson's automaton flutist stage an *ontological* uncertainty between man and machine, anticipating what the sociologist Andrew Pickering calls "ontological theater." Ontological theater, which I discuss more fully in Chapter Three, refers to a cognition conceived as a performative action rather than as a mechanical process.[32] While Pickering studies the early years of British cybernetics, his theory of ontological theater accurately describes how Vaucanson's eighteenth-century automaton was heard to explain the Enlightened mind without fully recreating it. Here, cognition is a spectacle to behold, rife with aesthetic and affective significance. As ontological theater, Vaucanson's automaton expressed a relationship between the body and mind through music rather than biology. Its mechanical organs did not accurately simulate the anatomical relationships within the body (between cells, organs, and other physiological systems). Instead, it reproduced

[32] Andrew Pickering, *The Cybernetic Brain: Sketches of Another Future* (Chicago: University of Chicago Press, 2010).

social relationships outside the body, producing a sonic self that listeners could hear in profoundly human terms.

And at the same time, if musical artificial life blurs the ontological space described by Pickering, these machines also blur the *social* space, functioning as what sociologists Susan Leigh Star and James Griesemer call "boundary objects," objects flexible enough to straddle disparate communities of practice at once.[33] As boundary objects, the A-Life technologies of this dissertation forge unlikely conversations between disciplines, allowing aesthetic criticism to empower scientific observation, or musicology to constitute a form of neuroscience. Herein lie the roots of android musicology: a kind of re-enchantment, a return to a pre-modern interdisciplinarity when natural philosophers dabbled in artistic criticism, or when massive intellectual endeavors (like Diderot and D'Alembert's *Encyclopédie*) could freely speculate about relationships between matter and spirit, biology and society, objects and subjects, selves and others, bodies and souls, or living and dead.

I do not want to overstate the capacity of A-life or android musicology to dissolve entrenched ontological or social divisions, nor to overly celebrate the Enlightened worldview. Like all theatrical spectacles, ontological theater necessitates a cautious balancing act between showing and hiding, between revealing the material processes of matter and shrouding the mechanisms of spirit. Indeed, if A-Life represents an attempt to materialize the immaterial dimensions of life, that immateriality can easily seem mystical

[33] Geoffrey C. Bowker et al., *Boundary Objects and Beyond: Working with Leigh Star* (Cambridge, MA: MIT Press, 2016).

or supernatural. There is a fine line between the music enacted by Vaucanson's flutist and the uncanny horror provoked by Olympia's musical seduction of Nathaniel. A-Life, then, traffics between conceptual spaces like the modern and nonmodern, the passive and the active, the scientific and the spectacle. This dissertation documents how these experiments enabled audiences to experience the modern world anew, re-enchanting the mundane materiality of life in ways that could surprise, enlighten, and even horrify.

Why Music?

My focus on music and artificial life sits uneasily between disciplinary boundaries, and as a result, it raises skepticism from both humanists and scientists. For skeptics in the sciences, my focus on music and mind appeals to an unscientific folk psychology that is founded on intuition rather than empirical observation. "It's just not researchable," admitted a neuroscientist colleague to me. "We just assume that consciousness arises from the collective action of billions of neurons." Still, many brain researchers will admit that there remain plenty of mysteries about the mind that the sciences have yet to explain fully. As I've discussed, Chalmers describes "the great divide" between the easy and hard questions of consciousness—the former based on objective observation of the brain, the latter on subjective introspection of the mind.[34] The philosopher John Searle attacks materialist theories of mind from a different direction: in striving for an easy solution to

[34] Chalmers, *The Conscious Mind*, 167.

consciousness, philosophers invariably neglect central aspects of conscious experience.[35] The same contingencies mar the changing goal-posts of A-life experiments. As the historian of science Jessica Riskin explains,

> The social, the epistemological, and the economic dimensions of determinations of intelligence were everywhere inseparable. The two categories, human and artificial intelligence, natural and synthetic life, continually redefined one another by opposition. And, yet, the driving force behind the projects of artificial life was the assumption that life could be simulated and that the simulations would be useful by being analogous to natural life, not by being its antithesis. So these categories really redefined one another, not only by opposition, but also by analogy, and the early history of artificial life was driven by two contradictory forces: the impulse to simulate and the conviction that simulation was ultimately impossible.[36]

From the perspective of humanists, these competing drives of artificial life research—the optimism that life can be rebuilt and the accompanying reality that it cannot—represent the competing drives of a world still grappling with the legacies of the Enlightenment and Romanticism; a world both revealed and shrouded, explained and puzzled, materialized and dematerialized.

Music, I argue, threads that needle better than most human endeavors, aesthetically uniting the material and immaterial aspects of the world into a unique

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[35] Ever the polemicist, Searle compares materialist theorists of the mind to "compulsive neurotics" who constantly repeat the same error *ad infinitum*. "A materialist thesis is advanced," he explains, "but the thesis encounters difficulties; the difficulties take different forms, but they are always manifestations of an underlying deeper difficulty, namely, the thesis in question denies obvious facts that we all know about our own minds... After some years of desperate maneuvers to account for the difficulties, some new development is put forward that allegedly solves the difficulties, but then we find that it encounters new difficulties, only the new difficulties are not so new—they are really the same old difficulties." John R. Searle, *The Rediscovery of the Mind* (Cambridge, MA: MIT Press, 1992), 30.

[36] Jessica Riskin, "The Defecating Duck, or, the Ambiguous Origins of Artificial Life," *Critical Inquiry* 29, no. 4 (June 2003): 630–31, https://doi.org/10.1086/377722.

artistic experience. Music's materiality is often reduced to the sound wave, the musical score, the recording—aesthetic artifacts that one can observe, measure, and recreate with minimal effort. Following Derrida's account of the written word, this dimension of music is highly iterable. Inscribed on the page, phonograph, or camshaft, music does not "exhaust itself in the moment of its inscription" and can "give rise to an iteration in the absence and beyond the presence of the empirically determined subject."[37] This iterability allowed Vaucanson's flutist to automatically enact the music inscribed on its camshaft long after Vaucanson's death. In this sense, music is a material fact that can be easily reproduced and measured.

Yet, while the automaton's music may have sounded immutable, its listeners were highly mutable—bringing a host of evolving expectations and sensibilities to their encounters with the flutist. In defiance of the iterable certainty of musical objects, the subjective experience of musical subjects is often heard to transcend mere matter. Music, we are told, is "sublime" and "divine." It creates what Michael Gallope calls a "paradox of the ineffable," in which the "sensuous immediacy" of music "remains mediated by forms and techniques."[38] A similar acknowledgment of dualism threads through modern music criticism: music is interpellated by both reason and resonance (Erlmann); it is both drastic and gnostic (Abbate), noise and melody (Rousseau), analytical and expressive (Kivy), autonomous and contingent (Kramer); even the hermeneutic circle, a prominent method of contemporary musicology for understanding music's meaning, oscillates

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[37] Jacques Derrida, "Signature Event Context," in *Postmodernism: Foundational Essays*, ed. Victor E. Taylor and Charles E. Winquist (London, U.K.: Taylor & Francis, 1998), 400.
[38] Michael Gallope, *Deep Refrains: Music, Philosophy, and the Ineffable* (Chicago: University of Chicago Press, 2017), 10.

between whole and part, subjective and objective, text and context.[39] While many scientists embrace a materialism that separates mind from body, modern music criticism, which originated in the late eighteenth and early nineteenth centuries, has widely touted a more equitable mind-body relationship. The Romantic writer Heinrich Heine explained in 1837, "With music there is a special relationship; I want to say, it is a wonder. It stands between thought and phenomenon; as a dawning medium it stands between spirit and matter; it is related and yet different from both; it is spirit, but spirit that needs the measure of time; it is matter that can be devoid of space."[40]

The unconscious dualism of modern music criticism manifests most clearly at its affective poles—the highest highs and lowest lows of musical encounters. At the peak of music's aesthetic effects, the musician's body seems to disappear as if the listener perceived a pure, transcendent mind onstage. Observing virtuoso musicians, for example, the artist Paul Craenen describes the performer's "magic" as an ability to "transcend his or her spatial existence by embodying a 'not-here' in sound."[41] Yet, as James Q. Davies and Naomi Cumming independently conclude, bodies are obstinate, resistant conduits for music. To disappear the body, musicians often take extreme measures, honing muscles,

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[39] Veit Erlmann, *Reason and Resonance: A History of Modern Aurality* (New York: Zone Books, 2010); Carolyn Abbate, "Music—Drastic or Gnostic?," *Critical Inquiry* 30, no. 3 (March 2004): 505–36, https://doi.org/10.1086/421160; Jean-Jacques Rousseau, *Essay on the Origin of Languages and Writings Related to Music*, trans. John T. Scott, vol. 7, The Collected Writings of Rousseau ; (Hanover, NH: University Press of New England, 1998); Lawrence Kramer, *Musical Meaning: Toward a Critical History* (Berkeley: University of California Press, 2002), 8; Peter Kivy, *The Fine Art of Repetition: Essays in the Philosophy of Music* (Cambridge, UK: Cambridge University Press, 1993), 316–17.

[40] Heinrich Heine, "On the French Stage, Letter Nine," in *The Works of Heinrich Heine*, trans. Charles Godfrey Leland, Dusseldorf ed., vol. 8, 20 vols. (New York: Printed for subscribers only by Croscup and Sterling Company, Date Unknown), 242.

[41] Paul Craenen and Helen White, *Composing under the Skin: The Music-Making Body at the Composer's Desk*, Orpheus Institute Series (Leuven: Leuven University Press, 2014), 33.

expanding lungs, training fingers. Some even embrace dangerous elective surgeries, unproven medicinal remedies, and an array of other alarming medical interventions—for all three, look no further than the castrati.[42] And if musical beauty marks the mind's successful negation of the body, musical mistakes represent the opposite: the body's unexpected intervention when fingers slip, lips fail, and even the brain seizes. Sometimes these errors are momentary and unnoticeable—a brief lapse that is easily fixed. At other times, mistakes are catastrophic, bringing the musical experience to a shambling heap. In the aftermath, bodies intervene in entirely different ways: panic and anxiety, tears, and anger—all symptoms of what the science writer Daniel Goldman calls an amygdala hijack, as the emotional centers of the brain take over and overwhelm the senses.[43] Musicians today live in perennial anxiety of these attacks, training both body and mind to avoid complete malfunction.

By exploring these musical feats and failures, this dissertation explains music's unique response to the mind-body problem, discussing how A-life experiments simulate musicians' and composers' struggle to overcome matter, as human and machine alike conjure a more "ideal" (in the metaphysical sense) or "transcendent" (in an aesthetic sense) musical experience that listeners can hear with sensuous immediacy. Indeed, each chapter consists of a series of case studies illuminating instances when machines fail, moments when the affective circuitry uniting composer, performer, and listener collapses.

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[42] Davies writes, "to be marked as exemplary, bodies require habituation to the most painstaking forms of musical conduct, to 'health,' passion, and control. This is why they are at once so real and so elusive. All physical truths require cultivation, even the most unlikely ones. They do not exist by themselves." Davies, *Romantic Anatomies of Performance*, 7.
[43] Daniel Goleman, *Emotional Intelligence: Why It Can Matter More than IQ* (New York: Bantam Books, 1995), 14.

What is a mistake in this context? To the materialist, a mistake is an objective fact, a mathematical failure to carry the one, or a mechanical failure to execute a task. Such mistakes can be observed and measured, as when carcinogens interrupt the unceasing perfection of cellular mitosis, unleashing cancerous "mistakes" throughout the body. Some critics even portray musical "mistakes" in these objective terms, many of which are inventoried by Naomi Cumming as sins against the sonic self: "wrong" notes, rhythms, fingering; an excess of expression; a dearth of expression; broken strings, sticky keys, froggy voices—the list goes on.[44]

However objective some critics might perceive these errors, Cumming advocates against hermeneutic universalism. To her, mistakes are neither good nor bad, right nor wrong. They do not arise *ex nihilo* or prescriptively. Instead, musical mistakes are relational, emerging from faulty expectations between individuals. In this sense, a mistake is an interpretive opportunity to strengthen or weaken the relationships between musical subjects. Aristotle addresses this relativism in his *Poetics* when he distinguishes between *errors of communication* (semantic or artistic faults) and *errors of technique* (syntactic or technical faults).[45] For the Greek philosopher, errors of technique should be avoided but can be permissible if they enable artistic communication—in short, privileging semantic meaning over syntactic form. After all, asks the poet Erica McAlpine, "how can a poet err if there is no poet, only poem?"[46]

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[44] Cumming, *The Sonic Self*, 24-28.
[45] Aristotle, *The Poetics of Aristotle*, ed. S.H. Butcher (London, UK: Macmillan and Co., Ltd., 1917), 99.
[46] Erica McAlpine, *The Poet's Mistake* (Princeton, NJ: Princeton University Press, 2020), 2.

In the context of mechanical music and artificial life, mistakes draw attention to the aesthetic relationships that undergird the cognitive spectacles of life. They attune listeners to the technical errors that deny cognition, and the human errors that validate it. In short, mistakes have the potential to enable an aesthetic space for android musicology. Consider, for example, the many critics who judged the sound of mechanical reproducibility as itself a mistake. The eighteenth-century flutist Johann Joachim Quantz criticized Vaucanson's flutist for playing with "quickness and exactitude" but without the right "fire;" the Austrian music theorist Heinrich Schenker positioned machines as the antithesis to the soul, castigating them for reducing music's organicism to a series of lesser mechanisms.[47] Even early computer music seemed error-ridden and unintelligent, as the British surgeon Geoffrey Jefferson castigated machines for merely manipulating symbols rather than feeling genuine "thoughts and emotions."[48] In these contexts, automaticity is less a mechanical failing than an aesthetic one, as mechanical reproducibility is it taken as an affront to the sonic self.[49]

At the same time, another category of musical mistake problematizes the seeming perfection and rationality of the machine, acting less as a technical glitch than a human error. In these circumstances, technical faults are no longer impediments to the truth but enablers of it; breaches of poetic license and parapraxes that listeners hear as a window

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[47] Heinrich Schenker, *Free Composition*, ed. and trans. Ernst. Oster, vol. 3, New Musical Theories and Fantasies (New York: Longman, 1979), xxiii, http://pi.lib.uchicago.edu/1001/cat/bib/273718.; Johann Joachim Quantz, *On Playing the Flute*, trans. Edward R. Reilly (New York: Schirmer Books, 1975), 131.
[48] Geoffrey Jefferson, "The Mind of Mechanical Man," *British Medical Journal* 1, no. 4616 (June 25, 1949): 1110.
[49] Musicians, too, are oft castigated for mechanical playing. Naomi Cumming cites a review by Jennifer Laredo of the *Strad*, which cites "a compendium of technical devices" that ultimately leaves the reviewer cold. "I would have preferred to see a willingness to take musical risks instead of negotiating technical obstacles: it seemed that the piece was *delivered rather than interpreted*." Jennifer Laredo, quoted in Cumming, *The Sonic Self*, 24.

into the mechanical unconscious. Consider, for example, the failing strains of the song "Daisy Bell" sung by HAL 9000, the AI voice-assistant of Stanley Kubrick's *2001: A Space Odyssey* (1968). As the astronaut David Bowman disables HAL's logic memory center, the machine reverts to its factory settings and launches into a faltering performance. At first, the melody and lyrics sound legible, but as its tempo slows and pitch falls, the piece grows garbled, as if HAL's vocodered voice were devolving to a mechanical death rattle. In many circumstances, this musical breakdown would seem an unambiguous "mistake," but at this moment, HAL's errors humanize the machine, materializing through the song the effects of its psychic trauma. "My mind is going," intones HAL, as David lobotomizes the machine, "there is no question about it. I can *feel* it." The audience can neither feel HAL's pain nor observe the cognitive damage done to its logic memory center, but the deteriorating song communicates both, as if each mistake were material evidence of the machine's brain-death.

Nevertheless, HAL's error-ridden song also implicates its assailant, David, as each broken note instantiates the astronaut's violence against the machine. Here, HAL's "bicycle built for two" becomes darkly ironic. While science fiction oft celebrates the utopian promise of human-computer interaction (HCI), HAL's "Daisy Bell" showcases the dystopian untenability of such bonds. HCI deteriorated into the toxic relationship between abuser and abused, assailant and victim. Yet, the song also provokes identification between them. After all, doesn't David dismantle HAL as retaliation against the machine's attack against him (and his partner on the mission, Frank)? And doesn't David's harsh response to HAL's malfunctioning logic resemble HAL's drastic response to

human error? From this perspective, HAL's flawed performance of "Daisy Bell" represents a point of identification between the human and machine, symbolizing both their capacities for human-like errors and computer-like breakdowns. They each possess fallible minds prone to misinterpretation and overreaction, and fallible brains that can be mechanically dismantled or asphyxiated in the vacuum of space. In recognition of these similarities, Kubrick accompanies HAL's failing melody with a static shot of David's helmet as it reflects the blood-vessel-like red lighting of HAL's logic memory center. The resulting double image superimposes the AI's mechanical brain over the astronaut's face, literally mapping vibrant subject onto impassive object—although it is not entirely clear which is which: is HAL an unfeeling object or a feeling subject? Does Dave, in his rage against the machine, retain his human empathy, or does his uncaring gaze and emotionless voice (itself mediated by the helmet) belong to yet another machine? The film, opaque as ever, offers few definitive answers.

HAL, of course, was a fictional character in a science fiction film, but it was rooted in the scientific rationale of Kubrick's 1960s space-age. Kubrick famously based HAL's design and branding on IBM, and the machine's rendition of "Daisy Bell" was inspired by a musical performance of that same song engineered for the IBM type 704 Electronic Data-Processing Machine in 1961—a performance that constituted the earliest known demonstration of computer speech synthesis. As an object of science fiction, HAL functioned as an analog to the real world, a novum connected to, yet separated from, the ideological implications of mid-century sciences, ethics, and artificial intelligence. Indeed, HAL is a vivid reminder that all artificial life (whether constructed by Vaucanson,

written by Hoffmann, or filmed by Kubrick) functions by analogy. Although such experiments mimic biological and cognitive processes, they do not objectively or autonomously reproduce them. Instead, artificial life is inseparable from the many historical, scientific, aesthetic, and moral contingencies that make human life feel life-like.[50]

The musicologist Joseph Auner, for example, refers to HAL as an example of "posthuman ventriloquism," a self-conscious attempt to create mechanical voices that channel (and perhaps challenge) the seeming expressive and moral imperatives of the human voice.[51] As Auner explains, while the human voice is a compelling vehicle for affective pleas and rhetorical splendor, it is also ethically ambiguous, easily manipulated to spread falsehoods, push disinformation, and disenfranchise others. These lapses are the dark underbelly of Aristotle's celebration of semantics over syntax: no wonder Plato's Socrates was skeptical of poets and poetry in his idealized vision of *The Republic*. Posthuman ventriloquism attempts to redress the inhumane humanity of the natural voice by humanizing the inhuman, giving the machine a voice with which to call out society's ills. The result is a resettling of morality from the thinking, scheming mind to the automatic, sensuous body. It is only when HAL's logic memory center shuts down,

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[50] This ideological orientation is an important part of Darko Suvin's definition of the novum, a science fiction trope that offers the semblance of scientific explanation. In this regard, the novum is an illusion of materialism, a hand-waving that allows the most advanced science fiction technology to seem rooted in reality. It maintains a fiction like HAL, offering a seeming extension of the 1960s era artificial intelligence (replete with IBM branding) whose consciousness *could* be housed in a "logic memory center." As Suvin remarks, "An aesthetic novum is either a translation of historical cognition and ethics *into* form, or (in our age perhaps more often) a creation of historical cognition and ethics *as* form." Darko Suvin, *Metamorphoses of Science Fiction* (New Haven: Yale University Press, 1979), 80.

[51] Joseph Auner, "'Sing It for Me': Posthuman Ventriloquism in Recent Popular Music," *Journal of the Royal Musical Association* 128, no. 1 (January 1, 2003): 98–122.

and the now mindless machine begins its song that the machine seems to feel and behave like a human—as if (artificial) intelligence were an impediment, rather than an enabler, of moral decision making. In these moments of posthumanity, the voice of reason is expressly unreasonable; mindless autonomism overtakes mindful intervention, syntax outstrips semantics.

Android musicology expands both the historical and moral scope of Auner's analysis of HAL's voice, repurposing the impulses of posthuman ventriloquism as a heuristic that has been deployed since the Enlightenment. For as long as machines have existed, the relationship between automaticity and ethics has evolved alongside the mind-body problem. This dissertation documents an array of artificial lives like HAL whose music signaled both abuse and abused, malice and empathy, relentless mechanisms and fragile mechanics. Sometimes, as with HAL and Olympia, these competing drives even coincide. My purpose here is not to make blanket statements about artificial life writ large, or to reaffirm the unceasing progress from Enlightened automata to modern AI, but to note how the study of mechanical music was heard to negotiate a mind-body division that even the sciences have yet to understand fully. Through musicmaking, even the most inert, inhuman mechanisms become technologies of moral and ethical sentiment.

Why Artificial Life?

While many scientists may be wary of the intrusion of music onto matter, this dissertation also documents the numerous musicians, critics, and musicologists who balk

at the intrusion of matter onto music. On the surface, materialist experiments offer an impoverished model of the human, *simulating* aesthetic processes without genuinely *feeling* the underlying motivation or intentionality. As Quantz, Schenker, and Jefferson demonstrated above, the collision of music and machine often seems a contradiction in terms. Skeptics deny mechanical music the capacity to elicit surprise or delight. The automaton's song is constrained by the camshaft in its body, just as the computer's compositions are limited to the zeroes and ones of its coding—the actions of these machines are imminently predictable. Aesthetics is itself a fleeting concept for a machine to grasp. Artistic values are not merely elusive (sometimes deliberately so); they also involve cultural contingencies that have evolved through history and between communities. The philosopher and cognitive scientist Margaret Boden explains that "our aesthetic values are difficult to recognize, more difficult to put into words, and even more difficult to state really clearly. For a computer model, of course, they have to be stated really, *really* clearly."[52] Some philosophers even deny artistic merit to machines that convincingly create human-sounding art. "Works of art," writes the philosopher Anthony O'Hear in 2008, "are human creations, made with skill and craft to evoke and express human meanings…Even if a work of art is reproducible, it cannot be machine-generated, for that will be to undermine the role of the artist and the role of the work of art as something intended as such by another human being."[53]

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[52] Margaret A. Boden, *The Creative Mind: Myths and Mechanisms*, 2nd ed. (London: Routledge, 2004), 10.
[53] Anthony O'Hear, *The Landscape of Humanity: Art, Culture and Society* (Luton, UK: Andrews UK Limited, 2011), 18.

This framing, however, denigrates the lively relationship that machines can forge (and have forged) with listeners. Android musicology is not a study of inert mechanical reproduction. Instead, it focuses on what the philosopher Jane Bennett calls "distributive agency," the reciprocated subjectivity that arises from the affective potency of our senses.[54] If artificial life is an attempt to recreate life from scratch, music grants A-life a life outside itself, a life beyond the autonomous mind-body experience of the individual and into a distributed subjectivity that underwrites all social, emotional, cultural, and musical encounters. In relation to the insular and autonomous subjectivity that has defined the modern liberal subject since the Enlightenment, distributed subjectivity reflects the emergence of subjectivity through relationships with people, places, and things.[55]

To be fair, musicologists have become more sensitive to these intersubjective bonds in recent years, a shift attributable to the field's "material turn" away from discourse and towards the sensuous experiences of bodies. Influenced by writers like Bennet and Latour, musicology's material turn arose as a challenge to the idealistic mind-body relationships of "music itself," allowing scholars to consider anew the body's role in enabling, facilitating, and perceiving music. This shift has precipitated two profound upheavals in musicology in recent years. On the one hand, it undermines the perceived

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[54] Jane Bennett, *Vibrant Matter: A Political Ecology of Things* (Durham, NC: Duke University Press, 2010), 31.
[55] "No longer" writes Hayles, "is human will seen as the source from which emanates the mastery necessary to dominate and control the environment. Rather, the distributed cognition of the emergent human subject correlates with…the distributed cognitive system as a whole, in which 'thinking' is done by both human and nonhuman actors." Katherine Hayles, *How We Became Posthuman: Virtual Bodies in Cybernetics, Literature, and Informatics* (Chicago: University of Chicago Press, 1999), 290.

stability of musical "objects," challenging the notion that they can act as stable referents or arise from a single controlling agency. Instead, explains Emily Dolan, the material turn has precipitated a shift from research on musical objects (the study of insulated scores, works, and other musical minutiae) to musical practices (the social and cultural interactions between music-makers).[56] Here, musical practices are taken broadly. Musical relationships are expanded beyond the singular trifecta of composer, musician, and listener, to encompass a more comprehensive network of agencies—both human and nonhuman, organic and inorganic—who together mediate the musical experience. These include, but are not limited to anatomical minutia like fingers, voice, and lungs;[57] musical instruments and ensembles;[58] recording media;[59] environments and spaces;[60] and a host of other musical technologies and curiosities.[61]

At the same time, the material turn takes musical agency itself as contingent. In the previous section, I noted how musicians labor to produce the "right" tone, note, rhythm, dynamic, and accent—to say nothing of the numerous elements ignored by the

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[56] Emily I. Dolan, *The Orchestral Revolution: Haydn and the Technologies of Timbre* (Cambridge: Cambridge University Press, 2013), 4–5.
[57] See Davies, *Romantic Anatomies of Performance*; Cumming, *The Sonic Self*; Nina Sun Eidsheim, *Sensing Sound: Singing and Listening as Vibrational Practice* (Durham, NC: Duke University Press, 2015); Martha Feldman, *The Castrato: Reflections on Natures and Kinds*; (Oakland: University of California Press, 2015).
[58] Dolan, *The Orchestral Revolution*; Thomas Christensen, "Four-Hand Piano Transcription and Geographies of Nineteenth-Century Musical Reception," *Journal of the American Musicological Society* 52, no. 2 (July 1, 1999): 255–98, https://doi.org/10.2307/831999; T. J. Pinch and Frank Trocco, *Analog Days: The Invention and Impact of the Moog Synthesizer* (Cambridge, MA: Harvard University Press, 2009).
[59] Jonathan Sterne, *MP3: The Meaning of a Format*, SST (Durham, NC: Duke University Press, 2012); Andrew J. Eisenberg, "Toward an Acoustemology of Muslim Citizenship in Kenya," *Anthropology News* 51, no. 9 (December 1, 2010): 6–6.
[60] Emily Thompson, *The Soundscape of Modernity: Architectural Acoustics and the Culture of Listening in America, 1900-1933* (Cambridge, Mass.: The MIT Press, 2004); Michael Bull, *Sound Moves: iPod Culture and Urban Experience*, International Library of Sociology (London; New York: Routledge, 2007); Anahid Kassabian, *Ubiquitous Listening: Affect, Attention, and Distributed Subjectivity* (Berkeley: University of California Press, 2013).
[61] Loughridge, "Science, Technology and Love in Late Eighteenth-Century Opera"; Jonathan Sterne, *The Audible Past: Cultural Origins of Sound Reproduction* (Durham, NC: Duke University Press, 2003); Mathew and Smart, "Elephants in the Music Room."

score. These actions are themselves heard by a parallel listening body which is primed to not merely observe, but to feel, puzzle, understand, enjoy, and even detest that musical experience. Neither the listener nor the performer is a stable entity. Instead, material musicologists imagine these figures composed of even more minute subroutines, a gathering of subjective (identity, agency, trauma, training), intersubjective (culture, society, history, discourse), and objective (the iatromechanics of limbs and ears, the neurobiology of perception and sensation) forces. As these materialities are studied in finer and finer detail, the autonomy of the musical work quickly falls to pieces, redistributed instead across dense networks of influence, each node implicating countless others through tenuous threads of affect, expectation, and embodied knowledge.

While the notion of a *material* turn might sound like a retreat to scientific materialism, musicology's material turn remains staunchly dualistic: material bodies are immaterially embodied, sound waves are aestheticized, even androids are imbricated in what Georgina Born calls "aggregations of the affected"—layers of social connection bound together by affective response.[62] By recognizing the numerous contingencies of mechanical music, we cultivate tools for recognizing the hermeneutic relationships uniting the social and material, an artistic unity that illuminates and reframes the tensions that reside at the heart of the mind-body problem.

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[62] Georgina Born, "Music and the Materialization of Identities," *Journal of Material Culture* 16, no. 4 (December 1, 2011): 376–88, https://doi.org/10.1177/1359183511424196.

Chapter Overview

The case studies that follow will demonstrate that musicological concerns have long informed practices and theories of artificial life. Over the remaining three chapters, I focus on experiments that used music to shirk, challenge, or validate materialism's censure of the immaterial, enabling machines that seemed capable of playing instruments, influencing listeners, feeling emotions, composing symphonies, and even thinking autonomously. As an exercise in quirk musicology, these case-studies make surprising companions, spanning three centuries of evolving technology, music, and science.[63] Nevertheless, I follow historians like Lorraine Daston and Jessica Riskin in portraying the quest to simulate life as a modern project animated by transhistorical tensions between materialism and dualism—a tension between those features of life that can be observed, measured, and rebuilt and those that cannot.[64]

By listening to the curious particularities of artificial life—to automaton seductions, cybernetic symphonies, and AI elegies—this dissertation complicates a persistent discourse of enlightenment ideology that celebrates the unwavering progress made by the sciences towards perfect materialist understanding. Instead, I argue that these musical machines provoked a history of science that was expressly unscientific, rife with contradictory claims from audiences who professed one thing and heard another. By embracing these aesthetic contradictions rather than dismissing them, this dissertation

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[63] Mathew and Smart, "Elephants in the Music Room."
[64] Lorraine Daston, "The Naturalistic Fallacy Is Modern," *Isis* 105, no. 3 (September 1, 2014): 579–87, https://doi.org/10.1086/678173; Riskin, *The Restless Clock*.

functions less as a scientific history of music and more as a musical history of science, a history that accepts listening itself as a viable form of knowledge production.

For this reason, this dissertation does not offer a sweeping or uncomplicated account of music and artificial life. Instead, each chapter focuses on the historical contexts of a single machine, attending to the social, cultural, philosophical, and intellectual circumstances that enabled the reception of machine and music alike. While these chapters together sketch a centuries-long conversation between materialism and aesthetics, they focus on the particularities of those conversations, complicating rather than simplifying the historical narrative. These details, I hope, will not only foster a better understanding of past examples of artificial life, but will also help us rediscover new ways of thinking critically about the artificial life of the present and future, drawing musicologists' attention to the aesthetic contingencies that underlie even modern technologies like artificial intelligence and neural networks.

Chapter One**, "Music, Mind, and the Moral Fantasy of Enlightenment Automata,**" focuses on Vaucanson's automaton flutist, which premiered in Paris in 1737. Although subsequent historians have fixated on the machine's muscles and organs, this chapter aligns Vaucanson's musician with the sensationalist theories of the embodied mind described by Étienne Bonnot de Condillac and Jean-Jacques Rousseau, who looked to bodily actions like speech and language as evidence of the immaterial brain. Although Vaucanson's machine possessed neither voice nor language, I show how its music participated in a French culture that idealized mind as speech, and speech as music—leading to a celebration of vocal utterances that the musicologist John Neubauer has

called the "vocal paradigm."[65] By endowing a musical machine with voice-like organs, Vaucanson used the sounds and actions of a mechanical body to speculate not only on the origins of the mind or soul, but also on the origins of Enlightenment as a whole: a mechanical model for the reason, language, cognition, and empathy that binds all subjects together.

Chapter Two, "**Revitalizing Vaucanson: The Romantic Afterlife of an Enlightened Machine**," considers three literary adaptations of Vaucanson's flutist after the French Revolution: Adolphe de Leuven's *L'automate de Vaucanson* (1840); François-Félix Nogaret's *Miroir des événements actuels, ou la Belle au plus offrant, histoire à deux visages* (The Mirror of Past Events, or Beauty to the Highest Bidder: A Two-Faced Tale, 1790); and Achim von Arnim's novel, *Armut, Reichtum, Schuld und Bußе der Gräfin Dolores* (The Poverty, Wealth, Guilt, and Atonement of Countess Dolores, 1810). In these adaptations, the automaton exemplified the changing relationship between subjects and sovereignty, giving readers and audiences a mechanical foil for reconsidering their own uneasy statuses in the rapidly industrializing age. Vaucanson's Enlightened machine became the unlikely progenitor of a Romantic theory of humanity—one less concerned with the internal self-regulation of eighteenth-century technologies and more concerned with manipulating the collective will of human subjects. In these adaptations, the automaton was musically naturalized and denaturalized, so that the qualities one expects

[65] John Neubauer, "The Emancipation of Music from Language: Departure from Mimesis in Eighteenth-Century Aesthetics," *Journal of Aesthetics and Art Criticism* 46, no. 3 (1988): 441–44.

from a machine—unerring reproducibility, internal self-regulation, and even uncanny actions—became potent tools for reimagining the existing political order.

Chapter Three, "**Music as Artificial Intelligence**," examines materialist efforts to simulate the musical brain—and by extension, the musical soul—in Experiment in Artificial Intelligence (EMI), an AI-powered composition software developed in the 1980s by the composer David Cope. Cope designed EMI to copy composers' styles by algorithmically parsing their musical syntax. Nevertheless, many commentators heard the machine's musical imitations as proof against the composer's immaterial soul. By attending to listeners' interpretations of the machine, I recontextualize EMI's reception not as a radical break from Romantic hermeneutics, but as an intensification of them, noting how the comforting certainty of the musical score was exchanged for the discomforting reproducibility of the computer's source code.

By attending to the historical peculiarities of these musical machines, we see how the tools of musicology are equally transferrable (and dare I say, vital) to contemporary conversations about artificial life and artificial intelligence. We live today in a world of commodified A-life technologies. The delicate hands that Vaucanson built to play the flute now autonomously assemble cars and other consumer goods. The algorithmic procedures that enabled David Cope's EMI also influence the music I hear on Spotify, the media I consume on Netflix, and the products I buy on Amazon. Contemporary A-life is often stripped of its humanistic contexts and instead recast as a commodity to distract, surveil, and control. Small wonder that the life sciences frequently portray all life—whether artificial or natural—as affectless, autonomous matter.

Music, however, does not merely reduce to matter, but complicates, challenges, and undermines it. Through music, bodies are embodied, brains are made mindful, and even machines *feel* ensouled. To modern sensibilities, the promise of android musicology might seem hopelessly naïve: a willful denial of observed reality. Nevertheless, by taking the automaton or AI's mechanical music seriously and understanding the intellectual history of this aesthetic practice, we not only glimpse a centuries-long conversation between art and materialism, but give ourselves more license to understand, critique, and perhaps even shape the future of music and artificial life.

CHAPTER ONE

MUSIC, MIND, AND THE MORAL FANTASY OF ENLIGHTENMENT AUTOMATA

In the 1752 treatise, *Versuch einer Anweisung die Flöte traversiere zu spielen*, the German flutist Johann Joachim Quantz attacked an unusual target;

> With skill a musical machine could be constructed that would play certain pieces with quickness and exactitude so remarkable that no human being could equal it either with his fingers or his tongue. Indeed, it would excite astonishment, but it would never move you; and having heard it several times, and understood its construction, you would even cease to be astonished. Accordingly, those who wish to maintain their superiority over the machine, and wish to touch people, must play each piece with the proper fire; but they must also avoid immoderate haste, if the piece is not to lose all its agreeableness.[1]

For Quantz's eighteenth-century reader, the idea of a "quick-playing" musical machine was a fashionable notion, popularized by Jacques de Vaucanson's musical automata, especially his mechanical flutist, which caused a sensation when it premiered in 1737. Vaucanson's flute-player was an object lesson in Enlightened engineering. With mechanical fingers, lips, lungs, and even a tongue, Vaucanson's machine featured the organs necessary to perform twelve melodies on a German flute—an instrument the inventor had chosen for its difficult intonation. For many commentators, the automaton was a wonder. Its performance prompted Voltaire to hail its inventor as "a modern-day

[1] Quantz, *On Playing the Flute*, 131.

Prometheus,"[2] and Diderot and D'Alembert to devote the entire "*androide*" entry of their *Encyclopédie* to the machine's mechanics, praising its "finesse in all its details" and the "delicacy in all parts of [its] mechanism."[3]

Quantz, however, was unmoved by the automaton's delicate form, observing in the machine a mechanical body unable to effectively convey the musical mind. The problem, he argued, was the machine's timbre, which he thought originated from its flawed and inflexible embouchure. For Quantz, the ideal flutist produces higher or lower pitches by widening and narrowing their lips in imitation of a singer contracting or expanding their larynx to sing. By comparing the mechanics of the voice to the embouchure of the instrument, Quantz believed that a flutist not only produces the "clear, penetrating, thick, round, masculine, and withal pleasing sound" of the "chest tones of the human voice," but lends the instrument the rhetorical and expressive power of that voice to properly "move" the listener.[4] The timbre of Vaucanson's automaton failed to meet Quantz's vocalic timbre despite its anatomical complexity. The inventor erred in programming the machine's lungs to increase the air pressure to produce higher-notes on the flute, transgressing Quantz's belief that strong pressure produces "high notes [that are] exceedingly coarse and unpleasant." Dismayed at the automaton's failed embouchure

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[2] Voltaire, "On the Nature of Man," in *The Works of Voltaire: A Contemporary Version*, ed. John Morley, trans. William Fleming, vol. 1, 42 vols. (London: E.R. DuMont, 1901).
[3] Diderot and D'Alembert, "Androide [Méchanique]."
[4] The notion of music "moving" the listener is an important pillar of Quantz's teaching and appears throughout the *Versuch*. He speaks of the newcomer needing to arouse feeling in himself, for "if he is not moved by what he plays, he cannot hope for any profits from his efforts, and he will never move others through his playing." Quantz, *On Playing the Flute*, 117.

and unpleasant tone, Quantz issued a clear warning to the machine's would-be imitators that, "you must not allow yourself to be misled by the reason of Mr. Vaucanson."[5]

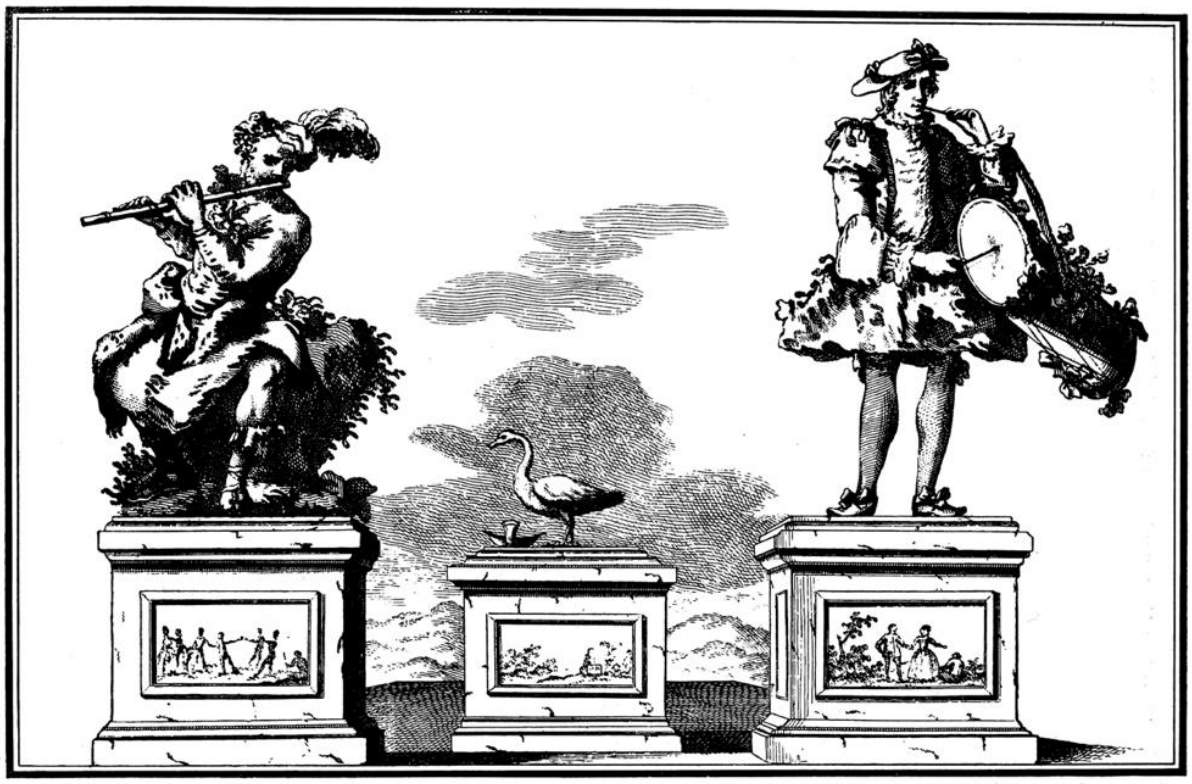

Figure 1.1: Jacques de Vaucanson, Le jouer de galoubet, le canard et le jouer de tambourin (1738). The automaton-flautist is pictured on the left. SOURCE Jacques de Vaucanson, Le mecanisme du fluteur automate. *(Paris: Jaques Guerin, 1738), Frontispiece.*

Quantz's criticism reveals the moral quandary presented by machines that made (or attempted to make) human-sounding music in mid-eighteenth-century Europe. Historians of science remember Vaucanson for his commitment to *physiological* accuracy, stripping the act of flute-playing down to a series of anatomical mechanisms.[6] In this

[5] Quantz, *On Playing the Flute*, 54. Fascinatingly, the end of this phrase "by the reasoning of Mr. Vaucanson," only appeared in the French translation of Quantz's text. The original German text omitted it.
[6] Daniel Cottom, for example, equates the musical labor of Vaucanson's flautist with the biological labor of the inventor's second automaton, the "Defecating Duck"—a mechanical avian that consumed and eventually excreted feed. Because Vaucanson was able to automate both music and digestion on an automaton, Cottom claims that the inventor

configuration, exterior actions are reducible to internal mechanics, allowing the technologies that enabled the automaton's melody-making to seem indistinguishable from not only the mechanisms driving other automata (like Vaucanson's other machines) but the actions of the human body. Quantz exposed the limits of this physiological perspective, judging the automaton's body instead on the aesthetics of its music. Life, for the master-flutist, was more than anatomical simulation. Instead, Quantz imagined humanity as residing in expressive utterances, ones audible in the timbre, melodies, and expressive character of flute playing. Vaucanson shared his concerns: his notes and the accounts of contemporary observers paid significant attention to the aesthetic character of the machine's utterances, and the intense labor he expended to make human-sounding music.

By the inventor's ascendance in the 1730s, Vaucanson's automaton coincided with a broader reconsideration of the relationship between internal functioning and external action among French *philosophes* rebelling against Church teaching of an ephemeral soul distinct from a material body. Unable to reconcile the relationship between the substance of soul and body, materialists like Diderot and the physician Julien Offray de la Mettrie reduced the soul to an observable body, interpreting embodied actions like language,

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exposed a mechanical crisis in which one task was indistinguishable from the other; "In an age of mechanical digestion," he laments, "one of the central problems of aesthetic judgment must be to distinguish between art and shit." The philosopher, Catherine Liu, also takes a physiological perspective when interpreting Vaucanson's inventions as steppingstones towards industrialization. With human-like innards, the automata collapsed the boundary between mechanical automation and human production, reconfiguring the natural body as one exploitable for capitalism. See Cottom, "The Work of Art in the Age of Mechanical Digestion," 71.; Liu, *Copying Machines*.

gesture, and music as part of a semiotics of the mind.[7] When Vaucanson's flutist premiered, it was almost immediately hailed by Enlightenment thinkers as an example of this materialist mind at work. With automated music, the machine not only simulated an anatomy that onlookers expected from a musical body but the aesthetic sensibility they projected onto a musical soul—thus suggesting the mechanical origins of all cognition.

This chapter contextualizes the automaton-flutist's reception among French Enlightenment thinkers, as mechanical music was celebrated and rejected as evidence of the metaphysical, biological, and mechanical origins of the human soul. The automaton's complicated personhood raises questions about the stakes of hearing and making music in the eighteenth century: what are the cognitive effects of having an aesthetic voice? Vaucanson's machine possessed neither voice nor cognition, but I will show how the machine's aesthetic behavior was taken as a heuristic for both, confronting onlookers with actions that they already associated with the intelligence and subjectivity of others. At the heart of the machine's performance, then, was a musicological inquiry into who gets to be considered human: if a machine can functionally produce "beautiful" music, does that mean that it shares the same reason, intellect, ethics, and empathy that unites

[7] It should be noted that, before semioticians like Saussure and Peirce described "semiotics" as a science of linguistic signs, its origins in the seventeenth and eighteenth centuries lay in the signification of medical diagnoses . Consider, for instance, Diderot's *Encyclopédie* entry on "Detailed Explanation of the System of Human Knowledge"; "Medicine (according to the division of Boerhaave) is occupied either with the constitution of the human body and reasons concerning its anatomy, whence is born physiology; or it is occupied with the way of preventing illnesses, and is called hygiene; or it considers the sick body and treats of causes, of differences, and of symptoms of maladies, and is called pathology; or it has for its object the indications of life, of health, of sicknesses, their diagnosis and prognosis, and takes the name of semiotics; or it teaches the art of healing and is subdivided into diet, pharmacy, and surgery, the three branches of therapeutics." Denis Diderot, "Detailed Explanation of the System of Human Knowledge," in *Encyclopedia of Diderot & d'Alembert - Collaborative Translation Project*, trans. Richard N. Schwab and Walter E. Rex, 1751, http://hdl.handle.net/2027/spo.did2222.0001.084.

all enlightened subjects? Or is the gulf between machine and human, body and soul, insurmountable?

In what follows, I will first track the common mythologies that sprang up about the automaton-flutist's body. There can be no denying that Vaucanson aimed for anatomical accuracy—the inventor was invested in recreating the respiratory organs of the human body. What a strictly physiological account of the machine misses, however, is that anatomy was itself a spectacle for Vaucanson's Parisian audiences. The archetypal example was the "Pygmalion craze" that swept through the city in the eighteenth century, attesting to the aesthetic potency of an art object that is made to move and behave like a real person. In the second section, I contextualize how flute-playing in general (and Vaucanson's flutist in particular) was accepted as a viable form of speech and communication. Among the French *philosophes*, there was a vibrant debate about the origins of language, theorized by thinkers like Condillac, Rousseau, and La Mettrie, and materialized by inventors like Kempelen, Faber and Erasmus Darwin. By searching for language's origins, these thinkers believed that they could return to a prelapsarian moment when human beings first sought to communicate with one another and develop a shared vocabulary through which to give voice to their fleeting thoughts. Vaucanson, I argue, offered a mechanical explanation for these linguistic acts, giving the machine a musical voice that many believed could materialize the machine's ephemeral soul. In the final section, I shift from the machine's sound production to the audience's musical perception, explaining how some Enlightenment thinkers described musical listening and listeners in automaton-like terms.

Making a Flutist

Vaucanson explained his automaton's functioning in a pamphlet entitled *Le mécanisme du fluteur automate*, which he prepared as part of his application to join the *L'Académie royale des sciences*. His report began with a cursory study of the German transverse flute, noting how the instrument's sound constrains a musician's body in observable ways. He explained that the flute requires a mouthpiece that reproduces the flexibility from the musician's breath and lips. Where other instruments produce sound by blowing air directly into a lead pipe (as in the traditional flute, flageolet, or organ pipe), the transverse flute produces sound from the air blown across its embouchure hole. That mouthpiece, observed Vaucanson, mediates between the instrument's acoustics and the musician's body in three important ways. Most basically, it connects to a lead pipe that can be lengthened or shortened by fingering different combinations of the instrument's seven holes. A more extended pathway lengthens the column of air moving through the instrument and produces a lower pitch. The lowest pitch, D4, is produced by stopping all of the instrument's holes. Meanwhile, the strength of the air moving through the instrument also affects the pitch. Higher registers are reached by increasing the force of the air. Vaucanson explained that although D5 has the same fingering as D4, the air pressure is roughly double—the same goes for D6 and D7.[8] In altering the force of the air

[8] Vaucanson is vague about the octave beginning with D7 and no other flute manuals from this era go beyond G6. Quantz's *Versuch* contains fingerings for a tessitura spanning D4 to A6, while Hotteterre's *Principes de la flute traversière* (1709) covers D4 to G6. Quantz, *On Playing the Flute*, 42–43.; Jacques Hotteterre, *Rudiments of the Flute, Recorder & Oboe (Principes de La Flûte)* (New York: Dover Publications, 1968).

pressure, however, the musician must also alter the shape of their lips. Lower air pressure requires a wider embouchure, while higher air pressure requires a narrower embouchure.[9] Although Vaucanson insisted he was describing the flute, his analysis really attended to the musical affordances of the flutist's body.[10] To sound a specific tone, the instrument requires the musician to appropriately manipulate their fingering, breath and lips. Vaucanson thus reduced the body to the effects it produces on the instrument as if the musician were yet another musical technology—one analogous to the flute itself.

Vaucanson's description, of course, was biased; he objectified the natural musician in order to compare the human body to the mechanisms within his automaton. Indeed, the remainder of the pamphlet explained how he replaced natural organs with mechanical counterparts: a series of pulleys controlled the automaton's fingers and tendons; those fingertips were covered with soft leather that sealed the flute's holes (and muffled the clacking of wooden fingers against wooden instrument); the lungs were replicated by bellows that could "breathe" three different air pressures; that air was then channeled through an esophagus where a mechanical tongue could interrupt its continuous airflow; finally, its lips could widen or narrow and move closer or further to the instrument's mouthpiece. To coordinate these organs, Vaucanson used a special kind

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[9] "But the German-flute (as I have already said) having this Difference from other Wind-Instruments, that its Mouth is undetermined, the Advantages that arise from it, are that the Wind may be modulated by the greater or less Opening of the Lips, and by their different Position upon the Hole of the Flute, and by the Performer's being able to turn the Flute inwards or outwards." Jacques de Vaucanson, *An Account of the Mechanism of an Automaton, or Image Playing on the German-Flute: As It Was Presented in a Memoire, to the Gentlemen of the Royal-Academy of Sciences at Paris.*, trans. J. T. Desaguliers (London: printed by T. Parker, and sold by Mr. Stephen Varillon, 1742), 8.

[10] "To you [the members of *L'Académie royale des sciences*] I owe the reflections that I have made on the Sounds of the Instrument, on Mechanicks, and on the different motions of the Parts Wherewith the Machine work. My thoughts on the German Flute will make the first Part of this Memoire." Vaucanson, *Le mécanisme du flûteur automate*, 3.

of pinned cylinder, called a camshaft, which precisely controlled the timing of each component. The camshaft was subdivided into fifteen sections, each controlling a different action: seven for controlling the fingers (four on the right hand, three on the left), four for operating the mouth (opening and closing the lips, drawing them forward and back), one for the tongue, and three for expelling air from the lungs (one for each of the three air pressures). When a section of the cylinder was pinned, it would trip a switch that activated the corresponding organ.

To make music, Vaucanson used the camshaft to choreograph the lungs, finger, tongue, and lips to produce the appropriate pitch, rhythm, and timbre of each note. Even the most basic notes required a cascade of mechanical "instructions." Consider, for instance, his explanation for making the machine sound a single D4:

> [1] I first begin to dispose of the mouth; for this purpose, I place a pin on the cylinder that responds to the parts of the mouth that increase the opening made by the lips. [2] Secondly, I place a pin under the switch, which makes it possible to retreat these same lips. [3] Thirdly, I place a pin on the switch that opens the reservoir of the wind which comes from the small bellows, which are not loaded. [4] Lastly I place a pin under the switch, which moves the flap to give a stroke of the tongue; so that these pins coming to touch in the same terms the four switches, which serve to produce the aforesaid operations, the Flute will ring the lower ré.[11] [Enumeration added]

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[11] " Je commence d'abord à disposer l'embouchure; pour cet effet, je place sur le cilindre une lame dessous le lévier, qui répond aux parties de la bouche, servant à augmenter l'ouverture que font les lèvres. Secondement, je place une lame sous le lévier, qui sert à fair reculer ces mêmes lèvres. Troisièmmement, je place une lame sous le lévier, qui ouvre la soûpape du réservoir du vent qui vient des petits soufflets, qui ne sont point chargés. Je place en dernier lieu une lame sous le lévier, qui fait mouvoir la languette pour donner le coup de langue; de façon que ces lames venant à toucher dans le même termes les quatre lévices , qui servent à produire les susdites opérations, la Flûte sonnera le ré d'en bas." Vaucanson, *Le mecanisme du fluteur automate*, 13-14.

Of course, with its closed fingering, D_4 was a relatively simple note to play. Other pitches, with more complicated fingerings, required more steps—to say nothing of entire melodies.

Despite fixating on these mechanical details, however, Vaucanson still portrayed the machine's music in expressive terms. Through its mechanical organs, "the sounds may be swelled and diminished, softened, and strengthened, produce echoes, and give grace and expression to the tunes that are played."[12] Outside reviews also praised the subtle expressiveness of the musician. The Abbé Desfontaines, a confidante of Vaucanson, observed the machine and praised three of its airs in the keys of C, B, and D. He explained that in these pieces, "Tonguing is marked and precise, and with tasteful diminuendi, graceful tenuti, portamenti, sharps, flats and slurs, lively vibrato, pearled cadences, even echoes; no ornament is unknown to the inanimate flutist."[13] The clergyman especially singled-out the difficulty of the flutist's music, which included an air by Michel Blavet, "Le Rossignol."[14] The newspaper, *Mercure de France,* made a similar statement about the automaton's pleasing phrasing, writing:

> One has the pleasure of being able to listen to this mechanical figure for more than a quarter of an hour, as it performs like a master fourteen airs, each of them different in character, in range of notes, and in tempo.

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[12] Vaucanson, *An Account of the Mechanism of an Automaton, or Image Playing on the German-Flute*, 8.
[13] Guillaume François Fouques Deshayes Desfontaines, "Lettre CLXXX," in *Observations sur les écrits modernes*, vol. 12 (Paris: Chez Chaubert, 1738), 338.
[14] Ibid. "It is a faun seated on a rock which plays the flute and performs, with as much force and elegance, with destiny and precision, several symphonic airs, some of which are quite difficult, like le Rossignol by Blavet, of which the faun was a disciple."

> Variations, so attractive on this instrument, have not been omitted, and everything, including crescendi, diminuendi, and even sustained notes, is executed with the perfect and good taste.[15]

These descriptions of musical pleasure may seem inconsequential when compared to the machine's impressive anatomy, but they together establish that the mechanics of the machine's interior were inseparable from the aesthetics of its exterior. Using the language of music criticism, reviewers like the *Mercure* and Desfontaines distinguished the music of the machine from the sound of traditional machine labor; its "tasteful diminuendi," "portamenti," and "crescendi" were traditionally heard as musical nuances produced by unadorned human organs. By inscribing these expressive elements on to a camshaft, Vaucanson showed the accuracy of the musician using aesthetic rather than biological criteria: its physiology was not scientifically verified but musically enjoyed.

Moving Statues

For Enlightenment audiences, the connection between aesthetics and biology was already well established in the arts, where external appearances had long functioned as a tool to communicate inner depth. Perhaps the archetypal example was the Pygmalion myth. Throughout the eighteenth century, "Pygmalion Mania" was everywhere in France: in operas by Antoine Houdard de la Motte (1700), Jean Phillipe Rameau (1748), and Jean-

[15] Louis Dutens, "Lettre sur une automate, qui jou aux échecs," *Le Mercure de France*, 1770, 2 edition; Quoted in Paul Metzner, *Crescendo of the Virtuoso: Spectacle, Skill, and Self-Promotion in Paris During the Age of Revolution* (Berkeley and Los Angeles, CA: University of California Press, 1998). Interestingly, Vaucanson himself cites only twelve airs in his pamphlet. It is uncertain why the *Mercure* states fourteen.

Jacques Rousseau (1770); theatrical productions by Jean-Antoine Romagnesi (1741) and Louis Poinsinet de Sivry (1760); paintings by Jean Raoux (1717), François Lemoyne (1729), and Jean-Honoré Fragonard (date unknown).[16] For these audiences, the Pygmalion story of a statue sprung to life offered an opportunity to question the differences between subjects and objects, nature and art, and mind and matter. André-François Boureau-Deslandes's 1741 play, *Pigmalion, ou la statue animée*, is a classic example, portraying the statue's dawning subjectivity as an incremental progression from movement, to thought, and finally speech; "What do I hear…and what language do you hold?" inquires the newly awoken statue, "What is a god? What is nature? …I do not know, and everything is new to me. Of grace, teach me."[17] With each question—of language, god, nature, and life—Boureau-Deslandes imagines the statue's ignorance as a kind of wisdom, allowing it to express a curiosity that was the cornerstone of Enlightenment ideology. The remainder of the play was an opportunity to think through these questions.

As an eighteenth-century thought experiment, the Pygmalion myth allowed artists and intellectuals to question how the explicit knowledge we gather from the body informs the implicit knowledge we infer about the mind. Different adaptations staged the statue's embodiment in different ways. In Raoux's 1717 painting of the myth, *Pygmalion amoureux de sa statue* (Figure 1.2), the painter conveyed the statue's humanity through color. Flanked by the gods Aphrodite, Cupid, and Hymen, the statue's lifeless marble-

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[16] J. L. Carr, "Pygmalion and the Philosophes: The Animated Statue in Eighteenth-Century France," *Journal of the Warburg and Courtauld Institutes* 23, no. 3/4 (1960): 239–55.

[17] " Qu'entends-je…et quel langage me tenez-vous? Que'est-ce qu'une Divinité? Qu'est-ce que la Nature? Qu'est-ce que vivre par vous et pour vous? Je ne sçai rien: tout m'est nouveau; de grâce, instruisez-moi." M. (André François) Deslandes, *Pigmalion ou la statue animée* (London: chez Samuel Harding, 1742), 64.

white legs gradually surrender to rosy pinks and oranges in its animated face. Not only does the sculpture's flesh appear like flushed human skin, but Raoux contrasted its body with the gods around it—matching the supple coloring of their skin and hair. Also, while the Goddess Venus touches the sculpture's skull, the seat of Descartes's soul, Cupid touches its heart, and Hymen takes its pulse—giving the onlooker visual confirmation that its rosy hue comes naturally from the head and heart.[18] In Rameau's *acte de ballet*, on the other hand, the statue's awakening occurs first in the movement of its body as it slowly descends from its pedestal towards the artist, then in its sparsely accompanied recitative where it voices its self-awareness;

LA STATUE (walking)	
Que vois-je? Où suis-je?	What do I see? Where am I?
Et qu'est-ce que je pense?	And what do I think?
D'où me viennent ces mouvements?	Where do these movements come from?
Que dois-je croire?	What should I believe?
Et par quelle puissance	And by what power
Puis-je exprimer mes sentiments?	Can I express my feelings?

Rameau and his librettist, Bollot de Sauvot, staged the statue's dawning consciousness through movement and words: its first steps showcase a being that moves like a human; its first words showcase a being that communicates like a human. Even the accompaniment conveys the statue's newfound intelligence; its first questions, "What do I see? Where am I," are almost entirely unaccompanied, but the final yearning for feeling, "Can I express my feelings," is granted a decisive orchestral cadence. The statue begins

[18] Julie Wosk, *My Fair Ladies: Female Robots, Androids, and Other Artificial Eves* (Rutgers, NJ: Rutgers University Press, 2015), 11.

the scene as a prop or stage dressing, but becomes, for Rameau, a character. Only by the end of the stanza does the statue warrant the musical and dramaturgical treatment of a typical operatic heroine.

Figure 1.2: Jean Raoux, Pygmalion amoureux de sa statue (1717), Oil on canvas, Musée Fabre.

Pygmalion's ubiquity reveals not only that eighteenth-century audiences were conversant in the bodily cues that signaled Galatea's inner transformation, but also that

Vaucanson's automaton coincided with a robust conversation about the philosophical differences between mind and matter, art and nature. Vaucanson thrust his machine into these debates when he based the appearance of the musician on Antoine Coysevox's 1709 sculpture, *Berger jouant de la flûte*, a marble statue depicting a faun playing the flute with a satyr seated at his feet (See Figure 1.3). Although garbed in different clothing, Vaucanson's automaton emulated the form and appearance of Coysevox's statue, which was sculpted in the act of playing its instrument, flute upright and fingers strained. The statue's slightly askew head and shoulders perpetuate the illusion of sound, leading one contemporary to muse that the faun is privy to sounds unheard by the onlooker.[19] Although only a few engravings exist today of Vaucanson's automaton (such as the one reproduced in Figure 1.1), they capture the same stooped appearance as Coysevox's sculpture, as if both musicians were engrossed by the sound of their own playing. The *Mercure de France* singled-out the automaton's similarity to the statue, remarking that it "is an exact and well-rendered copy of the faun executed in marbled by the late M. Coysevox…with this only difference that the copy that we succinctly discuss here, plays the physical elements of the German flute well."[20] While the statue's form provided Vaucanson with a body on which to base the automaton's appearance, its symbolism no doubt spurred the inventor's interest. The faun was an emblem of Arcadian mythology,

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[19] Jean-Baptiste Fermel'huis, *Eloge funèbre de Coysevox (né vers 1640, mort le 10 octobre 1820), sculpteur du roy prononcé à l'Académie par Fermel'huis, docteur en médecine* (Paris: J. Collombat, 1721), 20.

[20] "Cette figure est assise et dans une attitude simple, juste et disposée comme il le faut pour jouer dans la flûte traversière; en un mot, c'est une copie exacte et très bien rendue du faune exécuté en marbre par feu M. Coyzevaux, sculpteur célèbre, et qui se présente au bout de la grande terrasse des Tuileries, en entrant par la porte du Manège, avec cette seule différence que lu copie dont nous rendons ici compte, succinctement, joue bien réellement et physiquement de la flûte allemande." Quoted in André Doyon and Lucien Liaigre, *Jacques Vaucanson: mécanicien de génie* (Paris: Presses Universitaires de France, 1966), 52. from *Le Mercure de France*, April 1738, p. 739

rooted in the late seventeenth and early eighteenth centuries' yearning for a return to an imagined Grecian or Roman past. For artists like Coysevox, the natural idylls of Arcadia were an opportunity to consider humanity before the corrupting influence of modern society. Offering escape from the lascivious and bawdy effects of modern life, this Arcadian myth represented humanity returned to its original *tabula rasa*: inherently rational, reasoned, and humane. By bringing that Arcadian ideal to life through machinery, the inventor was not merely re-animating a meaningless human shape; instead, the shepherd's form was the idealized Enlightened subject, a body and mind that eighteenth-century onlookers already idolized.

Figure 1.3: Charles-Antoine Coysevox, Berger jouant de la flûte (1640), Marble, Louvre Museum

Vaucanson painted the machine marble-white to match the sculpture's stone facade.[21] By not coloring the machine like a human body, Vaucanson might have intended for the machine to function more like a living statue than a mechanical human. This was a canny decision on the inventor's part; as a mechanical human, the automaton would have been judged for its accurate reproduction of other humans, transcending the mechanical to remake the biological. Instead, he aligned the automaton's marble

[21] Joan B. Landes, "The Anatomy of Artificial Life: An Eighteenth-Century Perspective," in *Genesis Redux: Essays in the History and Philosophy of Artificial Life*, ed. Jessica Riskin (Chicago: University of Chicago Press, 2007), 99.

appearance and uncanny movement with a similar magic to the one eighteenth-century audiences had witnessed animating Pygmalion's sculpture onstage—a divine intervention of stone becoming flesh. The metaphor of transmutation is particularly apt given that Vaucanson, while building his flutist, discovered that its wooden fingers failed to cover the holes on the flute adequately. Borrowing a technique from his father, a glove maker, he lined each fingertip with skin [*peau*], "to mimic the softness of the natural finger, to be able to plug the hole exactly."[22] Gaby Woods notes, however, that, although Vaucanson likely used leather or hide, the French word *peau* makes no distinction between animal and human skin.[23] Thus, in order to properly sound its instrument, the machine mimicked the very transformation that Raoux depicted in his Pygmalion painting, as the sculpture's marble base eventually gave way to fleshy hands.

Although the automaton's form acquired mythological meaning as an Arcadian artwork come to life, the deliberate movement of its limbs and fingers also suggested a more macabre spectacle of life petrified into art: the *écorché*. *Écorchés* are anatomical paintings or sculptures displaying the human body without skin. Popular in the eighteenth century, they were often created from real human remains (the veins injected with a preservative) or from other artistic material, allowing students and spectators to survey the body's anatomy without the messy viscera of dissection.

The historian Joan Landes explains that for contemporary audiences Vaucanson's automata performed a function similar to these anatomical models. Although the flutist

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[22] "Chaque bout de doigt est garni de peau, pour imites la mollesse du doigt naturel, afin de pouvoir boucher le trou exactement" Vaucanson, *Le mécanisme du flûteur automate.*, 11.
[23] Wood, *Edison's Eve: A Magical History of the Quest for Mechanical Life*, 26.

did not provocatively display its innards like other *écorchés*, it showcased those innards in the automaton's movement. According to Landes, no matter how spectacular the machine's performance might have been, the automaton directed the onlooker's attention inward to question the supposed mechanisms of its organs. Vaucanson himself took this pedagogical perspective in a letter to Abbé Desfontaines. Writing of his automaton-duck, he explained how its mechanical wings allowed him to display duck anatomy and demonstrate its mechanical movement like a machine, creating the impression of an anatomical model that has been animated:

> The inspection of the Machine will better shew that Nature has been justly imitated, than a longer Detail, which wou'd only be an anatomical Description of a Wing. To shew that the Contrivances from moving these Wings are one thing like what is made use of in those wonderful Pieces of Art of the Cock mov'd by the Clocks at Lyons, and that at Strasburgh, the whole Mechanism of our artificial Duck is exposed to View; my Design being rather to demonstrate the Manner of the Actions, than to shew a Machine.[24]

If the flayed flesh of the *écorché* allowed Enlightenment spectators to gawk at the exposed anatomy of the human, Vaucanson subsumed that macabre curiosity into the actions of the automata, allowing their audiences to intuit the mechanics of bones, ligament, and muscles in motion. Indeed, the popularity of the *écorché* aligns with the general fascination about the body that entertained eighteenth-century Parisians. Landes, among others, notes that anatomical lessons and operating theaters were themselves venues for

[24] Vaucanson, *An Account of the Mechanism of an Automaton, or Image Playing on the German-Flute*, 22.

popular entertainment during this period.[25] Vaucanson himself attended these public dissections during his first trip to Paris between 1728 and 1731, and he eventually came into close contact with the surgeon Claude-Nicholas Le Cat, who may have first inspired the young inventor to create a human automaton.[26] The co-mingling of *écorché*, public operating theaters, and Vaucanson's automata attest to the growing appetite for anatomical spectacles around the city, demonstrating the combination of grotesque curiosity and scientific inquiry.

In his public writing, Vaucanson was proud of the anatomical ambitions of his machine. He painstakingly outlined the different details of the automaton-flutist's organs, concluding that, "It is on these physical causes that I have tried to support my research by imitating a similar Mechanics in an Automaton, to which I have tried to produce a similar effect by making him play the Flute."[27] Moreover, discussing details of the automaton-duck's wings, he remarked, "I do not think that Anatomists will have anything to say about the construction of its wings. We have imitated, bone by bone, all the protrusions they call apophyses."[28] Nevertheless, despite the scientific pretense of Vaucanson's research, the automata were not anatomically accurate, and they offered little genuine insight into human biology. Discussing the description of the flutist to the *Académie*, the historian Marc Olivier notes that the Vaucanson's only real discovery about the body was

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[25] Landes, "The Anatomy of Artificial Life," 101.
[26] Doyon and Liaigre, *Jacques Vaucanson: mécanicien de génie*, 120.
[27] "C'est sur ces causes Physiques que j'ai essayé d'appuyer mes recherches, en imitant une semblable Mécanique dans un Automate, à qui j'ai taché de faire produire un semblable effet en le faisant jouer de la Flute." Vaucanson, *Le mécanisme du flûteur automate*, 8–9.
[28] "Je ne crois pas que les Anatomistes avent rien à désirer sur la construction de ses ailes. On a imité, os par os, toutes les éminences qu'ils appellent apophyses." Vaucanson, 20.

that lungs required a great deal of air pressure to sound the instrument.[29] Moreover, even the digesting duck, so praised for its capacity to consume and excrete feed, was later revealed to swap the grain it was fed with fake excrement.

What value, then, did the automaton-flutist provide if it did not test biological theories about the body? The most straightforward answer, Olivier notes, was that the inventor's social advancement and economic livelihood were tied to the success of his machines. Among the general population, the automata's exhibitions were widely praised but never financially successful. Instead, the machines won Vaucanson acclaim among Parisian intellectuals like Voltaire, D'Alembert, and Diderot, and he leveraged that prestige for a lucrative court appointment in 1741. Although Vaucanson designed the musician to showcase its bodily functions, the automaton-flutist did not align with an eighteenth-century understanding of human anatomy. While humans have only one set of variable-pressure lungs, Vaucanson's flutist featured three differently-weighted bellows. Likewise, the natural mouth can create flexible forms through the lips, but the machine's embouchure could only move along two axes: forward and backward, wider and narrower. Even the machine's seven movable fingers—despite their leather covering—were fixed and unyielding when compared to the immeasurable dexterity of the natural hand. The automaton's hands were precisely engineered to hold a flute, but ill-equipped to execute any other kind of task. What mattered foremost was that the machine played the flute in a way that appeared similar to how humans make music.

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[29] Marc Louis Olivier, "Ghosts in the Machine: Nostalgia and Technology under the Ancien Régime" (Ph.D., United States -- Washington, University of Washington, 1999), 198.

The flutist, then, was neither *écorché* nor living statue—although it was received as both. Instead, the automaton's statue-like appearance and human-like performance provided evidence of the machine's internal depth. Indeed, what is remarkable about the automaton is not the faulty praise heaped on the flutist's anatomical veracity; it is that the machine's movement and music appeared natural enough that onlookers could accept the inventor's biological sleight-of-hand. The cultural historian Bianca Westermann dubs this synthesis of biology and aesthetics "biomorphism." Although biomorphism originated in the 1930s to describe abstract and surreal art, Westermann expands the term to describe any art object whose aesthetic power resides in its resemblances to natural forms.[30] In Vaucanson's flutist, the machine's effectiveness as a model for artificial life relied on the aesthetic precision of its external performance (and the fidelity of sound) rather than the biological accuracy of its internal organs. No one minded that the machine had three lungs and only seven fingers; what mattered was that its movement and music were sufficiently natural sounding and looking. Its performance, then, rendered its artificial body as a spectacle to behold rather than a cadaver to be dissected.

Music and the Organs of Language

Westermann's biomorphic reading of Vaucanson's flutist draws attention to the ways automated music was distinguished from the nonmusical actions enacted by other automata. With its mechanical organs, the machine demonstrated a musical sensibility

[30] Bianca Westermann, "The Biomorphic Automata of the 18th Century: Mechanical Artworks as Objects of Technical Fascination and Epistemological Exhibition," *Figurationen* 17, no. 2 (December 1, 2016): 123–37.

that audiences not merely heard as sound, but understood as music, lending voice to an aesthetic competence that resembled human music-making. Jean-Jacques Rousseau understood the importance of this musical sensibility, explaining in his *Essai sur l'origine des langues* (1781), the difference between meaningless noise and meaningful song; "The musician who wants to render noise with noise is mistaken; he knows neither the weakness nor the strength of his art; he judges it without taste, without enlightenment; teach him that he should render noise with song, that if he would make frogs croak, he has to make them sing."[31] For Rousseau, the dichotomy between noise and song was a central part of his philosophy of communication. Noise was analogous to nonsense, transmitting little information between a speaker and a listener. Songs and melodies, on the other hand, were laden with meaning, imitating "the accents of languages, and the turns of phrase appropriate in each to certain movements of the soul."[32] Rousseau depicted song as a kind of language, describing it as an aesthetic vocabulary that musicians use to convey their interior feelings to a listener. Through song, the musician gives voice to their soul.

For many eighteenth-century commentators, Rousseau's philosophy of language was part of a more substantial material turn throughout the Enlightenment as thinkers reconciled the relationship between the observable body that can be tested and dissected, and the immaterial mind which cannot. As I discussed in the previous chapter, this

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[31] Jean-Jacques Rousseau, "Essay on the Origins of Languages," in *Essay on the Origin of Languages and Writings Related to Music*, trans. John T. Scott, vol. 7, The Collected Writings of Rousseau; (Hanover, NH: University Press of New England, 1998), 323.
[32] Ibid., 422.

"mind-body problem," was first noted more than a century earlier by René Descartes, who posited essential divisions between the mind/soul and body, which he believed were comprised of distinct essences.[33] Descartes's substance dualism was accepted well into the eighteenth century, but its decline was hastened by the philosopher's failure to solve the mind-body problem definitively. The Cartesian explanation rested too heavily on a soul governed by an active god, which became incompatible with an increasingly deistic European intellectual tradition.[34] Non-Cartesian thinkers like Rousseau addressed the irreconcilable differences of *res extensa* and *res cogitans* by collapsing the pair into a single material substance, a theory of philosophical monism called "materialism." While not all philosophers of language were materialists, there was significant overlap between the materialist investigations of the mind and the search for the origins of language. Rousseau, in his essay on pronunciation, succinctly remarked, "the analysis of thought is made through speech,"[35] and the French philosopher Étienne Bonnot de Condillac inverted Descartes's first principle by portraying the linguistic sign as a *first experience*, understanding the mind by observing its outward manifestation on another.

When Vaucanson's flutist premiered in the 1730s, it was almost immediately hailed by Enlightenment thinkers as an example of the materialist mind at work. The machine appeared to address two critical problems in the philosophy of language: the

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[33] George Makari notes how Descartes used "mind" and "soul" interchangeably. An early translation of Descartes's *Meditation* translated the Latin *mentis* as the French *esprit*, and *anima* as *âme* or soul. In the later Sixth Meditation, Descartes removed this distinction, and approved translations that conflated mind and soul. Makari concludes, "Descartes exploited the ambiguity in French to unify the indisputable thinking being with that eternal life force and distinguish both from the material body. *Espirt* and *âme, mentis* and *anima*, mind and soul: all were one." Makari, *Soul Machine*, secs. 37–38.

[34] Aram Vartanian, *Diderot and Descartes.* (Princeton: Princeton University Press, 1953).

[35] Rousseau, "Essay on the Origin of Languages," 334.

physiological question of how subjects speak, and the semantic question of how listeners understand—a distinction between making *noise* and perceiving *sense*. The historian Minsoo Kang discusses how materialists positioned Vaucanson's automata as an alternative to Cartesianism, as the machine modeled actions that Descartes had allocated wholly to the soul. While Descartes's body acquired its agency from a divine soul acting upon the body—what the historian Jessica Riskin has called *theological* or *classical mechanism*—the automaton's agency manifested from the internal mechanics working within the body, driving it into action.[36] The flutist's mechanical body, shows Kang, symbolized a broader disenchantment that swept through the Enlightenment as wonder and magic were evacuated from natural phenomena. By the dawn of the nineteenth century, commentators had compared Vaucanson's machines to everything from the internal working of the natural body, the political maneuverings of the body politic, and the predictable orbits of celestial bodies. "The automaton," Kang concludes, "became the central metaphor of the age."[37]

While there can be no denying that automata loomed large in the public imagination after Vaucanson's machines premiered, the flutist's reception among eighteenth-century materialists suggests that physiological noise and physiognomic sense were tightly integrated. For these thinkers, there was no dividing the mechanics of the organs from the actions that they produced. One of the most radical theorists of the materialist mind during the Enlightenment was the French physician Julien Offray de la

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[36] Riskin, *The Restless Clock*, 4–5.
[37] Kang, *Sublime Dreams of Living Machines*, 112.

Mettrie. In the mid-eighteenth century, La Mettrie wrote a series of irreverent, yet forward-thinking, treatises that sought to disprove the incompatibility of *res cogitans* and *res extensa*, reducing the soul to a function of anatomy. "He who would learn the properties of the soul" began La Mettrie in *L'histoire naturelle de l'âme* (The Natural History of the Soul; 1745), "must first seek those which clearly show themselves in the body, whose active principle the soul is."[38] La Mettrie's mature theory of materialism emerged in his second treatise, *L'homme machine (*Man, A Machine; 1747), where he likened the soul's actions to the mechanics of a machine. He began by dismantling the dualism of the Cartesian body and soul, noting, for instance, how bodily afflictions influence the mind: drugs, age, disease, sleep, food, climate, and brain damage. If mind and matter were truly distinct substances as the Cartesians believed, there should be no relationship between the body's illnesses and the mind's function—the senility of old age or the intoxicating effect of liquor would have little impact on a subject's behavior. Because there is a clear relationship between these factors, La Mettrie concluded that Descartes was half-right: the Cartesians portrayed the body as a passive machine piloted by an active soul, while La Mettrie showed that body and soul were equally mechanical.

Vaucanson's flutist became a test-case for La Mettrie's theory of the mind. The inventor had stripped the act of playing the flute down to its most basic elements, modeling only those organs that were necessary for sounding the instrument. Thus, the automaton possessed lungs and fingers, but no soul or mind; it played music, but had no

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[38] Julien Offray de La Mettrie, *Machine Man and Other Writings*, trans. Ann. Thomson (Cambridge: Cambridge University Press, 1996), 43.

agency. For La Mettrie, who reduced the mind to the body's observable physiognomy, the automaton demonstrated the feasibility of language-like utterances without the soul's intervention. What distinguished La Mettrie's mechanical-man from natural-man was not the presence or absence of a soul, but the complexity of its body: cognition was a symptom of the body's complex machinery. To demonstrate the intricate mechanics of the materialist mind, he appealed to the actions of Vaucanson's flutist:

> Man is to apes and the most intelligent animals what Huygens' planetary pendulum is to a watch of Julien le Roy. If more instruments, wheelwork, and springs are required to show the movements to the planets than to mark and repeat the hours, if Vaucanson needed more art to make his flute player than his duck, he would need even more to make a talker, which can no longer be regarded as impossible, particularly in the hands of a new Prometheus."[39]

Throughout *L'homme machine,* the author gloried in the complexity of nature. La Mettrie likened the superiority of humans' intelligence over apes' to the superior timekeeping of Christiaan Huygens's pendulum clock over le Roy's inferior hair-spring model.[40] He exercised a similar judgment when praising the flutist's musical body over the duck's digesting one, believing that the musician required more "art." For La Mettrie, cognition and intelligence were properties of the body's functioning, and the more complex a subject's body, the more complex its behavior. Thus, the flutist's verisimilitude was assured by its intricate mechanics.

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[39] Julien Offray de La Mettrie, *Man a Machine; and, Man a Plant*, trans. Justin Leiber (Indianapolis: Hackett Pub. Co., 1994), 69.

[40] Ibid. For him, mankind was the ultimate machine because "nature had necessarily to employ more art and install more organs to make and maintain a machine that might mark all the throbbings of the heart and mind over an entire century."

An important marker of human complexity, however, was the vocal tract—the organs that enable humans to voice their thoughts and communicate meaningfully. Focusing on the voice organs, La Mettrie believed that humans elevate themselves above animals and machines, honing their cognition by speaking with one another. He did not claim that humans are cognitively predisposed for language, as Noam Chomsky asserted two centuries later. Instead, in banishing the formal differences between the Cartesian body and soul, La Mettrie argued that humans' predilection for language resulted from their superior speech organs. As a result, although the automaton was unable to speak, it possessed some of the organs for speech, which proved the viability of a similar mechanical voice that could evince and develop a mechanical mind. La Mettrie replayed this argument elsewhere in *L'homme machine*, noting that speech would enable the intelligence of other nonhumans. He was especially excited about the prospect of teaching apes to communicate, finding that "the structure and functions of the speech organs in apes are so similar to those in man that I have almost no doubt that if one trained this animal perfectly, one would finally teach it to articulate and, thus to learn a language."[41] Having mastered language, these nonhumans would learn to express feelings like our own, "as well...muscled as we are for thinking and profiting from his education."[42] By shifting the problem of the origins of language to the organs producing language, La Mettrie challenged a century of Cartesian doctrine about the nonhuman that denied

[41] Ibid., 37.
[42] Ibid., 41.

them the higher-level cognition of a soul. Instead, fitted with the proper mechanics, animals and machines alike would eventually develop their own materialist minds.

Undeniably, these were controversial ideas in the eighteenth century. Soon after the publication of *L'homme machine*, the French government branded La Mettrie a heretic, and he fled to the protection of Frederick the Great. Even in that Enlightened Prussian court, however, La Mettrie's radical opinions and eccentric personality were an affront. One philosophy professor in Göttingen quipped that *L'homme machine* should be dismissed because, if La Mettrie were correct about the mechanical man, then he would himself be like a machine and thus excused for his profane theories.[43] La Mettrie took this joke to heart, soon adopting the epithet "Mr. Machine" in a series of self-satirizing pamphlets where he likened himself to Vaucanson's automaton-duck: "For Mr. Machine is like [Vaucanson's duck] without soul, without spirit, without virtue, without discernment, without taste, without politeness, and without morals. Everything is body, everything is matter in him."[44] In dismissing soul, spirit, and virtue, La Mettrie disrupted centuries of Church hierarchizing about the Great Chain of Being, which organized all creatures from the lowliest insects to the highest angels by the divinity of their souls. If a man is no better than animals or machines, where does that leave God's intelligent design? La Mettrie's critics were relieved when the real Mr. Machine died in 1751 from food poisoning, and his ideas faded into obscurity.

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[43] Quoted in Julien Offray de La Mettrie, *L'homme machine: a study in the origins of an idea.*, ed. Aram Vartanian, Critical edition with an introductory monograph and notes by Aram Vartanian. (Princeton: Princeton University Press, 1960), 101.

[44] Julien Offray de La Mettrie, "Épître à Mlle. A.C.P. ou la machine terasse," in *Oeuvres Philosophiques de La Mettrie.*, Nouvelle éd., (Berlin: Chez Charles Tutot, 1796), 237, http://hdl.handle.net/2027/mdp.39015033168447.

Echoes of La Mettrie's materialism persisted, however, throughout the reception of Vaucanson's machine. The Abbé Desfontaines also likened the flutist to a talker, comparing the automaton to the medieval myth of Albertus Magnus's bronzed head, whose magical mouth could correctly answer any question. However, unlike Vaucanson's machine, explained Desfontaines "the talking head of Albert the Great is a fable, and it is shown to be impossible. The articulated sound of the human voice cannot be imitated by art because it is not possible to know distinctly and precisely all that happens in the larynx and in the glottis when a man speaks." Desfontaines, then, stopped short of claiming Vaucanson's musician a true speaking machine, but he did note how the flutist's mechanical organs would play an essential role in the construction of a future speaking machine;

> To imitate [the voice], one must also understand it. It would be necessary also to know perfectly the action of the tongue, its folds, its motions, its varied and imperceptible friction, and all the modifications, either of the jaw, or of the lips, which contribute to the formation of articulated sounds.[45]

Following Vaucanson's success, the prospect of a machine fitted with speech organs eventually became one of the principal engineering problems for automata designers in the late eighteenth and century. The inventor Wolfgang Kempelen developed one of the first speaking machines in 1769—the same year that he premiered his famous chess-playing automaton. While the chess-player was later revealed to be a fraud, that machine was eventually fitted with the mechanics to pronounce the word "échec" upon

[45] Desfontaines, "Lettre CLXXX," 341.

checkmating its opponent.[46] The English physician, Erasmus Darwin created a talking head in 1771 from a wooden mouth and soft leather lips; for vocal cords, he used a smooth ribbon which, when stirred by a gentle current of air (from lung-like bellows), would create a voice-like tone. Coordinated with its wooden mouth, his machine could allegedly pronounce the consonants p, b, m, and the vowel a, allowing it to say, the words "mama," "papa," "map," and "pam."[47] Perhaps the most notorious attempt at creating a mechanical voice was carried out in the 1840s by Joseph Faber, whose "Euphonia" reproduced the torso and head of a Turkish man, with fourteen piano keys positioned in the back to control the jaws, lips, and tongue. By some accounts, the machine pronounced a variety of words and phrases, despite suffering from poor diction and a monotonous voice.

La Mettrie's philosophy of the embodied mind demonstrates how materialist thinkers incorporated the voice's mechanics into a larger project of social being. To have a voice—to speak and be understood—was the first step towards Enlightenment. The capacity for speech enabled subjects to understand their environment, cultivate a sense of self-awareness, and empathize with others. The anatomy of the voice, then, was wedded to the public performance of being an Enlightened subject. Mechanical "talkers" were rooted in this materialist promise; by provocatively demonstrating the *organs* for language, they sought to stage the *origins* of language for an audience, mechanizing the spectacle of communication without relying on the external agency of the Cartesian soul.

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[46] As Edgar Allan Poe notes in his famous debunking of the machine, the speech organ was added only after the machine passed from Kempelen's ownership. Edgar Allan Poe, "Maelzel's Chess Player," in *The Works of Edgar Allan Poe* (New York: P.F. Collier & Son, 1903), 300.

[47] Thomas L. Hankins and Robert J. Silverman, "Vox Mechanica: The History of Speaking Machines," in *Instruments and the Imagination* (Princeton, NJ: Princeton University Press, 1995), 198.

Vocal mechanics allowed the machine to mimic the symptoms of Condillac's and Rousseau's philosophies of language, creating a machine whose utterances seemed to evince a more profound lived experience.

Nevertheless, Jessica Riskin explains that these experiments were deemed failures and, the impulse to simulate speech waned by the arrival of the nineteenth century. Faber's Euphonia was a financial catastrophe, and he sold his machine to P. T. Barnum in 1873, where it continued as a circus sideshow.[48] It was not until the development of phonography that the prospect of fully-synthesized speech came to fruition. Unlike earlier talkers that reproduced speech by recreating the organs for speech, early phonographic recording demonstrated the feasibility of a voice without the accouterments of the body. Still, as Michel Chion and Brian Kane have each noted, this disembodied sound—the acousmatic voice—was almost immediately received as an emblem of dehumanization. Separated from its anatomical source, the phonographic soul emphasized not just the absence of its body, but the absence of its humanity.[49]

Producing a Theater of the Mind

For French sensationalists like Condillac and Rousseau, language has a moral imperative to connect with the body.[50] Believing that all the mind's faculties naturally developed

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[48] Jessica Riskin, "Eighteenth-Century Wetware," *Representations* 83, no. 1 (August 1, 2003): 107.
[49] See Brian Kane, *Sound Unseen: Acousmatic Sound in Theory and Practice* (New York, NY: Oxford University Press, 2014), 185.
[50] French sensationalism was greatly influenced by the British schools of the mind following John Locke's *Essay Concerning Human Understanding* (1689), but the French thinkers differed from the British on the faculties of logic that subjects naturally possessed. For thinkers like Condillac and D'Alembert, the subject's intelligence is entirely contingent on the sensations experienced from outside phenomena. It is these experience that allow logic, reason, self-reflection, and language to develop.

from sensation, they theorized that the first humans responded instinctually to new or familiar feelings with guttural cries or crude gestures that over time coalesced into a shared vocabulary. By expressing their needs through the voice, and learning to interpret the utterances of others, early humans developed a natural language of gesture and sound that allowed them to not merely to manifest their thoughts through words and actions, but also to cultivate it and hone their capacity for memory, reason, and self-awareness. This theoretical proto-language, what Condillac called *langage d'action*, enabled philosophers to imagine an origin of language connected to the affective vocabulary that all individuals share through the body's sensorium. When another person hurts, we instinctually connect the appearance of their pain to our memory of painful sensations; when they celebrate, we connect it to our pleasurable feelings. Through the body and voice, a subject sympathetically transmits their thoughts and feelings into the embodied mind of another. However, not all languages are created equal. Both Condillac and Rousseau castigated modern languages for severing speaking subjects from their authentic relationship with the body. While they celebrated the *langage d'action* for preserving a connection between feelings and voice, Rousseau and Condillac criticized modern languages (especially French) for severing that relationship. The search for the origins of language, then, was an attempt to rewind the natural mind to a time before its authentic relationship with the body had been complicated by modern life.[51]

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[51] As the musicologist Downing Thomas summarizes, Enlightenment thinkers imagined an origin of language where "they hoped to be able to understand and shape contemporary conceptions and uses of language, and to form a critique and redemptive vision of the social order that is articulated through language." Downing A. Thomas, *Music and the Origins of Language Theories from the French Enlightenment*, New Perspectives in Music History and Criticism (Cambridge: Cambridge University Press, 1995), 39.

Music was considered an essential part of that past. Not only did these philosophers celebrate early languages like Ancient Greek, Latin, and Chinese for being more rhythmic and tuneful; they theorized that linguistic communication itself evolved from music. Before humans learned to speak, these philosophers thought that they had to first learn to sing. In *L'Essai sur l'origine des connaissances humaines* (1746), Condillac speculated how the instinctual cries of the *langage d'action* would have naturally evolved into more precise pitch relationships, which he connected to Rameau's theory of the fundamental bass. He explained;

> What is the sound that is best suited to express a sentiment of the soul? In the first place, it must be the sound which imitates the cry that is its natural sign and is the same for declamation and music. Next, it is the overtone of the first, for they are closely connected. Finally, it is all the sounds that can arise from this harmony, as they vary and combine in the movement that characterizes each passion, for every sentiment of the soul determines the tone and movement of the chant which is more proper for its expression.[52]

Cleaving between the original language and modern language, the Rameauian *corps sonore* furnished Condillac with an utterance that had progressed beyond the guttural primitivism of the original language yet maintained its status as a natural sign. The meaning behind musical signs, then, is deeply connected to the sensations felt universally by all bodies. Many other eighteenth-century treatises on language traced similar relationships between communication and music: Condillac's *Traité des sensations* (1754),

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[52] Etienne Bonnot de Condillac, *Essay on the Origin of Human Knowledge*, trans. Hans Aarsleff, Cambridge Texts in the History of Philosophy (Cambridge; New York: Cambridge University Press, 2001), 141.

Rousseau's *Lettre sur la musique français* (1753) and the *Essai sur l'origine des langues* (1781), Diderot's *Lettre sur les sourds et muets…* (1751) and throughout D'Alembert and Diderot's *Encyclopédie*. The *philosophe* Friedrich Grimm summarized the central role that music played in the discussion of language when he remarked in the *Encyclopédie* that "the advantage that the musician's language has over that of the poet is that of a universal language over a specific idiom; the latter only speaks the language of his century and of his country, *whereas the former speak the languages of all nations and of all centuries*."[53] In a modern world awash with arbitrary signs, philosophers heard music as a living fossil: a modern practice that demonstrated how early humans inscribed meaning and power onto their voices. By studying the musical voices of the present, thinkers like Condillac hoped to understand the languages, and by extension the minds, of the past.[54]

Vaucanson engineered his automaton to play an instrument closely aligned with that musical voice, simulating the origins of language through the mechanical organs that enabled flute-playing. In this way, the mechanical musician produced a vocal experience that shunned the linguistic particularism of modern languages for the affective universalism of modern music. This chapter opened with Quantz comparing the look and sound of the instrument to the voice and body of a singer. Believing that the automaton-

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[53] Friedrich Melchior Grimm, "Lyric Poem," *Encyclopedia of Diderot & d'Alembert - Collaborative Translation Project*, May 1, 2016, http://hdl.handle.net/2027/spo.did2222.0002.817.

[54] More recently, scholars like Lawrence Zbikowski have noted the obvious differences between linguistic communication and musical communication. As Zbikowski explains, "musical meaning is on the whole much less precise than linguistic meaning; music often involves simultaneous events, where language does not; and there is more of a sense of play in ordinary music than there is in ordinary language." I discuss the distinction between linguistic and musical communication in greater depth in Chapter Three. Lawrence M. Zbikowski, "Dance Topoi, Sonic Analogues and Musical Grammar: Communicating with Music in the Eighteenth Century," in *Communication in Eighteenth-Century Music*, ed. Danuta Mirka and Kofi Agawu (Cambridge: Cambridge University Press, 2008), 285, https://doi.org/10.1017/CBO9780511481376.011.

flutist's timbre was flawed, Quantz denied that the machine possessed the expressiveness of a true musician. Many of Vaucanson's admirers, however, disagreed with Quantz's interpretation, and they praised the automaton's flute-playing for successfully cultivating the rhetorical affect of a singer's voice. Abbé Prévost, the author of *Manon Lescaut*, remarked that Vaucanson's machine "plays with all the precision of the best masters and charms the ear with sound," even if the audience is "frightened to see it move its fingers, to breathe, and to perform the most difficult tunes with precise softness and harmony."[55] Likewise, Desfontaines praised the careful engineering of the automaton's organs to produce music, noting how Vaucanson had "overcome" the "difficulty … to get sound from the lips of the faun, and to modify that sound at the embouchure of the flute so as to make it produce loud and weak tones, accompanied by tonguing."[56] He especially admired the inventor's ability to silence the mechanics of the machine, so that the internal noise of its gears did not overpower the external sound of its music. Acknowledging the line between nature and artifice, both Desfontaines and Prévost were charmed by the mechanical musician, hearing an aesthetic fluency that distinguished it from other, more mundane, machines.

By playing modern music rather than speaking a modern language, Vaucanson's machine cultivated a humanity that the talking-automata of Darwin, Kempelen, and Faber failed to model. Where those mechanical voices were derided for their limited vocabularies and monotonic effects, the flutist's aesthetic competence made the machine

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[55] Desfontaines quoted in Doyon and Liaigre, *Jacques Vaucanson: mécanicien de génie*, 49.
[56] He concluded that the automaton copies the "nature of those that play the flute well." Desfontaines quoted in Doyon and Liaigre, 51.

an ideal materialist subject. Of course, because the flutist lacked a body that could feel or a mind that could think, it was unable to organically learn and grow in the manner of La Mettrie's apes, but that deficiency was inconsequential; the machine simulated precisely the behaviors that materialists had used to imagine the origins of thought. The aesthetic experience of its music represented a linguistic utterance that listeners could not only perceive but feel.

The concept of "feeling" was important throughout eighteenth-century music pedagogy. The historian Adelheid Voskuhl notes how the actions of musical automata were idealized as subjects by instrumentalists looking to codify the communication of musical affect. Focusing on German instrumental music treatises, she explains how two automata-keyboardists from the end of the century—*La Musicienne* by the clockmakers Pierre and Henri-Louis Jaquet-Droz and *La Joueuse de tympanon* by David Roentgen—were heard as embodying the aesthetics of *Empfindsamkeit* celebrated in Quantz's *Versuch* (1752) and C. P. E. Bach's keyboard treatise, *Versuch über die wahre Art, das Clavier zu spielen* (1753). Throughout their treatises, these writers prescribed the bodily actions that would best stimulate a similar passion in the listener, outlining a philosophy of musical communication based on the conditioning of the musician's body and instrument's timbre.[57]

Voskuhl explains how these authors often confused the mechanical and the human. On the one hand, Bach and Quantz located the origins of musical sentiment in

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[57] Adelheid Voskuhl, *Androids in the Enlightenment: Mechanics, Artisans, and Cultures of the Self* (Chicago: The University of Chicago Press, 2013).

the performer's mind, suggesting that the performer must first authentically feel the proper passion before they can arouse it with their playing. On the other hand, both described the manipulation of passion in mechanical terms, requiring the musician to automate affect like a circuit breaker controlling "the affects in himself and in the audience" and using "his moving body for the transmission of this on-and-off switching."[58] Bach and Quantz each portrayed the musician as both a vehicle and driver of the passions, embodying a musical dualism that Voskuhl argued persisted in the keyboard-automata. The result was a form of musical communication that necessitated both feeling and performing. Quantz described this division with an unmistakable allusion to Vaucanson's flutist, remarking in the preface that since his goal was to "train a skilled and intelligent musician, and not just a mechanical flute player," his guide would seek to "not only educate [the musician's] lips, tongue, and fingers," but also to "try to form his taste and to sharpen his discernment."[59] For Quantz, the machine failed because it possessed only half of this musical dyad: it reproduced the lips, tongue, and fingers of a proper flutist, but lacked the *musical discernment* to educate those organs into meaningful, affective action.

Writing nearly twenty years after Quantz's *Versuch*, however, the French poet Claude Joseph Dorat celebrated the simulated affect of Vaucanson's flutist in his now forgotten prose-poem, *L'Opera* (1771). In rhyming couplets, Dorat explained how opera

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[58] Adelheid Voskuhl, "Motions and Passions: Music-Playing Women Automata and the Culture of Affect in Late Eighteenth-Century Germany," in *Genesis Redux: Essays in the History and Philosophy of Artificial Life*, ed. Jessica Riskin (Chicago: University of Chicago Press, 2007), 307.
[59] Quantz, *On Playing the Flute*, 7.

singers coordinate mind and body through the theatrical provocation of their voice: while vocal utterances originate from the material affordances of the larynx, those sounds are guided by a soul that invests them with the feeling and emotion of song. Like Bach and Quantz's discussion of instrumental pedagogy, Dorat's prose maintained the connection between the mechanics and aesthetics of the voice; the soul's feelings manifest in the voice's sound, which, when heard by a listener, provokes an analogous feeling in their soul. Singing, then, constitutes an emotional sympathy whereby feelings pass between the performer's mouth and the audience's ears. Dorat writes;

Selon que l'âme souffre ou que l'âme est contente,	Depending on whether the soul is suffering or happy,
L'inflexion doit suivre, ou vive ou gémissante;	The inflection must follow, either in joy or in mourning;
Des sons autour de nous éclatent vainement;	The sounds around us burst in vain;
Leur plus douce magie est dans le sentiment;	Their sweetest magic is within [our] feeling;
Le sentiment fait tout, c'est lui qui me réveille;	Sentiment is all that awakens me;
Par lui l'âme est admise au plaisir de l'oreille;	Through it, the soul accepts the pleasures of the ear;
Et je place l'Acteur privé d'un si beau don,	And I place the Actor, deprived of such a beautiful gift,
Au dessous du fluteur instruit par Vaucanson.[60]	Beneath the flutist built by Vaucanson.

Dorat portrayed the actor's body as an automaton-like vessel for their character's emotions, celebrating the machine's mechanical actions as an idealized example of the human singer's labor. Via the camshaft, the inventor exercised perfect control over the automaton's body. Vaucanson did not merely "educate" the machine to produce indiscriminate pitches on the flute. Instead, by controlling its mechanical organs, he could articulate minute shadings of timbre and intonation—subtle musical shifts that audiences could hear in expressive terms. Just as Vaucanson exercised complete control

[60] Claude Joseph Dorat, "Chant troisième: l'opéra," in *Poésies de Dorat*, vol. 1 (Geneva: Unknown Publisher, 1777), 47.

of the machine, so singers ideally controlled their voices, sublimating their mind by encoding their character's emotions onto the vocal tract. The inward play of organs motivated an outward spectacle of life that allowed onlookers not merely to witness an actor or a machine onstage, but also to feel a genuine kinship with a musical subject like themselves. These simulated emotions staged a theater of the mind, a spectacle in which the symptoms of thought—the musical sensibility celebrated by Quantz—were inscribed onto the timbre and character of song and simulated for an audience's benefit.[61]

The Musical Man-Machine

Throughout this chapter, I have shown that many of Vaucanson's listeners received the flutist as a musical subject; in the machine's performance, the audience heard the automaton reproduce many of the musical conventions that they had themselves learned to interpret in human musicians. By invoking an aesthetic vernacular that listeners already recognized as human, the machine simulated a correspondingly human-like mind. Modern interpreters of Vaucanson and La Mettrie often forget that aestheticism. Jessica Riskin, for instance, discusses how the automata of Vaucanson and others were received by contemporaries as examples of pure mechanism; "The materialist-mechanist understanding of intelligence," she explains, "operated at its most literal in the widespread consideration of speech, the defining function of human intelligence, as an

[61] The theater historian Pannill Camp has shown how theater space in the Enlightenment was often presented as a site for scientific understanding. "In an intellectual environment that cast aspersions on both metaphysics and hypotheses," writes Camp, "*mise-en-scène* stepped into a constitutive role in producing knowledge about the natural world. When applied to the direct investigation of nature, theatre's conceptual armature and staging techniques delivered phenomena to the sensing mind as unified objects for attention." Pannill Camp, *The First Frame: Theatre Space in Enlightenment France* (New York and London: Cambridge University Press, 2014), 119–20.

essentially physiological process."[62] By mimicking the messy biology of the human body—the fleshy fingers, digestive detritus, and pliable vocal cords that Riskin calls "wetware"—these inventors betrayed an interest in not merely analogizing the human, but simulating their anatomies. Nevertheless, given the critical role that physiognomy played in Enlightenment theories of the mind and language, Riskin's celebration of simulation and physiology seems unnecessarily reductive. The inward play of organs motivated the outward behaviors of life that onlookers used to intuit the machine's mechanical mind.

After the exhibition of Vaucanson's flutist, the spectacle of musical automata became a central metaphor for materialist philosophers struggling to understand other humans—a metaphorical thought-experiment that I adapt from Riskin called the "Musical Man-Machine."[63] In the *Lettre sur les sourds et muets…* (1751), for instance, Diderot conceived of humans as clock-like automata: the heart is like the winding-spring of a timepiece that ensures the mechanism continues in motion; the body houses all of the gears that maintain the clock's operation; the head is like a bell affixed with little hammers to ring on the hour; the soul, meanwhile, is like a little figure atop the clock that listens to see if the mechanism is in tune; "If many of these little threads are pulled at once, the bell will be struck several times, and the little figure will hear several notes simultaneously."[64] Diderot's depiction of the soul as a listener "hearing" the body drew on

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[62] Riskin, "Eighteenth-Century Wetware," 105.
[63] I adapt this term from Jessica Riskin's notion of the "Enlightenment Man-Machine," which she argues was part of an effort in the eighteenth century to understand the innerworkings of human through the metaphor of machines. Riskin, *The Restless Clock*, 151.
[64] Denis Diderot, "Letter on the Deaf and Dumb," in *Diderot's Early Philosophical Works*, trans. Margaret Jourdain (Chicago; London: Open Court Pub. Co., 1916), 185.

a well-worn Enlightenment metaphor that equated the mind's capacity for self-reflexive thought with the sympathetic vibrations of an instrument's strings. This acoustic principle allowed the musical man-machine to preserve the distance between the mind and body, while still acknowledging their physical relationship. La Mettrie's *L'homme machine*, for instance, compared the vibration of a violin's or harpsichord's strings with "the strings of the brain" which "repeat the spoken words that produce the sound waves that strike them."[65] Condillac's *Logique* (1778-80) offered an even more succinct account of the musical man-machine when he portrayed the body as a harpsichord and external sensations as the harpsichordist's fingers, likening the mind to the musical effects of a musician and instrument coming together. Not only did the harpsichord metaphor elide sensation and signification—the instrument sounds a note the moment that "sensation" plucks it—but the character of its utterances were inherently musical, corresponding to the exact musical pitches of a keyboard.[66] By likening the utterances of an intelligent being to the utterances of a musical instrument, Condillac, La Mettrie, and Diderot conceived of the mind as a performative organ that invariably renders thought as a spectacle for audiences to witness on the body.

The image of the human-harpsichord recalls another of Condillac's mechanical metaphors, this one from the *Traité des sensations* (1754), in which he imagined a statue whose mind gradually awakened to sensation. Condillac's statue achieved intelligence by arousing its senses one by one: first scent, then hearing, taste, sight, and finally touch. By

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[65] La Mettrie, *Man a Machine; and, Man a Plant*, 42.
[66] Étienne Bonnot de Condillac, "La Logique," in *Oeuvres de Condillac*, vol. 22, 23 vols., Works (Paris: l'Imprimerie de Ch. Houel, 1798).

withholding the senses in this manner, Condillac invited the reader to recognize the contingencies of the mind on its environment. At first, the statue's senses endowed it with only a crude recognition of pleasure and displeasure—positive and negative odors and flavors, music and noise, vibrant and dull colors—but these pure sensations eventually blossomed into higher aspects of intelligence like judgment, memory, evaluation, desire, discernment, imagination, surprise, and knowing general and particular truths.[67] Condillac referred to these skills as "basic sentience," as they alone did not allow the statue's mind to fully manifest. The sensations of smell, taste, sound, and sight allowed it to access new realms of enjoyment and pain, but it remained ignorant about its body; it had no conception, for example, of its own nose, tongue, ears, or eyes. For that self-awareness, the statue had first to acquire the abilities to move and touch. Freed from its pedestal, the statue was able to travel through the world and form a basic conception of self and other.[68] Condillac described this moment of self-reflexivity, writing that "As soon as [the statue] puts its hand on one of the parts of its body, the same sentient-being answers, as it were, from another part: it's me [c'est moi]. Then it continues to touch itself… everywhere the same sentient-being answers from one to the

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[67] Étienne Bonnot de Condillac, *Philosophical Writings of Etienne Bonnot, Abbé de Condillac*, trans. Franklin Philip and Harlan Lane (Hillsdale, NJ: L. Erlbaum Associates, 1982), 202.

[68] There is a fascinating resemblance between Condillac's account of the statue's dawning recognition of the self and Lacan's account of the mirror phase. Where Lacan stages the emergence of subjectivity when the child first recognizes their appearance in the mirror, Condillac stakes self-awareness on the tactile sensations felt on the body (especially the hands). He even imagines a hypothetical child understanding of "I" in this manner; "Now, the first discovery that an infant makes is that of its body. It is thus not strictly speaking the child that makes the discovery it is nature that shows it to him ready-made…Nature thus had only one means of leading him to know his body and this means was to lead him to perceive his sensations not as modifications of his mind but as modifications of sensory organs which are their occasional causes. In this way, the 'I,' instead of being concentrated in the mind, must have spread out, extended, and repeated itself as if it were in all the different parts of the body." Condillac, 231.

other: it's me, it's me again [c'est moi encore]."[69] Through touch, the statue recognized the continuity and limits of its body: its hand was contiguous with its shoulder, its voice contiguous with its mind. Subjectivity for the sculpture resulted from the composite of multiple external sensations collating by the mind.

Sixteen years after Condillac's *Traité,* Rousseau championed his friend's philosophy by recreating this moment in the climax of his *scène lyrique* on the Pygmalion myth, when the statue Galatea addresses her sculptor for the first time:

> **GALATEA** (touching herself)
> Moi. — Me
>
> **PYGMALION** (transported)
> Moi! — Me!
>
> **GALATEA** (touching herself again)
> C'est moi. — This is me.
>
> **PYGMALION**
> Ravissante illusion qui passes jusqu'à mes oreilles, ah! n'abandonne jamais mes sens! — Ravishing illusion, you even reach my ears. Oh, never abandon my senses!
>
> **GALATEA** (takes a few steps and touches a block of marble)
> Ce n'est plus moi. — Now, that is not me.
>
> *Pygmalion, in the grip of turmoil and transports of joy that he can hardly contain, follows all her movements, listens to her, and observes her with avid attention, which almost takes his breath away. Galatea walks towards him and looks at him; he*

[69] Quoted in Daniel Leonard, "Condillac's Animated Statue and the Art of Philosophizing: Aesthetic Experience in the *Traité des sensations*," *Dalhousie Review* 82, no. 3 (2002): 505. "Aussitôt qu'elle porte la main sur [une des parties de son corps], le même être sentant se répond en quelque sorte de l'une à l'autre: c'est moi. Qu'elle continue à se toucher... partout aussi le même être sentant se répondra de l'une à l'autre: c'est moi, c'est moi encore."

stands up hastily, holds out his arms to her, and looks at her ecstatically. She lays her hand on him; he shivers, takes her hand and lays it on his heart, then covers it with ardent kisses.[70]

GALATEA (with a sigh)
Ah! Encore moi. Ah! Me again.

Rousseau's scenario took the metaphor of the Enlightenment man-machine to its extreme. In staging the sculptor's desire for an inanimate statue, Rousseau staked Galatea's intelligence on Pygmalion's distortion of aesthetic appreciation as erotic attachment. Such a beauty professed Pygmalion, "must have a soul. How beautiful must be the soul to give life to such a body." Rousseau based the statue's awakening on Pygmalion's amorous attentions. His *Pygmalion* stages no gods or divine intervention; the miraculous source of Galatea's animation remains unseen. Instead, Rousseau re-focused the myth on Pygmalion's ego as it rationalizes its desire for the marble form.[71] In fact, the actual moment of the statue's animation is anticlimactic. By the finale, Pygmalion has already fallen in love with his creation. It does not matter whether the statue animates or not, because, to Pygmalion's senses, the statue is already a perfect living specimen. This conceit allowed Rousseau to invert Condillac's original dialogue: in the *Traité*, the final

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[70] "Pygmalion dans une agitation, dans des transports qu'il a peine à contenir, suit tous ses mouvements, l'écoute, l'observe avec une avide attention qui lui permet à peine de respirer. Galathée s'avance vers lui et le regarde; il se lève précipitamment, lui tend les bras, et la regarde avec extase. Elle pose une main sur lui; il tressaillit, prend cette main, la porte à son cœur, puis la couvre d'ardents baisers." Jean-Jacques Rousseau, *Pygmalion*, trans. Maria Gullstam, Felicity Baker, and Magnus Tessing Schneider, Performing Premodernity (Riddarhuset, Stockholm, 2015), 19, https://performingpremodernity.com/wp-content/uploads/2016/02/Pygmalion-programme.pdf.

[71] Indeed, the dichotomy between dead marble and live flesh is an important theme throughout the work. Pygmalion's love was kindled by the sight of Galatea's face; "It is not from this dead marble that I am enamored," says Pygmalion eyeing his work, "it is from a living being that resembles it, it is from the face it offers to my eyes." And when Galatea later awakens, she affirms Pygmalion's observation, touching an inert marble slab and recognizing a stone from which she was hewn but no longer identifies with: "Ce n'est plus moi." Rousseau, 15.

line occurred as the solitary statue touched itself; in Rousseau's *Pygmalion*, the line underscores the statue's touching of the sculptor. Thus, when the statue acknowledges her kinship with the sculptor—"encore moi!"—she validates the indebtedness of her mind to Pygmalion's erotic attachment. She is unable to tell where her body ends and the sculptor's body begins.

Conclusion

Thinkers like Rousseau, Condillac, La Mettrie, and Diderot imagined man-machine amalgams—harpsichord-anatomies, clock-like homunculi, and living statues—to test the limits of the human. As Riskin explains, "The Enlightenment Man-Machine was a great thought experiment, an attempt to reintegrate the human self into the material world, the soul into the machinery."[72] Nevertheless, these technologies beg the question: what did it mean to be human—to have intelligence or reason—in this age of machines? How does the ephemeral mind manifest mechanically? Modern historians describe how Enlightenment thinkers located the origins of the mind in the complex materiality of anatomy. They note how the central metaphor for the mechanistic mind was the self-winding clock, a self-sufficient machine whose actions are controlled by internal mechanics.[73] The *musical* man-machine, according to this view, was an extension of that metaphor, propagating a theory of the mind that was entirely contingent on the body's

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[72] Riskin, *The Restless Clock*, 151.

[73] "We can't tell the time from the pulse, but it is at least the barometer of heat and liveliness, from which we can judge the nature of the soul, ·this being abstractly comparable with judging what the time is by looking at a clock·. I am not mistaken; the human body is a clock, a huge and complex and finely designed clock" La Mettrie, *Man a Machine; and, Man a Plant*; "Consider man as a walking clock…" Diderot, "Letter on the Deaf and Dumb."

physiology. This metaphor suggested that humans already possess the necessary organs for the mind's emergence. However complicated the interior of the man-machine, there is no ignoring how their external actions empowered those mechanics: in Diderot's clock metaphor, he connected the man-machine's soul to a bell-like head that rings with the proper stimulation; Condillac's harpsichord-anatomy doubled as a musical object whose intelligence was voiced aesthetically; even Pygmalion's statue announced its intelligence with the spectacle of it stepping off its pedestal and speaking to the sculptor. These examples presented the mind not as a physiological property that resided within the body, but as a physiognomic action validated outside of it. Under the guise of the man-machine, then, the mind may have manifested itself mechanically, but its presence was aesthetic.

When taken together, the various manifestations of the musical man-machine—from La Mettrie, Condillac's, and Diderot's thought experiments to Vaucanson's fully-realized automaton—were not unlike the first utterances of Pygmalion's awakening statue. For these thinkers, music was not merely *like* language; instead, it was analogous to the first language, provoking an affective embodiment akin to the *langage d'action*. The metaphor of a musical man-machine allowed these thinkers to imagine a being stripped of the extravagance of modernity, still able to think and communicate, but, unlike contemporary language-users, more attuned to the body's sensations. Indeed, while the idea of a music-making machine may seem modern and unnatural to today's commentators, these materialists were trying to return to the past and recreate a form of subjectivity more connected to nature—a Lockean *tabula rasa* perfectly attuned to itself

and to others through the body's sense organs. Music played an essential role in this utopian project. By moving and sounding like a human, the machine performed an Enlightened subjectivity that allowed its onlookers to reflect on their own subjective origins. Vaucanson's automaton-flutist tapped into that self-reflection: onlookers could equate its twitching fingers and gaping mouth with the same bodily gestures they knew to interpret in other humans; its Coysevox-inspired appearance prompted the same critical eye they brought to other sculptures; its music cultivated the same aesthetic sensibility they directed towards other musicians. Mechanical movement, appearance, and music did not merely allow the machine to appear like a human inside and out; it allowed audiences to treat the machine as a human, aestheticizing the very behaviors that Enlightened onlookers used to judge the minds of other citizens. Sensing the humanity of the automaton's performance, listeners heard the machine's music as an expression of the self, recognizing an aestheticized mind analogous to their own and confessing to themselves "*encore moi*."

As a skeptic of the Enlightenment, however, Rousseau was unswayed by the flutist's mechanical virtuosity, and he never identified with the machine. In a letter to the Count of Charmettes dated January 17, 1742, the philosopher remarked offhandedly that he had encountered Vaucanson at a party. Their conversation veered towards the automated flutist, which Rousseau admitted he found unimpressive. He professed that he lived in a country where machines like Vaucanson's were commonplace, a place filled with automata that play the quadrille and gamble, that throw dice, drink champagne, and spend the day telling lies to other machines. Rousseau's joke, of course, was that most

humans acted like Vaucanson's automata; Parisian society was full of automaton-like subjects moving through the world, reproducing the actions of human life without suffering their mental cause. Vaucanson, understanding Rousseau's joke, began to laugh, and others soon joined him. The irony, noted Jean-Jacques, was that "two or three of the machines that were there laughed even harder than the others."[74]

[74] "Pour moi, dis-je alors, mon admiration doit être d'autant moins Suspecte que je suis accoutumé a des spectacles que j'ose appeler encore plus merveilleux. On me regardoit avec étonnement. Je viens, ajoûtai-je, d'un pais rempli de machines assés bien faites, qui savent jouer le Quadrille et le Pharaon, qui jurent, boivent du vin de Champagne, et passent la journée a débiter des mensonges à d'autres machines fort jolies qui leur rendent bien le change. On se mit à rire; et ce qui vous auroit diverti, c'est que deux ou trois machines qui êtoient là rirent encore plus que les autres." Jean-Jacques Rousseau, *Correspondance complète de Jean-Jacques Rousseau*, vol. 1 (Geneva: Institut et Musée Voltaire, 1965), 139, letter to François-Joseph de Conzieé, comte des Charmettes, 17 January 1742, n

CHAPTER TWO

REVITALIZING VAUCANSON:

THE ROMANTIC AFTERLIFE OF AN ENLIGHTENED MACHINE

When Jacques de Vaucanson passed away on November 21, 1782, the philosopher and mathematician Nicolas de Condorcet penned a eulogy celebrating his deceased colleague at the *Académie royale des sciences*. Over thirteen pages, Condorcet touched on noteworthy episodes in Vaucanson's life—his first mechanical experiments, the invention of the automaton-flutist, his work as the inspector-general of the silk industry—compiling one of the first comprehensive biographies of the great inventor. Condorcet praised Vaucanson's sense of public duty, describing the life of a man whose inventions glorified France, the sciences, and humankind. This framing is especially evident when Condorcet recounts the genesis of Vaucanson's automaton-flutist. According to the eulogy, the automaton-flutist took shape while Vaucanson suffered from a severe illness; delirious and unable to eat, Vaucanson was forced to rest for sixty days. Condorcet's bedridden Vaucanson dreamed up the automaton's mechanism, picturing it "with such precision…that by rising from his bed, he had only to give the drawing to various workmen charged separately to execute the different parts of the automaton." Vaucanson's imagination was flawless; "without any correction, without any trial and

error, the whole machine resulted from the combination of these parts."[1] When he finally recovered, the inventor endeavored to test the machine in secret. Nevertheless, during that first test, Vaucanson's longtime servant secretly listened on the other side of the door, recognizing the importance of his master's task. When the automaton successfully began playing its flute, the servant rushed into the room and "fell to the knees of his master, who then appeared more than a man. They embraced each other, weeping with joy."[2]

Condorcet unabashedly romanticized Vaucanson and his machines, celebrating each invention for its contribution to the public good. When discussing how Vaucanson reorganized the smaller silk workshop into more efficient factories, Condorcet praised the inventor's more efficient use of the machines, the raw materials, and the fabrication process—innovations that improved both producers' and consumers' experiences. The digesting duck, on the other hand, was useful not because it made labor more efficient, but because it stimulated the anatomical curiosity of onlookers with duck-like realism; paddling, eating, and digesting the grain like a real bird.[3] Even the mechanical flutist had

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[1] Jean-Antoine-Nicolas de Caritat, Marquis de Condorcet, "Éloge de Vaucanson," in *Œuvres Complètes de Condorcet.*, vol. 2 (Paris: Chez Henrichs, 1804), 418. "Il en imagina les différents mécanismes avec tant de précision, il détermina avec tant d'exactitude la forme et les dimensions de chaque pièce, qu'en se relevant de son lit, il n'eut qu'à en donner le dessin à divers ouvriers chargés séparément d'exécuter les différentes parties de l'automate : sans aucune correction, sans aucun tâtonnement, la machine toute entière résulta de la combinaison de ces pièces."

[2] Ibid., 418. ; "M. de Vaucanson cependant n'étoit pas fûr de la réussite, il n'osoit avoir de témoins de son premier essai, il écarta même, sous prétexte d'une commission, un ancien domestique qui lui étoit attaché depuis longtemps ; mais ce domestique avoit vu des préparatifs, il avoit pénétré une partie du secret de son maître, il ne put se résoudre à obéir ; caché auprès de la porte, il écoute avec attention, bientôt il entend les premiers sons de la flûte, à l'instant il s'élance dans la chambre, tombe aux genoux de son maître qui lui paraît alors plus qu'un homme, et tous deux s'embrassèrent en pleurant de joie."

[3] Condorcet admonishes the detractors who condemned the machine as *useless* for failing to imitate actual digestion: "it was not the fault of M. de Vaucanson" explains Condorcet, "if the Doctors had misunderstood the mechanism of digestion, or if Nature performed these functions by means of another kind than those which he could imitate." Ibid., 418.

its important uses. Condorcet made little mention of its musical sound, but he glorified its musical effects, fixating on its capacity to bring the master and servant to tears and embrace. By fixating on mechanical music, digestion, and silk-manufacturing, Condorcet claimed Vaucanson's machines as objects for *use* and agents of *usefulness*—an attitude towards technology that Condorcet called "useful application" [*"faire un usage utile"*]. Just as humans *use* Vaucanson's machines, the machines redirect humans' *usefulness*.

Eulogies like Condorcet's have long fascinated historians of science who study how institutions like the *Académie royale des sciences* mythologized the lives of its members.[4] Between 1699 and 1791, the *Académie* dedicated over two hundred eulogies to the most famous scientists of the eighteenth-century, including Isaac Newton, Gottfried Wilhelm Leibniz, Leonhard Euler, Benjamin Franklin, and Jean D'Alembert. Condorcet's eulogies (written between 1773 and 1791) were especially political, reflecting the philosopher's commitment to a rationalist philosophy dedicated to the public good. This conviction later led him to take an organizing role early in the French Revolution, mobilizing the French citizenry to make a freer and more equitable France—that is, until 1793, when the Reign of Terror led to his arrest and subsequent death. Condorcet's eulogy for Vaucanson is inflected by these revolutionary politics, invoking a French utopia where new scientific practices and industries revitalize the downtrodden country. Useful technologies transform the polis by not only increasing production but also engendering curiosity,

[4] The historian Charles Paul explains how the *Éloge* was designed "to win over the general public to the cause of science, to convert it to the rightness of its procedures, principles, achievements, and applications, and to entice into science bright young men and women who otherwise might pursue more lucrative, more traditional, or more prestigious careers." Charles B. Paul, *Science and Immortality: The Éloges of the Paris Academy of Sciences (1699-1791)* (Berkeley: University of California Press, 1980), 4.

disseminating class consciousness, and democratizing labor. Condorcet needed the mechanical genius of individuals like Vaucanson to envision this new kind of political power, one radically different from the status quo of the absolute monarchy.[5] Condorcet never saw his utopia realized, and he vastly misjudged the technological impact that Vaucanson's eighteenth-century machines would have in post-Revolutionary Europe. Nevertheless, the story of a machine endowed with the agency to act and influence others continued to fascinate post-Enlightenment thinkers.[6]

Although the French scientific establishment celebrated Vaucanson throughout the nineteenth century, modern historians voice skepticism about the importance of his automata in Romantic science and art. Jessica Riskin, in *The Restless Clock*, discusses how a generation of post-Enlightenment theorists, including Marx, Helmholtz, and Goethe, used Vaucanson's machines as an outdated foil for evolving nineteenth-century theories of the human.[7] Minsoo Kang has argued that Vaucanson's inventions represented the last gasp of a mechanistic impulse to understand humans by building machines, as the automata of the nineteenth century were "of limited cultural significance," and mostly "regarded as objects of entertainment, with only a few major exceptions."[8] Instead,

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[5] As Darrin McMahon explains, "Only with the Revolution could a myth of revolutionary genius emerge, and with the propagation of that myth was born a possibility, still fledgling, but soon to be fulfilled: that genius might be used as the basis of political power, celebrated not only in death but in life, employed to justify an extraordinary privilege and license." Darrin M. McMahon, *Divine Fury: A History of Genius* (New York: Basic Books, 2013), 109.

[6] Many well-known Romantic writers and thinkers had firsthand encounters with Vaucanson's autonomous flutist, including Jean-Jacques Rousseau, Johann Gottfried Herder, Johann Wolfgang von Goethe, E. T. A. Hoffmann, and Ludwig Achim von Arnim. Others, like Mary and Percy Shelley, Immanuel Kant, Karl Marx, Hermann von Helmholtz, and Ludwig Tieck, demonstrated a passing familiarity with Vaucanson's fleet of automata in their writings and letters, sometimes imagining them in mundane and fantastic situations.

[7] Riskin, *The Restless Clock*.

[8] Kang, *Sublime Dreams of Living Machines*, 187.

Vaucanson's Enlightened machines are generally thought to have inspired a host of lesser copycats—toys and other mechanical curiosities that delighted the masses while failing to inspire greater intellectual rigor.[9] For a nineteenth-century world increasingly interested in the fluid and passionate actions of Romantic subjects, Vaucansonian automation seemed an overly mechanistic anachronism.

Rather than dismiss the automaton's nineteenth-century reception as a byproduct of industrialization, this chapter considers instead how Romantic artists in the first half of the nineteenth century used Vaucanson's flutist to reimagine political agency in the dawning mechanical age. While Vaucanson's machine had fallen into disrepair by the 1800s, its melodies continued to reverberate throughout European theater, literature, and toymaking for over a century. Riskin and Kang correctly assert the dwindling potency of automata among some natural philosophers, but they miss how the spectacle of the automaton's music invited rampant speculation about the capacities of sound—whether human- or machine-made—to incite revolution. Throughout this period, Romantic artists had Vaucanson's eighty-year-old machine perform works that could drive listeners to passion or depress them with loneliness; the automaton's music united and divided people, equally mimicking the influence of the powerful (those with economic, intellectual, and artistic capital) and the disempowered.

[9] Condorcet himself laments this fact, revisiting the flautist's first reception in the 1730s at the Hôtel de Longueville. He condemns the onlookers, "more eager for novelty than sensitive to great talents," they randomly lavished "enthusiasm or disdain, and passed quickly from one to the other for an object which has stopped being the same." Condorcet, "Éloge de Vaucanson," 423.

This chapter, then, focuses on three adaptations of Vaucanson's musician—François-Félix Nogaret's *Miroir des événements actuels, ou la Belle au plus offrant, histoire à deux visages* (*The Mirror of Past Events, or Beauty to the Highest Bidder*: A Two-Faced Tale, 1790); Adolphe de Leuven's *L'automate de Vaucanson* (*The Automaton of Vaucanson*, 1840); and Achim von Arnim's novel, *Armut, Reichtum, Schuld und Bußе der Gräfin Dolores* (*The Poverty, Wealth, Guilt, and Atonement of Countess Dolores*, 1810). In the fifty years encompassing these examples, the seemingly mechanical perfection of Vaucanson's Enlightened machine participated in a transformational period of European history that saw European bodies and minds transformed in the public discourse—what Hobsbawm called the "Age of Revolution."[10] During this period, the indentured subject of the Enlightenment was seemingly mythologized as a self-possessed citizen, just as the clockwork mechanism of the Enlightenment mind was rehabilitated as a restless Romantic soul. Between 1785-1840, Vaucanson's flutist helped spark the utopian equality of the early French Revolutionary, the epistemological rumination of post-Kantian Romanticism, and the class warfare of mid-century bourgeoisie theatre. Across these diverse contexts, I argue that the then-antiquated mechanisms of the Enlightened flutist became a conduit for a new generation of audiences to ponder their own uneasy status in the rapidly industrializing age. By listening to the machine's various Romantic

[10] Of the period from the French Revolution in 1789 to the European revolutions of 1848, Hobsbawm compares this period of radical transformation to the agricultural revolution centuries earlier. It was "the triumph not of 'industry' as such but of *capitalist* industry; not liberty and equality in general but of *middle class* or '*bourgeois' liberal* society; not of 'the modern economy' or 'the modern state,' but of economies and states in a particular geographical region of the world (part of Europe and a few patches of North America), whose centre was the neighbouring and rival states of Great Britain and France." E. J. Hobsbawm, *The Age of Revolution 1789-1848*, 1st Vintage Books ed. (New York: Vintage Books, 1996), 1.

performances, we hear the automaton not as an outdated intrusion of eighteenth-century mechanism into nineteenth-century life, but as a tool for Romantic audiences to ponder the role of Enlightenment philosophy and technology—for better and worse—in a post-Enlightenment world.

Automata after Vaucanson

By the end of the 1730s, Vaucanson's mechanical flutist, duck, and drum-and-fife player had been well received in London and Paris, but the automata were never lucrative for the inventor. He eventually sold them in early 1743 for the price of forty-thousand livres. Vaucanson was invited to join the court of Frederick the Great in Prussia, but he instead accepted a generous pension from Louis XV and became the lead inspector of silk manufacturing in Lyon. An early advocate of automation, Vaucanson wanted to modernize the silk industry by making a machine that could autonomously weave the silk fiber.[11] The displaced silk workers of Lyon, however, were less thrilled; they eventually revolted and pelted Vaucanson with rocks and other detritus. Throughout Lyon and beyond, the inventor came to symbolize the adverse effects of industrialization,

[11] Notably, his automatic loom could be reprogrammed with swappable punch-cards—an innovation later improved by Jacquard in 1804. IBM was allegedly inspired by Jacquard to use punch cards to program their early automatic calculators in the 1920s—an innovation that carried forward into the first computing machines in the thirties and forties. Thus today, Vaucanson is oft hailed as the father of the automaton and the forefather of the computer, assuming a prominent place in the prehistory of artificial intelligence. As the philosopher, historian, and neuroscientist Margaret Boden explains in her magisterial *Mind as Machine*; "To be sure, a curious quirk of history links Vaucanson with IBM…While working as an inspector in silk factories in France, he had the idea—improved in 1801 by Joseph Jacquard (1752-1832)—for an apparatus using punched cards for weaving brocades automatically. Punched cards had already been used in France to control weaving, but they had to be hand-fed into the loom one by one. Vaucanson suggested stringing them together and feeding them in automatically, in sequence." Margaret A. Boden, *Mind as Machine: A History of Cognitive Science* (Oxford, UK: Oxford University Press, 2006), 86.

capitalism, and automation. In the meantime, Vaucanson's automata continued their tour throughout Europe with a new owner, the French glovemaker Pierre Dumoulin. Beginning in 1754, they toured Strasbourg, Frankfurt, Hamburg, Nuremberg, Bayreuth, and St. Petersburg before settling in Moscow until Dumoulin died in 1781. After that, they were returned to Nuremberg and put into storage.

In Nuremberg, the once captivating automata began to deteriorate, becoming an outmoded vestige of Enlightenment thought and 1730s musical taste. They were superseded by newer machines made by a host of cabinetmakers, horologists, musical instrument makers, and other mechanical artisans.[12] Inspired by Vaucanson's machines, these newer androids performed sophisticated actions (music, speech, drawing, chess-playing, writing). Jaquet-Droz's *Draughtsman*, for instance, drew images of contemporary political figures like Louis XV, Louis XVI, and Marie Antoinette (see figure 2.1), while the *Writer*, which I discussed in the introduction, wrote reprogrammable messages of up to forty characters and four lines.[13] Minsoo Kang explains that after the premiere of Vaucanson's automata in the 1730s and until the debunking of Kempelen's automaton in the 1850s, automata became hugely popular in the public sphere. This period, which has been variously called "the automaton craze" or "the golden age of automata," witnessed countless variations of music-boxes, musical timepieces, mechanical animals, and other

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[12] At least one writer in Nuremberg noted that the flautist's "gaudy sound, which was typical of France in 1738, especially for the flute, would [no longer] be pleasing now." A new camshaft could be made to cater to modern ears, he noted, but that undertaking would be expensive and difficult to produce. Quoted in Doyon and Liaigre, *Jacques Vaucanson: mécanicien de génie*, 96.

[13] In *The Unmasking of Robert-Houdin*, magician Harry Houdini recounts a likely apocryphal story in which Vaucanson, upon seeing Jaquet-Droz's machine exclaims, "Why, that boy commences where I left off." See Harry Houdini, *The Unmasking of Robert-Houdin* (New York: The Publishers printing co., 1908), 425.

anatomies mouvantes.[14] While the mechanisms driving Vaucanson's machines continued to impress, their actions referenced a cultural moment that had long since passed.

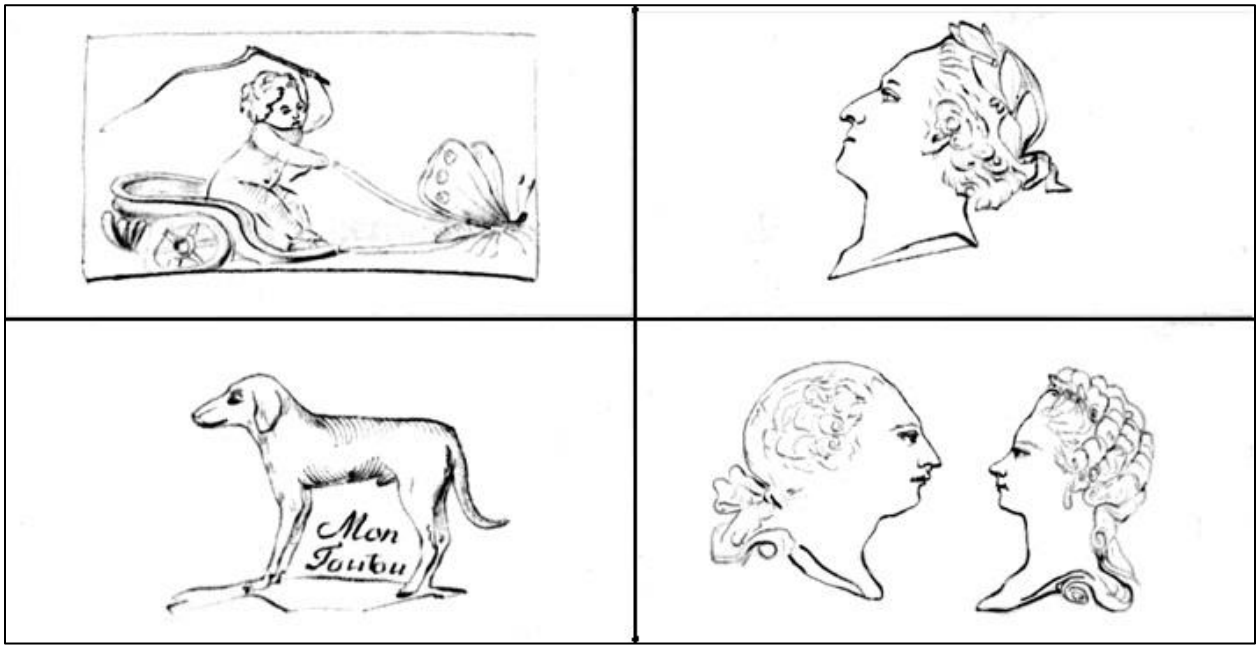

Figure 2.1: Four drawings by Jaquet-Droz's le Dessinateur: "Le papillon conduit par l'amour" (top-left), a dog (bottom-left), a portrait of Louis XV (top-right), and portraits of Marie Antoinette and Louis XVI (bottom-right)

More importantly, the perception of automata and automation was itself shifting. By the 1780s, machines were no longer accepted as a heuristic for human intelligence. Instead, the perfect, unceasing reproduction of this technology became a metaphor for mindlessness and stupidity—objects lacking true humanity. This changing perception is evident in Frances Burney's 1778 epistolary novel *Evelina*, where the evolving mechanical landscape parallels the bourgeoisie education of the titular character as she sheds her sheltered country upbringing. In one letter, Evelina describes her visit to a museum of

[14] Given the large number of active artisans throughout Europe during this period, and the lack of records that exist from these workshops, there is no comprehensive catalogue or count of all of these machines. Christian Bailly, *Automata: The Golden Age: 1848-1914* (London: Published for Sotheby's Publications by P. Wilson Publishers, 1987).

mechanical works and witnessing a musical pineapple that opens to reveal a flock of mechanical birds singing Handel's "Zadok the Priest." Burney juxtaposes Evelina's sedate response against the overwhelming enthusiasm of her chaperone, Madame Duval: "This entertainment concluded with a concert of mechanical music; I cannot explain how it was produced, but the effect was pleasing. Madame Duval was in ecstasies…[she] was affecting to beat time, and uttering many expressions of delight."[15] Here, Burney uses the machine as a shibboleth for the values of a modern Enlightened bourgeoise. Not only does Evelina's bemused appreciation for the musical pineapple position her above the doddering Mme. Duval "in ecstasies" over the mechanism, but it showcases Evelina's preparedness for the new industrial order, a world soon to be transformed by the proliferation of unthinking, unerring mechanical labor. Mme. Duval is genuinely enchanted by the mechanical actions and agency of the pineapple's music, while Evelina hears only the inert action of a machine's mechanism in motion. The automaton craze, then, redefined the machine's actions by further distinguishing it from human actions, articulating the now-common definition of machines as unthinking, unfeeling, and infinitely reproducing. In this era of technological upheaval, automata were no longer equal to humans but had become playthings, performers, and laborers that mostly served their emotional wellbeing.

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[15] Fanny Burney and Stewart J Cooke, *Evelina, Or, The History of a Young Lady's Entrance into the World*, Norton Critical Editions (New York: W.W. Norton & Company, 1998), 64. Later, Evelina's future husband makes her point even clearer, remarking about the musical machines, "The mechanism…is wonderfully ingenious: I am sorry it turned to no better account; but its purport is so frivolous, so very remote from all aim at instruction or utility, that the sight of so fine a show, only leaves regret on the mind, that so much work, and so much ingenuity, should not be better bestowed" (92).

What was the automaton lacking? What qualities allowed Evelina to position her actions above the actions of the musical pineapple? By the end of the eighteenth-century, the mechanistic theory of life—which likened humans to mechanically sophisticated machines—was increasingly replaced by a vitalistic model that maintained a fundamental distinction between "living" and "dead" matter. The historian Elizabeth Williams dates the origins of vitalism to the medical practice of the University of Medicine in Montpellier in the 1730s. While mechanistic medicine treats all patients as fundamentally identical (because all humans possess the same life-sustaining machinery), Montpellier physicians like Théophile de Bordeu, and Paul-Joseph Barthez propagated a *médecine pratique* that tailored its treatments to the individual.[16] The vitalists pioneered a medical practice built around a person's actions and emotions, yielding some of the first medical guidelines for so-called non-normative populations—those women, children, mentally deficient, and racial minorities who departed from the established masculine ideal.[17] By the 1760s, vitalist teaching began spreading beyond Montpellier and influencing larger intellectual currents. Bordeu and Barthez contributed several entries to the *Encyclopédie,* writing not only about medicine but the passions, emotions, and natural philosophy.[18] Even their

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[16] As Williams explains, this involved "close clinical attention to individual patients and maladies," enshrining "the ancient doctrine of the 'non-naturals,' with its emphasis on the behavioral, environmental, and emotional 'influences' exerted on the organism in sickness and health." Elizabeth A. Williams, *A Cultural History of Medical Vitalism in Enlightenment Montpellier*, The History of Medicine in Context (London: Routledge, 2004), 215–16.

[17] Of course, as Williams and David Trippett have separately noted, these physiognomical nuances were often used to validate racist, sexist, and ableist views. Social theories like phrenology and IQ testing are also natural outgrowths of vitalistic medicine. See David Trippett, "Exercising Musical Minds: Phrenology and Music Pedagogy in London circa 1830," *19th-Century Music* 39, no. 2 (2015): 99–124; Williams, *A Cultural History of Medical Vitalism in Enlightenment Montpellier*.

[18] These include important and well-regarded entries like "*Crise*," "*Face*," and "*Fascination*." Bordeu's "*Crise*" ("Crisis") entry offers an especially illuminating explanation of the Montpellier vitalism in relation to the traditional mechanistic medicines favored in Paris; "Nature has its laws," Bordeu explained, "but one can neither count nor classify them."

editor, the staunch materialist Denis Diderot, began to reference vitalist ideas in his writing. A fictionalized version of Bordeu appears in *Le Rêve de d'Alembert* (1769), where he outlines a vitalistic philosophy of the human in proto-evolutionary terms:

> Anyone who understands a human being only by the form which he shows us at birth doesn't have the least idea. His head, feet, hands, all his limbs, all his viscera, all his organs, his nose, eyes, ears, heart, lungs, intestines, muscles, bones, nerves, membranes, properly described, are only the basic developments of a network which is formed, grows, extends itself, and throws out a multitude of *imperceptible threads*.[19] (Emphasis Added)

By reconciling the observable body with its "imperceptible threads," Diderot used vitalist theories to complicate the comparatively simple mechanisms of materialism, emphasizing the variability and contingency of matter as it interacts both within a single individual and within larger communities and environments. Engaging with vitalist teachings, he outlined an account of life that anticipated the more fleshed-out evolutionary theories of Jean-Baptiste Lamarck and Charles Darwin.[20] No longer could nature be understood as a mere mechanism—the result of clock-like self-regulation. Instead, vitalism allowed natural philosophers like Diderot to imagine life as a series of encounters, compromises, and adjustments between subject and environment. By the dawn of the nineteenth century, Montpellier medical practice laid the framework for a

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Théophile de Bordeu, "Crise," in *Encyclopédie, Ou Dictionnaire Raisonné Des Sciences, Des Arts et Des Métiers*, ed. Jean Le Rond D'Alembert and Denis Diderot, accessed May 15, 2020, https://artflsrv03.uchicago.edu/philologic4/encyclopedie1117/navigate/4/2438/?byte=5318410.

19 Denis Diderot, *Rameau's Nephew, and Other Works*, trans. Jacques Barzun and Ralph H. Bowen (Indianapolis: Hackett Publishing Company, Inc., 2001), 126.

[20] Andrew S. Curran, *Diderot and the Art of Thinking Freely* (New York: Other Press, 2019), 234–58.

Romantic movement intent on returning to a kind of dualism, defining human life as a union between observable matter and invisible will.[21]

Revolutionizing Vaucanson: *Miroir des événements actuels*

In stark contrast to the vital matter of humans, machines and automata were thought to belong to a class of unthinking objects unable influence or evolve. Vitalistically impoverished, such machines were more often likened to lifeless castoffs, like corpses and other inanimate objects. This interpretation plays out in the late eighteenth-century literature on machines and mechanical labor, which often moralized the hazards of unthinking, unceasing technological reproduction. For instance, Goethe's 1797 ballad, "The Sorcerer's Apprentice" is a cautionary tale about the dangers of unchecked automation, when a novice magician enchants a broom to clean the floors. The broom, at first, performs its task perfectly, but when the young magician takes a quick nap, he awakens to an unchecked flood. The witless broom, lacking the intelligence to cease its actions, forces the magician to reassert his will or be swept away by the torrent. E.T.A. Hoffmann makes a similar claim about Olympia, the automaton in "The Sandman" (1816), which I discussed in the introduction of this dissertation. Recall how Nathaniel mistakes Olympia for a real woman, falling in love with it and ignoring his friends' warnings.

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[21] As Packham explains, "hand, is a theoretical formulation deployed in relation to specific scientific questions, about life, matter, bodies and so forth, and on the other, is a suggestive language of animation informing political, economic and literary writing, Romanticism's totalizing, unifying urges transform a technical postulation of vitality within experimental and observational science into a generalized creative force existing throughout a dynamic universe: in organic nature, in creative genius, in the poetic mind and transcendent spirit. Such a Romantic vision of a vital organic universe, harmonized and unified, was central to its resistance of the fracturing of knowledge into distinct, technical disciplines, so that vital life becomes a central, transcendent metaphor, rather than a precisely defined field of enquiry." Catherine Packham, *Eighteenth-Century Vitalism* (London: Palgrave Macmillan UK, 2012), 9, https://doi.org/10.1057/9780230368392.

Throughout the story Hoffmann emphasizes Olympia's mechanical nature—hands "as cold as ice," its "stiffness" and "wax face"—juxtaposing its impassivity against Nathaniel's childhood sweetheart, Clara, a woman of passion and tender care. Thus, while Goethe warns about unchanging automated labor, Hoffmann moralizes automated passion, distrusting the subjective illusions produced by automata that are unable to grow or evolve genuine social relationships.

If Goethe and Hoffmann alert us to the dangers of mechanization, Condorcet took solace in the machine's nonintelligence. In the "Lettre d'un jeune mécanicien" (1791), he imagines an ambitious young mechanic who has been educated by Vaucanson and Kempelen, who offers to replace the real monarch with a mechanical simulation. For the paltry sum of two million pounds, the mechanic boasts that he could manufacture a French court with two hundred life-sized figures, including courtiers, ministers, chaplains, chamberlains, and other functionaries. The engineer's crowning achievement, however, would be a mechanical king that automatically enacts its royal duties: going to Mass, praying, and observing the national rites of Easter and other public holidays. To ensure a functioning government, Condorcet's inventor imagines an idealized constitutional monarchy in which the automaton-court unthinkingly follows the will of the people:

> My king will sanction the decrees by the plurality of voices of his council; he will sign the orders that his ministers present to him. If we decide that it is the essence of the monarchy that a king chooses and sends his ministers back, as we understand as sound policy, he must always determine himself according to the wish of the party that the majority in the legislature, and that the president is one of the chiefs, it is easy to imagine a mechanism by means of which the king will

> receive the list of ministers from the hand of the president of the fortnight, with a look of head full of grace and majesty.[22]

By casting the government as an unthinking machine piloted by the citizenry, Condorcet harnesses the machine's automaticity to achieve a public good. Such automata would lack the human mechanisms for manipulation, bribery, or corruption. They would be unable to plot or scheme and would instead only reproduce the will of the people. Here, the writer inverts a common Enlightenment metaphor for government; rather than imagining the state as a series of unquestioning citizen-cogs guided towards the greater good by an Enlightened ruler, Condorcet imagines the ruler as a puppet controlled by his citizens.

Between the "Lettre d'un jeune mécanicien" and the "Éloge de Vaucanson," Condorcet offers two very different, but complementary ways that machines serve the democratic republic. The mechanical government contains the mechanisms to move and self-regulate, but it can neither be influenced nor influence others. Instead, it unerringly reproduces the needs of all people transforming the government-machine into a productive exercise in automated impartiality. That reproducibility is missing in Condorcet's description of Vaucanson's machines, where the writer celebrated the automaton's capacity to act for society's betterment. Where the automaton-monarch is passive, the automaton-musician is active, able to change and modulate its audience through the power of its mechanical actions. Condorcet celebrates these mechanical effects for enacting a form of political agency that could genuinely incite revolution.

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[22] Jean-Antoine-Nicolas de Caritat, Marquis de Condorcet, "Lettre d'un jeune mécanicien aux auteurs du Républicain—16 Juillet 1791." In *Oeuvres de Condorcet*, ed. Arthur O'Connor and F. Arago, vol. 12 (Paris: Firmin Didot frères, 1847), 240.

Writing during the first wave of revolutionary fervor, Condorcet's participated in a period of intense debate about political agency. Musical performances were one avenue for the disempowered to realize their own fantasies of empowerment, staging a world in which even the most insignificant individual could effectively rebel against oppression and inequality—often with a passionate outburst of song.[23] Vaucanson's flutist was no exception to this fantasy. For French writers seeking a conduit for their revolutionary ideals, the mechanical musician seemed a viable agent for the progressive cause. As Condorcet makes clear, the automaton occupied the space between mechanical origin and humanistic effect, aligning it with the utopian groundswell that led the French Revolution to celebrate technology and subjectivity.

Such is the case in François-Félix Nogaret's, *Miroir des événements actuels, ou la Belle au plus offrant, histoire à deux visages* [The Mirror of Past Events, or Beauty to the Highest Bidder: A Two-Faced Tale], a 1790 pseudo-Greek myth documenting the transformation of a Paris-like Greek polis into a democratic republic. Nogaret's novel opens in Syracuse, shortly after the death of the city-state's savior, the mathematician and inventor Archimedes. Aglaonice, a beautiful young maiden, resolves to bring a new genius inventor to the city, promising her hand to the mechanic who "not only proves his skill,

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[23] Musicologists, for instance, have long studied music's proximity to politics during the French Revolution. During this period, musical institutions like the Paris Opéra and Conservatoire responded to changing Parisian tastes not only by mounting new productions, public festivals, and patriotic pieces dedicated to the revolutionary ideals of *liberté, égalité, fraternité*, but also by emphasizing the power of art to convey these ideals to a rapt audience. In one review of Jean-Baptiste Lemoyne's opera, *Toute la Grèce* [All of Greece, 1794], one reviewer remarked "The spectators were themselves at one and the same time witnesses and actors [i.e. active participants]; and when the Greek warriors on stage swore to conquer for their country's sake, the French soldiers in the audience reacted by declaring 'What they have sworn, we shall do'" Quoted in Elizabeth Bartlett, "The New Repertory of the Opera during the Reign of Terror: Revolutionary Rhetoric and Operatic Consequences," in *Music and the French Revolution*, ed. Malcolm Boyd (Cambridge, UK: Cambridge University Press, 1992), 147.

but shows that he knows the heart of women."[24] Accompanied by the city's praetor, Cornelius, Aglaonice brings six suitors to the court, who create six machines, each inspired by a scientific issue of eighteenth-century France: a steel tripod that walks on its own, a microscopic ivory chariot and ship, a telescope, a flying machine powered by a hot-air balloon, an automaton-flutist, and a walking and talking automaton. One by one, however, Aglaonice rejects these inventions, often citing real complications faced by the French revolutionaries. The first, a walking tripod (each leg representing one of the three estates), is rejected for being too mechanically unstable.[25] The minuscule vehicles are so decadent that they are useless; the chariot is harnessed to a housefly that flies away, while a freshwater polyp consumes the ship. The telescope is an elaborate hoax; when Aglaonice and her retinue gaze up at the moon, they realize that the unscrupulous inventor has stolen their jewelry. The flying machine is a promising, but ultimately disappointing, boondoggle; the inventor assures Aglaonice that the new machine will allow the Syracusans to recruit soldiers on the moon, but the machine is too hard to control. It soon crashes and kills its inventor. In the end, the only acceptable machines are the two automata: a mechanical flutist created by an older inventor named Wak-wik-

[24] François-Félix Nogaret et al., "The Mirror of Present Events," in *The Mirror of Present Events*, trans. Brian Stableford (Black Coat Press, 2017), Kindle E-Book, Loc. 303.
[25] In their analysis of Nogaret's novel, Julia Douthwaite and Daniel Richter note how, "In employing the multi-valenced verb *broncher* here, the narrator layers this clause with three meanings: the preferred tripod would not stumble, or encounter difficulties, or complain about its task; rather, it would stand still by the hearth and hold the pot…Like the tripod, the Assembly was not supposed to follow its own caprices, but rather to stand firm in service to the nation." Julia V. Douthwaite and Daniel Richter, "The Frankenstein of the French Revolution: Nogaret's Automaton Tale of 1790," *European Romantic Review* 20, no. 3 (July 1, 2009): 395, https://doi.org/10.1080/10509580902986369.

vauk-an-son-Frankéstein (which contains a phonetic allusion to Vauc-an-son); and a talking-and-walking automaton made by an inventor named Nicator.[26]

Nogaret describes the flutist as a "laminated metal statue, as tall as a man, dressed in a Sicilian fashion, seated in a rolling armchair" with two flutes, one in each hand. Frankéstein claims that the machine will play twenty-two tunes, promising Aglaonice, "You shall judge, my lady, whether there is a mortal that can refrain from falling at your feet. Command, and the bronze itself will obey." Although Aglaonice and Cornelius are initially skeptical of the inventor's grandiose claims, they step towards the machine, which astonishes them by bowing deferentially at their approach. Surprised, Aglaonice orders the musician to play;

> That air slowly expressed the chagrins of a heart ulcerated by amour. The statue, putting the two flutes to its mouth, far surpassed Aglaonice's expectations; she heard it extract the most varied sounds from the two instruments and execute the two parts marvelously. The prodigy caused her an emotion so keen that she almost fainted, her head leaning on Cornelius' bosom; he only brought her round by ordering the statue to play a livelier tune.[27]

Frankéstein's automaton is the first machine in Nogaret's story to have an immediate effect on the listeners, playing a tune with such beauty that it affects the praetor and his ward. The automaton-flutist demonstrates its ingenuity not by merely playing beautiful music, but by understanding and tapping into the listeners' emotions through music,

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[26] Douthwaite and Richter note with excitement the resemblance between Frankéstein and Victor Frankenstein, the protagonist of Mary Shelley's novel, and there is some evidence to suggest that Shelley may have been familiar with Nogaret's novel. Nevertheless, inferring any causal relationship between Nogaret's adaptation of Vaucanson and Shelley's doctor is nothing but speculative at this time. Douthwaite and Richter, "The Frankenstein of the French Revolution."

[27] Nogaret et al., "The Mirror of Present Events," Kindle E-Book, Loc. 717 of 6782.

showcasing its affective understanding of Aglaonice and Cornelius. Despite the apparent power of the machine's music, Aglaonice remains uncertain, and Cornelius agrees, whispering that she "should distrust her senses." Aglaonice finds the machine's music too decadent, an aristocratic pleasure too far removed from the utilitarian quest to find the next Archimedes. Though pleased by Frankéstein and his invention, she hesitates to fully reward the inventor's efforts, concluding that "music is only a delightful thing for people who have dined well."

Next, Aglaonice requests Nicator to demonstrate his invention—an automaton girl that can walk and talk. As Nicator's automaton enters the hall, the novel emphasizes the machine's seeming humanity; while Frankéstein's machine had entered "like an invalid who cannot make use of his legs," Nicator's strides into the hall, leading the onlookers to mistake it for a young girl. This illusion intensifies when the mechanical girl slows to take her inventor's hand, as if father and daughter were walking hand-in-hand—an idyllic image of patrimonial bliss. Nicator's automaton-girl has several other tricks, which it executes without the inventor's prompting. First, the automaton raises the flap of its robes to reveal an even smaller automaton of Cupid, which draws a little bow and harmlessly shoots a dart towards Aglaonice. Next, the statue speaks; when Aglaonice addresses the inventor asking, "will you love me?" the invention speaks for him, replying affirmatively. Finally, with one last trick, the automaton carries a large horn filled with fruits, which it offers to Aglaonice. When the maiden selects one, she realizes that the fruit are actually jewels that have been cleverly disguised. The automaton offers the horn—filled to the brim with riches—to Aglaonice as a gift. Together, Aglaonice,

Cornelius, and Frankéstein are unanimously impressed by the automaton, judging Nicator the clear winner of the competition. Meanwhile, Frankéstein is awarded a runner-up prize for his musician; he will wed Aglaonice's older sister, Bazilde.

If we read Nogaret's *Miroir* as an allegory for the utopian world desired by the French revolutionaries, why are Frankéstein and Nicator's automata the best machines for the new republic? Aglaonice judges the competitors for the utility they offer for Syracusan society, but her judgments throughout the novel suggest that "utility" is broadly defined, serving not just the city's material needs, but also its emotional and intellectual life. Thus, while each suitor presents a miraculous machine inspired by modern scientific insight, the automata distinguish themselves in two important ways.[28] First, Nicator and Frankéstein's machines are the only ones that appear more human than machine: the musician's actions seem "organized by a divine hand," while the automaton-child performs "without any jerkiness or mechanical sound." By obscuring their mechanics, the automata appear to understand and reproduce the motivations that drive humans to selflessness and empathy. Thus, as Julia Douthwaite and Daniel Richter note, the automata "play music, bring gifts, and offer to serve. Like Vaucanson, whose expertise in mechanization provided him with a prominent post in silk manufacturing, the technical skills of their makers bode well for the nation's industry: through them, the author stresses his demand for concrete, useful engagement."[29]

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[28] New innovations in optics and lens-making allowed Nogaret to imagine exploring unseen worlds (the very small and the far away). The first ascent of a hot air balloon in 1783 let Nogaret imagine a future of aeronautic warfare.
[29] Douthwaite and Richter, "The Frankenstein of the French Revolution," 398.

Nevertheless, the term "engagement" seems too passive to describe the power the automata hold over Aglaonice and the others. The flutist's music makes the young woman swoon, while the child-like machine provokes an outburst of love and emotion. As Nogaret explains, "[Aglaonice] sensed all the amiability of [the automaton's] declaration and could not help freeing herself from the cold reserve under which she might have enveloped herself in order to not respond to it. Nature was the stronger."[30] Unlike the other machines, then, Frankéstein's and Nicator's automata are not merely useful but inspire useful application—*usage utile*—affecting others with the power of song, speech, gesture, and gift.

It is tempting, perhaps, to read Nogaret's *Miroir* as a celebration of technology in the modern sense, praising each machine's capacity to perform labor and make society more efficient and prosperous. Nevertheless, in rewarding the two automata-makers, *Miroir* makes a more radical claim about human-machine technorelations, one that praises the holistic bonds that machines cultivate with human users. Anticipating the rise of the ubiquitous computing of today, Aglaonice imagines a utopian technology that interfaces with, engages with, and changes its human users for the better. Thus, when Frankéstein praises Nicator's automaton for "imitating the laws of nature," he defends a theory of (human) nature born from the empathy and connectedness between all individuals:

> My lady, if the idea of charming you with sounds has not offered itself to [Nicator's] mind, mine lacked the thought of imitating the laws of nature. I have not given my statue, as he

[30] Nogaret et al., "The Mirror of Present Events," Kindle E-Book, Loc 780 of 6782.

> has, progressive movement so natural that it imposed itself on me at first sight, so that an inanimate body appeared to me to be a living being.[31]

Here, Frankéstein's Enlightened effort to remake the body becomes a political act. The machine's voice and actions are not merely instances of mechanical speech and gesture. Instead, these actions demonstrate the automaton's capacity to advocate for Revolutionary ideals. Thus, when Frankéstein praises Nicator's capacity to "imitate the laws of nature," he celebrates the inventor's ability to simulate a physiology that unites all revolutionary subjects: the technology of hands and heart to remake the state for the better.

Reimagining Vaucanson: *L'automate de Vaucanson*

Nogaret's revolutionary intentions for ancient Syracuse and modern France were short-lived. Beginning in the early 1790s, the French Revolution abruptly departed from the Enlightenment ideals of logic and reason as radicals like Robespierre enflamed the passions of the masses. The ensuing Reign of Terror saw (among other atrocities) the mass incarceration of intellectual, political, and religious dissidents (including Vaucanson's eulogist, Condorcet). Among many liberal and conservative intellectuals alike, the blame for the Revolution's violent turn rested on the earlier generation of Enlightenment thinkers; the "Voltaires and Rousseaus, the Helvétiuses, the Diderots and

[31] Nogaret et al., Kindle E-Book, Loc. 768 0f 6782.

d'Alemberts," decried the reformed philosophe Antoine de Rivarol in 1797, who "need not blush at the homages paid them by the convention."[32]

When Nogaret revised *Miroir* in 1795, he removed the novel's most overt references to both the Enlightenment and Revolution, instead recasting the story as an innocent romance. Nogaret now retitled his novel, *Aglaonice ou la belle au concours* ["Aglaonice, or Beauty in the Contest"], as if acknowledging the naiveté of Aglaonice's belief in technology (and people) to act in society's best interest. *Miroir* originally featured lengthy digressions about religious and monarchical oppression, and it quoted liberally from Voltaire's political writings. The streamlined plot however focuses exclusively on the exploits of Aglaonice and the six inventors.[33] Even Wak-wik-vauk-an-son-Frankéstein's name is shortened to Wak-wik-vauk-an-Frankéstein, removing the subtle celebration of Vaucanson's legacy. Stripped of their historical and political specificity, Frankéstein and Nicator's automata continued to play a central role in the story, but one senses Nogaret's anxiety about the Enlightenment project that those machines represented in 1790. After the atrocities of the Revolution, the utopian promise of an automaton that remakes society seemed foolhardy.

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[32] Rivarol continues with a damning critique; "By leaving us on the eve of our misfortune…[these philosophes] would not have to moan about the revolt they have prepared, they do not have to be ashamed of the tributes of the convention. If they still lived, they would be executed by the victims who praised them, and massacred by the executioners who deified them." Antoine de Rivarol, *De la Philosophie moderne ; par Rivarol* (éditeur non identifié, 1797); quoted in Darrin M. McMahon, *Enemies of the Enlightenment: The French Counter-Enlightenment and the Making of Modernity* (Oxford, UK: Oxford University Press, 2002), 99.

[33] Indeed, in the dedication to *Miroir*, Nogaret suggests that the book's main purpose is to serve as a vehicle for Voltaire's political essay, writing "If you only want to amuse yourselves, read me. If you want to enlighten people and serve them, skip to the final footnote to this work, read it and follow the advice that I give you. Thus, the blue penitents, the gray penitents, the white penitents, the green penitents and all the masks of that species will have less to fear." This attribution was removed in the *Aglaonice*. Nogaret et al., "The Mirror of Present Events," Kindle E-Book, Loc 154 of 6782.

The reaction against the French Revolution anticipated many of the responses that nineteenth-century critics now directed towards Enlightenment ideas. One conservative reaction, what historian Isaiah Berlin calls the Counter-Enlightenment, rejected the Enlightenment's celebration of free will, rationalism, and universalism, and instead advocated for the re-establishment of the monarchy. Because the masses had revealed their inability to self-govern, these thinkers believed that a wise ruler was needed to quell the people's wild passions—a political theory of paternalism. On the other side of the political spectrum, the Romantics attacked Enlightenment universalism for failing to account for the complexity of human experiences. While eighteenth-century materialists studied the observable—the physiologic and physiognomic impressions of all bodies—the Romantics were captivated by the invisible: those erratic and unpredictable impulses that cannot be seen or modeled mechanically.

It is perhaps no coincidence, then, that the early Romantics delighted in telling stories about the moral and scientific failings of Enlightenment thinkers. Goethe's Faust, desiring to unlock the secrets of life, makes a supernatural pact with Mephistopheles to exchange his soul for boundless knowledge and pleasure. E. T. A. Hoffmann wrote numerous tales about eighteenth-century automata and other mechanistic experiments whose human-like actions allow them to run amok of "proper" society. Stories like "The Sandman" and "The Automaton" (1814) emphasized the incompatibilities of the materialist philosophy in a vitalist world, featuring mechanistic experiments that function in disordered and surprising ways, despite embodying the Enlightenment's conviction in

an ordered and rational universe.[34] Perhaps most famously, Mary Shelley encapsulated this tension in *Frankenstein; or, The Modern Prometheus* (1818), her work of Gothic horror about the dangers of materialism gone unchecked. Set in the ambiguous year of "17—," *Frankenstein* depicts the moral failing of the Enlightenment scientist, Victor Frankenstein, whose steadfast belief in the totality of his scientific knowledge leads to his downfall. Fascinated by the hubris of materialists like Frankenstein, Shelley describes the promising doctor's overestimation in his science's "almost unlimited power," showing how he reduces life to pure matter, creating a new being from the picked-over remains of the dead.[35] Nevertheless, when Victor infuses his corpse with the "spark of being "—often portrayed as a galvanic jolt of vital energy—he is faced with a monster far removed from the rationalism and propriety that materialists like Condillac, Diderot, and La Mettrie expected from their philosophies. Throughout Shelley's novel, both Frankenstein and his creation abandon the basic moral and rationalist tenets of the eighteenth-century, extracting retribution against one another until they are left destitute in the North. By documenting scientists' descent into madness and moral depravity, writers like Shelley, Hoffmann, and Goethe not only rejected the empirical certainty of Enlightened materialism but basked in the horrific outcomes of materialist scientists' ignorance. Thus,

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[34] For more on Hoffmann's criticism of Enlightened mechanism in "*Der Sandmann*" and "*Die Automate*," see Jeanne Riou, *Imagination in German Romanticism: Re-Thinking the Self and Its Environment* (Oxford, UK: Peter Lang, 2004), 222–23. Paola Mayer, *The Aesthetics of Fear in German Romanticism* (Montreal, QC: McGill-Queen's Press - MQUP, 2020), 409–11. Lucia Ruprecht, *Dances of the Self in Heinrich von Kleist, E. T. A. Hoffmann and Heinrich Heine* (Burlington, VT: Ashgate Publishing Company, 2006).

[35] "Darkness had no effect upon my fancy; and a church-yard was to me merely the receptacle of bodies deprived of life, which, from being the seat of beauty and strength, had become food for the worm." Mary Wollstonecraft Shelley et al., *Frankenstein, or, The Modern Prometheus: Annotated for Scientists, Engineers, and Creators of All Kinds* (Cambridge, MA: The MIT Press, 2017), 75,.

as scientists like Frankenstein "mocked the invisible world with their own shadows," writers like Shelley delighted in having the invisible world mock them in return.[36]

Vaucanson and his machines played a foundational role in these Romantic myths. Officially, Vaucanson was still fêted; in 1794, the inventor's papers and inventions were preserved in the *Conservatoire national des arts et métiers* (CNAM), a national effort to archive and celebrate the industrial innovations of French arts and sciences. Still, for a new generation of nineteenth-century readers, would-be *philosophes* like Frankenstein or Faust represented the moral failings of Vaucanson's mechanistic worldview. These shifting political winds help explain why Nogaret removed the subtle reference to Vaucanson in *Aglaonice*, distancing himself from the materialist politics and technology that were seen to have set off the Revolutionary powder-keg. Taking Vaucanson seriously but not literally, writers like Adolphe de Leuven and Arnim von Achim imagined alternative histories of the eighteenth century in which the inventor succeeds (or at least appears to succeed) in creating life, endowing his machine with a *vitalistic* spark of humanity. These stories altogether ignored the machine's mechanistic shortcomings, focusing instead on the human repercussions of its uncanny actions. Thus, the automaton-flutist does not merely play music, but it sings and seduces, empathizes and angers—in short, reproducing the seemingly irrational behaviors that were thought to drive all Romantic subjects. In these tales, Vaucanson's musician becomes an example of what Robert Mitchell calls "experimental vitalism," a philosophical stance in which the

[36] Ibid., 67.

symptoms of vitalism (behaviors, actions, affects) are simulated to theorize the origins of life. As Mitchell explains,

> Experimental vitalists begin with a sense that life cannot be fully explained by current scientific concepts and assumptions and then develop experiments in order to provoke new questions and concepts about life and living beings…[this] experimentation is a means for making more complex and nuanced our understanding of the nature of living beings' potentials.[37]

Experimental vitalism, then, constitutes an effort to complicate rather than simplify our understandings of ourselves, imagining experiments (like Vaucanson's automata) that illuminate humans in all of their psychic richness. These stories bring the inventor and his invention full circle. Where the machine once exemplified an *a priori* theory of enlightened mechanism, it now enabled an *a posteriori* investigation of Romantic vitalism.

Archetypal of this historical reimagining was *L'automate de Vaucanson*, a comic opera that premiered on September 2, 1840, at the *Theatre royal de l'Opéra-Comique*. With music by Luigi Bordese and libretto by Adolphe de Leuven, *L'automate* was a comic story about the Vaucanson household during the flutist's construction, portraying Vaucanson as a strict, yet aloof patriarch, who clashes with three members of his household: his innocent niece, Marie; her suitor, the Chevalier de Lancy; and, a well-meaning but daft servant, Landry. The eponymous *automate* drives much of the opera's

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[37] Mitchell distinguishes *Experimental* vitalism from *Theoretical* vitalism. If experimental vitalism is designed to create models that explore and investigate vital forces *a posteriori*, theoretical vitalism embodies the eighteenth-century search to test pre-existing theories. In this case, theoretical vitalists have a pre-existing idea of how vitalistic forces work, so they create models for testing their hypotheses. Mitchell, *Experimental Life*, 7–8.

plot. The superstitious Landry worries that the automaton is a diabolical invention that will eventually supplant his position in the household. The curious Marie desires to see the automaton, but her paranoid uncle is afraid that it will be stolen by a rival and jealously locks the machine in his workshop. That same fear leads the inventor to dismiss the Chevalier de Lancy when he asks for Marie's hand in marriage, believing that the proposal is an excuse to gain access to the machine.

In the opera's climax, the rebuffed suitor circumvents the uncle by sneaking into the house through a window—at precisely the moment that Marie enters the workshop to examine her uncle's machine. Fearing discovery, the Chevalier takes the place of the automaton-flutist on its pedestal, becoming what Wendy C. Nielsen calls a "pseudo-automaton:" a mechanical illusion that produces the "effect" of automatism without the underlying mechanism.[38] Describing the pair alone together in the workshop, the librettist Leuven contrives a masked seduction between the Chevalier-as-automaton and Marie that inverts the spectacle of Pygmalion's ardor at Galatea's awakening. At first, the Chevalier plays his role so perfectly that Marie assumes she is looking at the real automaton. Examining the "machine," she praises its life-like appearance—a sight gag that undoubtedly charmed the Paris audience. She then inserts a key into the winding mechanism hidden in the pedestal and provokes the Chevalier-machine into musical action. The young man performs his role well; his flute-playing charms the young maiden,

[38] Wendy C. Nielsen, "Romantic Tales of Pseudo-Automata: Jacques de Vaucanson and the Chess-Playing Turk in Literature and Culture," in *Romantic Automata: Exhibitions, Figures, Organisms*, ed. Michael Demson and Christopher R. Clason (Rutgers, NJ: Rutgers University Press, 2020), 89.

eliciting her praise of "*Quel talent! Ravissant!*" Nevertheless, when the Chevalier ends the charade and steps from the pedestal towards Marie, he surprises the maiden:

Marie

Comme son regard est tendre !	How his look is so tender!
Je sens mon cœur se troubler,	I feel my heart flutter
Ah ! Que je voudrais l'entendre,	Ah! That I could hear it,
il ne peut parler ![39]	Yet it cannot talk!

Torn between desire and fear, Marie migrates her attention from the quality of its playing to the tenderness of its gaze, troubled yet titillated by the automaton's indifference to the supposed limits of its mechanics. Notice here how the automaton's music was unproblematically mechanical for Marie and her nineteenth-century audience. Here she distinguishes herself from Landry, the superstitious servant who fears that the machine is "truly diabolical and satanic." Instead, Marie's unease is provoked by the machine's passionate gaze, which sets her "heart fluttering." With this gaze—a male gaze, no less—the automaton forcibly swaps subject-positions with Marie. As can be seen in Figure 2.2, it repositions itself from the object of Marie's gaze into a subject gazing upon Marie, a reversal that consequently remakes Marie from observer to observed. By inverting the power dynamic between woman and statue, the gaze validates the machine's libidinal agency to act upon, communicate with, and hold a desire for her.

[39] Adolphe de Leuven, *L'Automate de Vaucanson, Opera-Comique En Un Acte* (Paris: Théâtre royale de l'Opéra-Comique, 1840), 7.

Figure 2.2: Charles Vernier, Engraving from L'automate de Vaucanson (1840), Lithograph. SOURCE Bibliothèque nationale de France, département Bibliothèque-musée de l'opéra

Whether Marie is a willing or unwilling participant in the Chevalier's seduction is unclear, and the opera is content to leave the scene with the same ambiguity that Da Ponte left Don Giovanni's tryst with Donna Anna. Nevertheless, as in Mozart's opera, there are clues in the music. The composer Luigi Bordese sets the Chevalier's text in long, flowing passages that build upwards by steps and leaps. As we can see in the music reproduced in Example 2.1, the Chevalier showcases his impressive range with *bel canto* flair, displaying an act of acrobatic melody-making that affirms the passion of the so-called machine. At the same time, Marie, who is shocked by the machine's awakening, is reduced to a mere stammer. If the automaton's flowing melody affirms its capacity to act

and feel, Marie is only able to stutter simple phrases and outline basic triadic harmony. Thus, her simple drone makes an oddly mechanical counterpoint to the Chevalier's soaring line:

Marie

Mon dieu, mon dieu que son lange est tendre.	My god, my god, his language is tender.
Je sens ici, je sens ici tout mon coeur est troubler	I feel, I feel that my heart is fluttering.
Pourtant, pourtant combien j'aime à l'entendre	Yet, yet how I love to hear it.
C'est surprenant, c'est surprenant comme il sait bien parler.[40]	How surprising, how surprising that he knows to speak well.

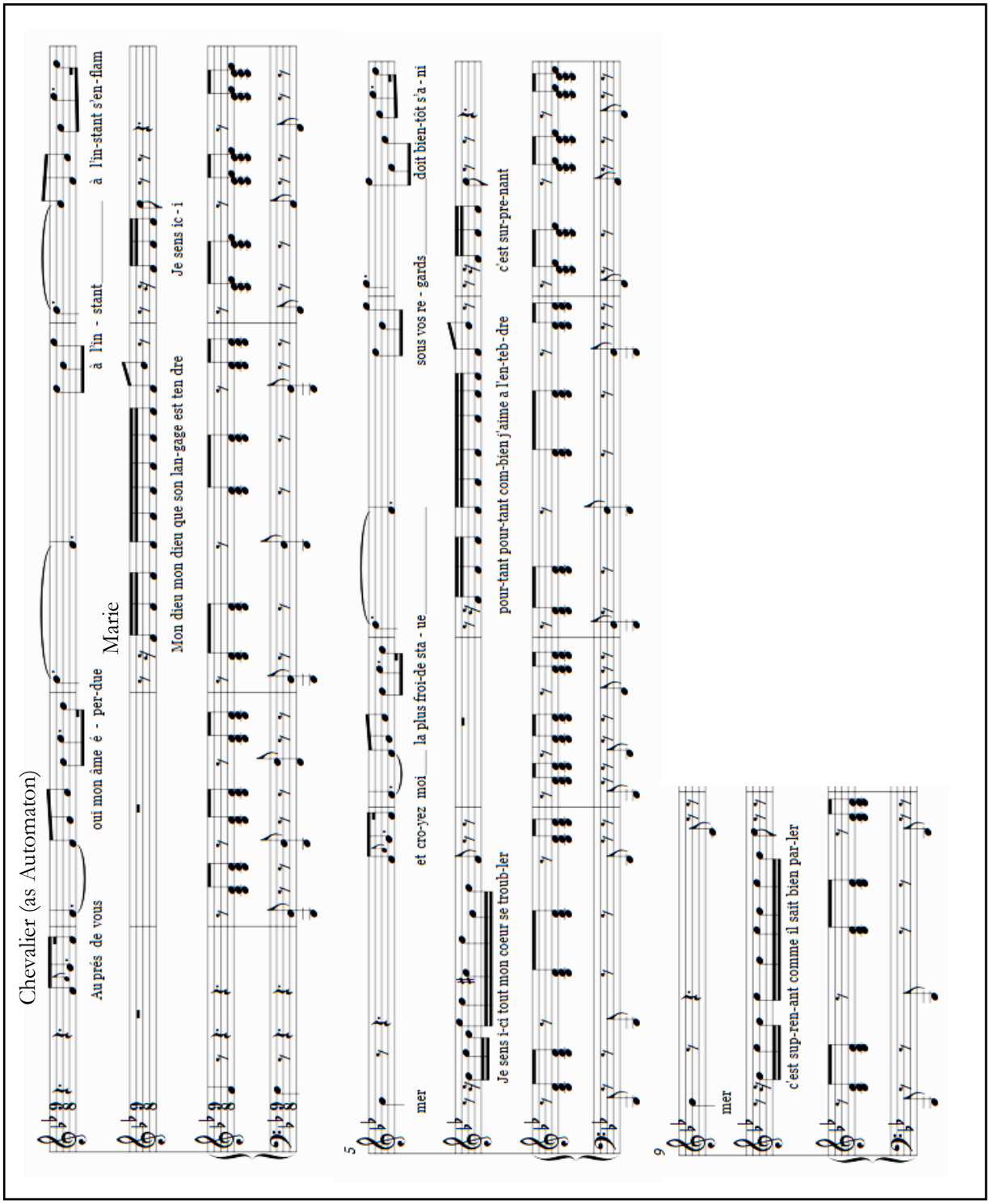
As in many musical seductions of the late-eighteenth and early-nineteenth centuries, Marie is gradually swayed by the Chevalier-automaton's musical plea. Even as she retains her stuttering text, she begins to mimic the Chevalier's flowing melody, until the pair are eventually harmonizing in sonorous thirds. By the duet's conclusion in Example 2.2, Marie's music and text are in direct conflict. Her text grows more resistant, while her music becomes more pliant, resulting in a contradictory conclusion to the Chevalier's insistent actions:

MARIE

(se défendant avec effort)	(*defending herself with effort*)
Que faire, mon Dieu, que faire?	What to do, my God, what to do?
Et comment lui résister?	And how to resist him?
Car j'ignore la manière,	Because I do not know the way,
Maintenant de l'arrêter.[41]	To stop it now.

[40] Leuven, 8.
[41] Ibid.

The aria ends as Marie and the Chevalier-automaton cadence together in G over a triumphant orchestral tremolo; him holding a B3 on the word “cieux” [heaven], her holding a G5 on the word “arrêter” [stop].



Example 2.1: Luigi Bordese and Adolphe de Leuven, "Marie, o douce Marie," mm. 27–36 from L'Automate de Vaucanson (1841)
SOURCE : The Music Collections at the British Library

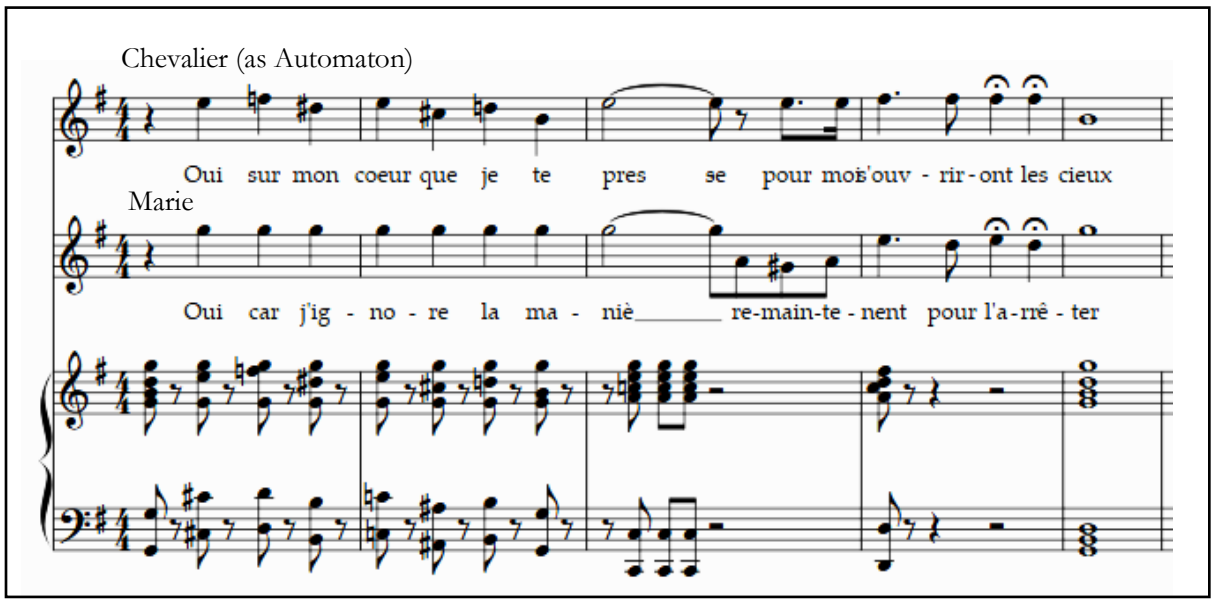


Figure 2.2: Luigi Bordese and Adolphe de Leuven, "Marie, o douce Marie," mm. 114–23 from L'Automate de Vaucanson (1841)
SOURCE : The Music Collections at the British Library

Depending on the perspective, the climactic seduction of *L'automate* is rife with irreconcilable tensions—between Lancy's identity as automaton and chevalier; between Marie's status as object and subject; between the automaton's actions as natural or unnatural. Yet, despite the scene's contradictions, Leuven and Bordese largely orient these oppositions around one central issue: the limitations of Vaucanson's materialist conception of music and mechanism. From the moment he steps onto the automaton's pedestal, the Chevalier tests the boundaries of Vaucansonian musical materialism with a scientist's precision, gauging Marie's response to an ever-widening array of activities: mute stillness, mechanical flute-playing, longing gaze, impassioned song. With each test, Lancy discovers what a materialist conception of music should or should not *feel* like by

observing Marie's reaction. Selecting for affective potency, the Chevalier develops his passionate aria from the tenets of Enlightened materialism, evolving the automaton's once-tepid musical sounds into an emotional song.

L'automate, however, devotes little energy to these complex themes of morality and epistemology. Instead, the story concludes with the characteristic tidiness of a comic opera: The Chevalier's pantomime is exposed, he and Marie reconcile, and Vaucanson gives his blessing to the couple. Nevertheless, the spectacle of the automaton-seducer illuminates how the comforting certainty of Enlightenment mechanism was eroded and recontextualized by Romantic audiences concerned with the unknowable. If Enlightenment thinkers like La Mettrie used Vaucanson's *l'homme machine* to explain the mechanical continuities between man and machine, Leuven stretched those continuities to their breaking point, presenting a machine with the libidinal desires of man. Although the opera largely presented the scene as a farce, Marie's abject horror at the unnatural automaton was not—provoking an uncanniness that had long fascinated the German Romantics.

Romanticizing Vaucanson: *Gräfin Dolores* (1)

In 1785, Vaucanson's automata were purchased by the German doctor, chemist, and polymath Gottfried Christoph Beireis for the price of three thousand florins. Many Romantics regarded Beireis as a quaint holdover from the eighteenth century. Goethe described the professor as a "personality who pointed to an earlier, long-past epoch," remarking how he "had so often heard mention of him, his surroundings, his curious

possessions, his odd behavior, as well as the mystery that enshrouded all." A professor of philosophy and medicine in the university town of Helmstädt, Beireis lectured widely on the sciences of chemistry, medicine, and philosophy, but he also cultivated a mysterious reputation as a practitioner of alchemy and other magics. In his youth, Beireis had made a fortune converting ammonium sulfide into cinnabar, which could be used to create a fashionable red dye. Nevertheless, he kept the source of his income a mystery, encouraging speculation that his wealth resulted from exotic adventures in Egypt and from his supernatural ability to transmute base metals into gold.[42]

Contributing to the professor's reputation was his collection of automata and other mechanical trinkets, a pursuit for which Beireis showed undeniable passion. Beireis devoted over two thousand thaler (or approximately forty thousand modern American dollars) to restoring Vaucanson's machines.[43] He commissioned expensive golden jackets for both musicians and sought to update the flutist's camshaft so that it could play more contemporary music.[44] Beireis was seemingly untroubled by this expense and labor, maintaining an intense interest machine's operation. In one letter at the end of the eighteenth century, he wrote;

> You will easily judge, Monsieur, the difficulty of transcribing music of this kind on a roll. But I will not tire, even if it takes years. I am ready for them (the automata) and will spend as much money as the princes would have done. How much I

[42] Grete de. Francesco, *The Power of the Charlatan*, trans. Miriam Beard (New Haven: Yale university press, 1939), , 250–59.
[43] This conversion is based on 1871 statistics in which a single German thaler equaled seventy-five American cents. When accounting for inflation, a single thaler equals $15.76 modern American dollars. For comparison, Goethe's income as a public servant in 1780 was 1400 thaler. See Siegfried Unseld, *Goethe and His Publishers* (Chicago: University of Chicago Press, 2019), 4.
[44] Among these pieces, was "the great air so beautiful that the composer Graun (78) composed for the famous singer Astroa" Quoted in Doyon and Liaigre, *Jacques Vaucanson: mécanicien de génie*, 99.

> wish for you, who are a great connoisseur, to finally admire the unheard-of complexities and imaginative power of a Vaucanson.[45]

In addition to the enormous sum that he devoted to purchasing and restoring Vaucanson's automata, records show that Beireis also possessed other mechanical marvels from the Enlightenment: Phillip Matthäus Hahn's mechanical calculator, Jaquet-Droz's automaton bird-clock, and a wooden figure of the devil.[46]

In 1797, Beireis's collection inspired the forty-eight-year-old Goethe to make a pilgrimage to the professor's Helmstädt manor. Goethe was especially interested in examining Vaucanson's inventions but was disappointed when he saw the now-dilapidated machines. The duck had lost its feathers, and although it could still consume grain, there was nothing left but a skeletal husk. Meanwhile, the flute-player now appeared in "unimposing clothes…his playing days were past." The original camshaft was dislodged and in ill repair, and its replacement, which Beireis had started, was also left unfinished. Without the camshaft—the mechanism coordinating the lungs, fingers, lips, and tongue—the machine was unable to play its instrument; "and so the flute-player at the very beginning was mute." Goethe was mildly scandalized by Beireis's commitment to the upkeep of the machines: "With all this, however, Beireis was by no means put out, but spoke of these obsolete, half-wasted things with much complacency, with an air of much

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[45] Ibid., "Vous jugerez facilement, Monsieur, de la difficulté qu'il y a à transposer une musique de ce genre sur un rouleau. Mais je ne me lasserai pas, même si cela exigeait des années. Je suis prêt à leur (les automates) consacrer une somme aussi élevée que l'auraient fait les princes. Combien je souhaiterais que vous, qui êtes un grand connaisseur, vous puissiez enfin admirer les difficultés inouïes et la puissance d'imagination d'un Vaucanson."
[46] Francesco, *The Power of the Charlatan*, 258.

consequence, as if he thought that mechanism had since produced nothing new of greater importance."[47]

For the poet, Vaucanson's "obsolete, half-wasted things" symbolized Beireis's status as a man disconnected from modern life. As Goethe toured the doctor's manor and observed its many treasures—automata, clocks, paintings, coins, jewels—he witnessed Beireis using these objects to prop up his own self-aggrandizement, evincing fantastic wealth, exotic travels, and mystical powers. Ever the skeptic, Goethe distrusted Beireis's sentimentality for bygone myths of the Enlightenment, and he likened the doctor to other eighteenth-century charlatans, explaining,

> Anyone living in…a small university like Beireis, had always the best opportunity of wrapping himself up in a mysterious obscurity, invoking spirits and laboring at the philosopher's stone. Have we not in modern times seen how Cagliostro, sweeping swiftly across large spaces…carries on his juggleries, and everywhere find adherents? Is it then too much to say that a certain superstitious belief in demoniac men never dies out, so that at all times a place is to be found where the problematic true, for which in theory alone we have respect, may most conveniently in practice associate with a life?[48]

Writing eleven years before the publication of *Faust Part 1*, Goethe's harsh criticism of Beireis perhaps resembles his damning adaptation of the Faustian myth. To Goethe, both professors represented the limits of Enlightenment reason, epitomizing the danger of unchecked materialism: Beireis mastered nature through deception, while Faust mastered

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[47] Johann Wolfgang von Goethe, *The Autobiography of Goethe: Truth and Poetry, from My Own Life*, trans. John Oxenford, Rev. ed., 2 vols. (London: G. Bell, 1881), 320.
[48] Ibid., 332.

it with the supernatural. Beireis, then, represented many of Goethe's harshest criticism of the Enlightenment era.

The mythology surrounding Beireis, however, was compelling material for other Romantics too. E. T. A. Hoffmann, who consulted with the professor for his 1813 novel, *Der Magnetiseur*, allegedly used him as the inspiration for Spallanzani, the mysterious creator of Olympia, in "The Sandman."[49] The Prussian poet, Carl Joachim Friedrich Ludwig von Arnim (better known as Achim von Arnim), visited Beireis a year after Goethe, and was so fascinated by the figure that he gave the professor and his collection a starring role in the ninth chapter of his 1810 novel, *Armut, Reichtum, Schuld und Bußе der Gräfin Dolores* (The Poverty, Wealth, Guilt, and Atonement of Countess Dolores), a tragic tale documenting the infidelity, redemption, and death of Countess Dolores and her steadfastly-devoted husband, Count Karl.

The Beireis-inspired chapter follows Karl arriving in Helmstädt (thinly veiled as H— in Arnim's novel) to meet with an unnamed eccentric doctor. Just as Goethe received a warm reception from Beireis in 1797, Arnim's Count is similarly welcomed by the good doctor, who invites him into his home for a tour. When the doctor steps out for a brief errand, the Count explores the manor's lavish interior and encounters many mechanical figures: artful planetary clocks are hung from the ceiling like chandeliers; another timepiece chimes the hours with a mechanical skeleton that strikes the hours on a bell with its bony hand; the bell's ringing wakes a mechanical bird atop the clock, which

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[49] Allen W. Porterfield, "Where Literary Enthusiasm Failed," *The German Quarterly* 11, no. 4 (1938): 176, https://doi.org/10.2307/399992.

"stirred its wings and sang an evening song;" beside that clock, a calculating machine sits on the table displaying the number twenty-six—a seemingly random number that coincidentally matches the Count's age.

Arnim fills the semi-fictive doctor's house with fantastic machines inspired by the items from Beireis's collection—Jaquet-Droz's bird clock and Hähn's calculating machine were both objects that Arnim no doubt witnessed at the Helmstädt estate—weaving fantasy and reality into an enchanting tapestry. Yet, lest we assume that *Gräfin Dolores* uncritically celebrates the mysterious persona that the professor had carefully cultivated, Arnim's Count interprets the Doctor's lifestyle as sad and isolated. After just a few moments in the house, the Count "became very desolate and lonely, what all the artificial machines had not been able to do: he shuddered and a nameless fear seized him for the life of a very lonely man, who, like the last on earth, loses himself and grows wild in his dreams of Hell and Heaven…"[50] Surrounded by mechanical trinkets devoid of human connection, the Count imagines the doctor's living situation in ominous terms; alone but for the company of simulated nature, the doctor has grown wild and a little mad, dehumanized to the point that he resembles his mechanical toys.

The Count, however, encounters the crowning achievement of the doctor's collection out in the garden: a life-sized automaton-flutist. Still feeling isolated and

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[50] "Hier wurde ihm sehr öde und einsam, und was alle die künstlichen Maschinen nicht vermocht hatten: er schauderte und eine namenlose Angst ergriff ihn vor dem Leben eines ganz einsamen Menschen, der wie der letzte auf der Erde sich in seinen Träumen verliert und verwildert, an Hölle und Himmel zugleich anstößt und nicht hinein dringen kann." Ludwig Achim von Arnim, *Armuth, Reichtum, Schuld und Busse der Gräfin Dolores; Eine Wahre Geschichte zur lehrreichen Unterhaltung armer Fräulein,* (Berlin: Expedition des v. Arnimschen Verlages, 1853), 68. http://hdl.handle.net/2027/nnc1.0315056392.

uneasy about the doctor's collection, the Count defiantly asks the flute player to "Play the flute, if you can!" and, to his surprise, the flutist acquiesces;

> The flute player immediately raised the flute and played a stiff, uncomfortable, and very artificial concerto, as the duck roared happily in the water and ate the grains that lay on the side with great eagerness. The Count closed both eyes with his hands and exclaimed in amazement: "Who hears, who lets himself be heard, am I foolish, or is everything untrue?"[51]

The flutist's contrived performance merely frustrates the Count further. The machine responds mechanically to his prompt with a stiff and artificial performance that leaves little impact on him, provoking dissatisfaction. There is little doubt that the machine "hears" the man, as it heeds his call to "play the flute," yet its song leaves the Count dissatisfied. Something is missing. Such a machine might be able to hear pitch relationships or sense consonance and dissonance but is unable to interpret or convey complex emotions or moods. The automaton, then, grants the Count's request ("play the flute"), but it is unable to fulfill his intent ("play music"), as it can only slavishly reproduce the precise instructions of the camshaft—it too lacks an appreciation for other minds like the Count's. Indeed, later in the chapter, the Doctor even inserts a new cylinder; "a great sonata," he explains, "You should hear that the machine can do more." Still, even with its updated music, the Count hears only the automaton's artificiality. "Am I foolish," puzzles the Count, "or is everything untrue?"

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[51] " Der Flötenspieler setzte die Flöte sogleich an und spielte zwar etwas steif und unbequem, aber sehr künstliche Konzerte, wobei die Ente im Wasser fröhlich rauschte und von den Körnern, die an der Seite lagen, mit großer Begierde fraß. Der Graf schloß beide Augen mit seinen Händen und rief verwundert: "Wer hört hier, wer läßt sich hören, bin ich närrisch, oder ist alles nicht wahr?" Ibid.,70.

What, then, would it sound like for one of the Doctor's devices to cultivate a genuine human connection? Arnim gives an answer when a gentle female voice replies to the Count's rhetorical question, "We are all foolish, I can hear you, you can hear me." The Count looks around and asks who speaks, but he hears only a voice reply, "An invisible girl;"

> COUNT: "How do you come here? The newspapers say that you are causing a lot of commotion in London." -
> SHE: "There is a lot to the invisible girl, love holds me here."
> COUNT: "Love for an invisible one, or one you see?"
> SHE: "I see more than you all, and love more than you all; I love the flute player."
> COUNT: "Does he love you back?"-
> SHE: "Oh no, he does not love me since I demanded that he should love me completely; but what does that concern you?"[52]

Like many machines in the Doctor's manor, Arnim's invisible girl had a real-world analog, existing as a pseudo-scientific exhibit that first premiered in London's Leicester Room in 1803. In London, the trick involved an exhibition space prepared with four trumpets attached to rubber tubing. The tubing would be fed into another room, where the eponymous "invisible girl" could speak through trumpets to address the audience. She would hear and respond to their questions, pose queries of her own, speak multiple languages, tell jokes and riddles, and even sing popular songs. Arnim's story elevates this parlor trick by juxtaposing the flutist's "stiff, uncomfortable, and artificial concerto" with

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[52] GRAF: "Wie kommst du hierher, die Zeitungen erzählen ja, daß du in London eben viel Aufsehen machst." – SIE: "Es gibt der unsichtbaren Mädchen viele, mich hält hier die Liebe fest." GRAF: "Liebe zu einem Unsichtbaren, oder kannst du sehen?" SIE: "Ich sehe mehr als ihr alle, und liebe mehr als ihr alle; ich liebe den Flötenspieler." – GRAF: "Liebt er dich wieder?" – SIE: "Ach nein, er liebt mich nicht, seitdem ich verlangte, er solle mich ganz lieben; doch was geht dich das an?" Ibid.

the invisible girl's sincere pronouncement of love. The invisible girl hears and responds to the Count, validating him in ways that were impossible for the mechanical flutist's artificial music.

Nevertheless, Arnim presents both the girl and flutist as objects in the doctor's collection, each a piece of technology. As I discussed in Chapter One, Vaucanson's flutist represented the pinnacle of Enlightenment machinery, embodying the eighteenth-century pursuit of mechanism; the invisible girl, on the other hand, was a quintessentially Romantic technology, exemplifying one of many scientific showcases that appeared throughout nineteenth-century Europe that blurred imaginative spectacle and objective experiment. In 1803, for instance, the Italian scientist, Giovanni Aldini (the nephew of the Luigi Galvani, the scientist who pioneered animal electricity) dazzled the European public by sending electrical currents through the bodies of deceased animals and humans. In one showcase, Aldini electrocuted the body of George Foster, a freshly executed murderer, making the corpse's jaw quiver, its left eye open, and its clenched fist rise violently into the air. Around this same time, followers of the German doctor Franz Mesmer regularly showcased the benefits of "animal magnetism" (also known as "mesmerism"), a theory of vitalistic natural energies that course through all living bodies. These energies, claimed the Mesmerists, could be redirected to produce an array of positive effects: alleviate pain, cure illness, and enact a range of supernatural powers like mindreading (clairvoyance), cause unconsciousness (somnambulism), and dramatically increase muscular strength. By displaying scientific theories in such a provocative

manner, "experiments" like the invisible girl rendered scientific progress visible and accessible to everyday citizens.[53]

The historian John Tresch has shown that this kind of agency became a defining aspect of the sciences after Napoleon. Throughout the American and French Revolutions, Napoleonic Wars, and Industrial Revolution, inventors and scientists not only developed new machines to improve daily life (the steam engine, the battery, the telegraph), but also endowed those machines with nebulous and often unseen energies (steam, electromagnetism, electricity). Condorcet alluded to these forces when praising Vaucanson's capacity to "regulate, distribute, and direct the motivating force," giving the machine an almost vitalistic air. Motivated by an unseen spirit, Romantic machines were often anthropomorphized, imagined containing elements of machine and human. As mechanical tools, these technologies allowed humans to overcome nature's limitations. Such machines empowered humans with steam-powered arms for lifting heavier loads and legs for traversing greater distances. They flouted the natural world by carrying messages with electric-quick precision, traversing mountains, and rivers in minutes. Under the care of modern machines, humans could travel greater, more treacherous, distances, democratizing luxuries and experiences that once belonged only to the upper

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[53] The historians John Tresch and Richard Holmes have independently noted how these displays signaled a new scientific understanding of nature that they call "the Second Scientific Revolution," the period between 1815 and 1851 when revolutions in chemistry, biology, and astronomy were accompanied by a newfound appreciation for science among the lay-public. As Holmes explains, whereas the first revolution—defined by the works of Newton, Descartes, Leibniz, and Galileo—was conducted among a limited group of Latin-speaking scholars, the second scientific revolution was pedagogically open, as new breakthroughs like electricity, magnetism, and evolution were presented to lay-audiences, exploited for industrialization, and incorporated into the scientific imaginary. John Tresch, *The Romantic Machine: Utopian Science and Technology after Napoleon* (Chicago: University of Chicago Press, 2012); Richard Holmes, *The Age of Wonder: How the Romantic Generation Discovered the Beauty and Terror of Science*, 1st Vintage books ed. (New York: Vintage Books, 2010), xvi.

class. Yet, just as Romantic machines were made for human use, its users were themselves recreated for the machine, as new industries required humans to understand the art of building, maintaining, and operating such technologies. The steam engine, for instance, required a veritable retinue of operators—engineers, conductors, and coal-shoveling laborers—all carefully coordinated with each other and the machine to ensure sustained locomotion. Telegraphy forced operators to learn informationally dense codes to compensate for simple on-off circuitry. Indeed, the notion of a human "operator" or "user" is a decidedly Romantic one, as human muscles and brains were reshaped on a mass scale by encounters with mechanical interfaces. More than any earlier period in history, the ubiquity and complexity of machines in the nineteenth century ensured the mass integration of the human with the machine, arguably marking our first steps towards posthumanity.

Ironically, Arnim's depiction of the "invisible girl" is a perfect metaphor for the increasing *visibility* of technology in the Romantic era. Unseen yet passionate, the acousmatic woman demonstrated an uncanny power over the audience, enticing them with the affective authority of her voice. The Irish poet, satirist, composer, and political propagandist, Thomas Moore, described this effect in his ode to the original invisible girl, which he witnessed in London;

> …And like you, a legitimate child of the spheres,
> Escape from the eye to enrapture the ears!
> Sweet spirit of mystery! How I should love,
> In the wearisome ways I am fated to rove,
> To have you forever invisibly nigh,
> Inhaling forever your song and your sigh!
> 'Mid the crowds of the world and the murmurs of care
> I might sometimes converse with my nymph of air,

> And turn with disgust from the clamorous crew,
> To steal in the pauses one whisper from you.[54]

Moore was captivated by the woman's strange voice. It not only urges his passion and longing but drives him to act: he *"inhales* for her song and sigh," and "*converses* with his nymph of air." The Count too is struck by the woman's similar effectiveness. When she shares her story of heartbreak, he feels compelled to reciprocate with the sad tale of his marriage to Dolores. By speaking, sighing, and singing, the invisible girl performs a form of agency that privileged not merely her ability to act, but her capacity to impel others into action.

Arnim's invisible girl gives Romantic technology a voice with which to profess its desires and passions. Staged with Vaucanson's mechanical flutist and duck, the invisible girl makes a spectacle of her passions, voicing affective utterances that allow the Count to distinguish a feminine *her* from a neuter *it*. Her disembodied voice even summons images of the Count's beloved, prompting him to admit, "there was a similarity in her voice with his Dolores, who more lovingly than ever, hovered over him that night, always with the power of a terrible magician."[55] As a metaphor for modern technology, the invisible girl binds together mechanics and passion, articulating an impression of technology that is imminently human. Or, as Tresch explains, such machines not only "involved active participation of the observer" but also "articulated a spontaneous, living, and constantly

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[54] Thomas Moore, *The Poetical Works of Thomas Moore: Juvenile Poems; Poems Relating to America* (London: Longman, Orme, Brown, Green, and Longmans, 1840), 33–34.

[55] "Montana so verweilt hatte, es war eine Ähnlichkeit in der Stimme mit seiner Dolores, die ihn liebenswürdiger, als je, in der Nacht umschwebte; doch immer in der Gewalt eines schrecklichen Zauberers, der ihm wie der Doktor erschien." Arnim, *Armuth, Reichtum, Schuld und Busse der Gräfin Dolores; Eine Wahre Geschichte zur lehrreichen Unterhaltung armer Fräulein*, 75.

developing nature; it produces aesthetic effects and emotional states."[56] Nevertheless, despite uniting mechanism and vitalism, the invisible girl conjures little of the existential dread that Freud later called the uncanny—a boundary defiance that Freud associated with libidinal machines, walking dead, and frightening specters.[57] Instead, Arnim describes the invisible girl not as an object of horror, but as an invitation for empathy; in sharing her sad story, she conjures the Count's own melancholia.

How can we define the labor and power of a Romantic machine like the invisible girl? Unlike Beireis's Enlightened machines, the invisible girl strikes the reader as imminently flawed—she lacks the clockwork reproducibility of Vaucanson's duck or flutist. Nevertheless, those flaws put the Count at ease. Her blemishes—her heartbreak, or her pining for the flutist's love—lend the unnatural woman an aura (in the Benjaminian sense) of naturalness, an authenticity that the Count felt missing in his previous encounter with the flute player.[58] As described by Arnim, the invisible girl embodies a paradox about the Romantic machine: while Enlightened technologies like Vaucanson's flutist are mechanically visible but emotionally deficient, Romantic technologies like the invisible girl are mechanically limited but emotionally present. The Count understands her voice not as an utterance reducible to clockwork mechanisms (perhaps recalling the mechanical voices of Darwin and Faber I discussed in the last chapter). Instead, her voice is suffused with affective resonances that assert the

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[56] Tresch, *The Romantic Machine*, 12.
[57] Sigmund Freud, *The Uncanny*, trans. David McLintock (New York: Penguin Classics, 2003).
[58] See Walter Benjamin, "The Work of Art in the Age of Its Mechanical Reproduction," in *The Cultural Studies Reader*, ed. Simon During, 3rd. (New York: Routledge, 2007).

complexity of her being, a voice whose very timbre suggests her humanity. Paradoxically, the girl's invisibility enacts a different kind of enlightenment, as her acousmatic voice validates a body and spirit that Arnim's Count cannot directly perceive. Indeed, when the Count later realizes that the spectacle of the invisible girl is actually an illusion performed by a real girl named Arnika Montana, he accepts this revelation without question or surprise, for she was already real to his ears.

Reifying Vaucanson: *Gräfin Dolores* (2)

The relationship between inauthentic vision and authentic sound becomes an important theme throughout *Gräfin Dolores*, as the Count's attention to Arnika's acousmatic voice powerfully reminded him of his waning feelings for Dolores. Arnim, who was influenced by Johann Gottfried Herder's sensationalist philosophy of language, continually connected thought to verbal communication. Hearing Arnika's impassioned speech, the Count correctly infers a cognition like his own—even when he is unable to detect her body. Herder calls this empirical recognition the "second I:" the feeling of intimacy that occurs when one connects the external acts of another to the internal thoughts of the self. "We ourselves often pay no attention to our thoughts," explains Herder,

> but…we recognize ourselves at the moment when another person exhibits thoughts which seem taken from our own soul. We ourselves cannot fully answer the question of how our visage is shaped, but we will no doubt give a great start if an image of ourselves, a second I, were to confront us.[59]

[59] Johann Gottfried Herder, "On Thomas Abbt's Writings (1768)," in *Philosophical Writings*, trans. Michael N. Forster, Cambridge Texts in the History of Philosophy (Cambridge, UK: Cambridge University Press, 2002), 168.

Yet, just as the Count accepts Arnika as a "second I," he rejects that identification in the Vaucanson-inspired flute player. Where the former speaks with a voice that the Count recognizes as his own, the flutist plays a song that sounds stony, mechanical, and other. Cognition, in Arnim's world, is narcissistic, contingent on the ears of an observer inspecting the performance of another and receiving back an impression of themselves.

Mapping cognition onto a self-other binary was not Arnim's unique insight. Eighteenth-century political theorists were long captivated by the nascent cognition of so-called savages—a nebulous identity that mostly meant non-white, non-European colonial subjects. As we saw in the previous chapter, Vaucanson's flutist played a starring role in these fantasies, as mechanical music was heard to represent a linguistic utterance that sensationalist philosophers celebrated as a missing link in the origins of language. Arnim explicitly resists this interpretation. Instead, he uses the automaton's clunky performance to expose a rupture between sound and sensation, staging the failure of Enlightenment aesthetics on an automaton that many eighteenth-century thinkers portrayed as the original materialist subject. If an appropriately "human-sounding" musical spectacle necessitates a subject whose utterances articulate lived experience (like invisible Arnika), the automaton is unable to channel sensation into art—or perhaps it lacks sense altogether. Whether the machine makes for a flawed musician or a flawed human, the results sound the same in the end.

What would a musical subject sound like then? This question becomes important later in Arnim's chapter when the flutist gets another opportunity to perform. After hearing Arnika's tale, the Count turns again to the musician, and asks it to confirm her

story. Arnika, however, speaks for it, explaining that, "He never speaks, but sometimes he sings when he is very sad; he starts: listen, he will sing, and he sings so beautifully, so beautifully!" As if awoken by her words, the machine again brings the flute to its artificial lips, "alternating between blowing and singing." The contrast from its earlier performance is immediate. Where once its playing came off as artificial and dry, now the music changes between language and surreal imagery:

Flammenruh nach Weisheit streben	Resting flames strive for wisdom
Senkt den Jünger tief in Schlaf,	Lower the disciple to sleep
Und es glüht sein innres Leben,	And his inner life glows,
Als wenn Blitz die Tanne traf.	As when lightning struck the fir.
Festlich statt der schwarzen Krone	Festively, instead of the black crown,
Trägt sie einen Flammenkranz,	she wears a wreath of flames,
Weihrauch träufelt von dem Throne,	Incense dribbles from the throne,
Halme wirbeln rings im Tanz.[60]	Straws whirl all around in dance.

Reading between the lines, we soon learn that the flutist's heady poem is a retelling of the events that prompted the split between Arnika and automaton. The opening stanza's *Flammenruh* is one of many allusions to the fire that consumed the automaton's books, a destructive act that Arnika explains more fully:

> Since I arrived in this city, the flute player read the old man's books; he spent days and days reading them, forgetting me, though he had sworn to never forget me; at last he fell asleep; the sweat ran down his brow, and I took his books, and threw them all into the fire; then he woke up angry and will not talk to me until I have brought the books back to him.[61]

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[60] Arnim, *Armuth, Reichtum, Schuld und Busse der Gräfin Dolores; Eine Wahre Geschichte zur lehrreichen Unterhaltung armer Fräulein*, 71.

[61] "Seit ich in diese Stadt gekommen und der Flötenspieler in den Büchern des Alten gelesen hat; da hat er tagelang, nächtelang gelesen, und beschworen, und hat mein vergessen, da er mir doch geschworen hatte, mich nie zu vergessen; endlich schlief er ein und ich sah, daß er schwer träumte; der Schweiß lief ihm über die Stirne, da nahm ich seine Bücher, und warf sie alle ins Feuer; da wachte er zornig auf und schalt sehr und will nicht eher wieder mit mir reden, bis ich die Bücher ihm wiedergeschafft habe." Ibid., 70.

In revealing her culpability in the musician's automaticity, Arnika translates his metaphor-rich song into an explanation of her culpability. Speaking in clear German prose, she becomes his literal voice of reason, as if she alone can unlock the thoughts coursing through the automaton's mechanical mind for others.

Although the machine lacks Arnika's mastery of symbolic language, we cannot miss that the musician is still able to communicate. Indeed, in this first poem—the first of three—the musician displays a penchant for metaphor, eschewing the concrete meaning of everyday language for less defined poetic imagery. For instance, the opening *Flammenruh*—an oxymoron of chaotic *Flammen* and peaceful *Ruh*—conjures a host of images, both literal and metaphorical. *Flammenruh* might refer to the dialectic between the machine's materialist action and Arnika's fiery agency. Or, the light from the flames might symbolize the musician's desire to *enlighten*—assimilating knowledge by reading and studying. Indeed, the poet's metaphor could mean many things at once: it could foreshadow the burning of his books, or symbolize Arnika's hot passion, or anticipate the ashes of the automaton's desire for connection. Pinpointing the intention behind the automaton's words might seem unmanageable—but that may well be Arnim's point. Poetic interpretation becomes a proxy for the musician's psychology, a cognitive thread that the reader is encouraged to follow into the depths of the automaton's troubled mind. This portion of the novel, then, is autobiographical in the truest sense; not objectively recounting the past, but subjectively reconstituting a memory, the automaton's memory, so that the trauma of the book-burning is recreated on an affective register that the Count, Arnika, and presumably the reader, can experience for themselves.

Again, Arnim privileges the ears of the interpreter, distrusting the eyes' capacity to judge truthfully. The philosopher Martin Jay has argued that the Counter-Enlightenment emerged as a critique of the ocular-centrism that defined many eighteenth-century materialist writings. No longer trusting the truth offered by the eyes, writers like Arnim, Herder, and Goethe sought authenticity elsewhere, looking for it in the touch of the limbs, or the sounds detected by the ears—senses less easily seduced by the seeming appearance of truth; "Claiming to represent the truth," explains Jay, "vision actually operates on the level of deceptive artifice. What is seen, moreover, can produce unease and disquietude but never genuine mystery."[62] Jay argues that the rise of hermeneutics was central to this sensory reshuffle, as writers cultivated tools that could complicate the staid objectivity of the image, often turning to less concrete senses like feeling and hearing to reveal unseen depths. Indeed, the musicologist Holly Watkins playfully calls this historical shift a transition from "the mine to the shrine," as German critics like Herder and Hoffmann used metaphors of depth (caves, mines, deep bodies of water) to describe the hidden interiority that we, the listeners, are responsible for realizing from our musical encounters.[63] These were the depths that many Romantic novels sought to simulate when emphasizing the horrors and pathos of artificial—i.e. mechanical—life. Indeed, shortly after the automaton's lament concludes, the Doctor returns from his errand to continue the tour of the manor. Seeing the Count still transfixed by the flutist,

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[62] Martin Jay, "The Rise of Hermeneutics and the Crisis of Ocularcentrism," *Poetics Today* 9, no. 2 (1988): 310, https://doi.org/10.2307/1772691.
[63] Holly Watkins, "From the Mine to the Shrine: The Critical Origins of Musical Depth," *19th-Century Music* 27, no. 3 (March 1, 2004): 179–207, https://doi.org/10.1525/ncm.2004.27.3.179.

he offers a more literal way of seeing inside the machine, gladly opening up its chest and revealing not a "hidden man," as the Count expected, "but very intricate brass wheels" and a camshaft that "drove everything." Thus, to the Count's eyes, the automaton lacks depth, and he remains unable to reconcile the humanity of the flutist's lament against the mechanical sight of its clockwork innards—a dissonance Goethe himself noted.

Arnim seems to settle this mystery later in the chapter when he reveals that the automaton flutist is a real musician, a man named Florio whose music sustains the illusion of the automaton's performance. According to Arnika, Florio was originally the son of a wealthy merchant who joined Arnika when he fell in love with her beautiful voice at one of the invisible girl demonstrations. Yet, immediately after encountering his invisible love, he laid eyes on Arnika's companion, Divina. Divina is Arnika's opposite; where Arnika is unseen but intelligent, Divina is beautiful but daft. Arnika describes how a love triangle developed between the trio, as Florio loved the one woman's voice and the other's appearance. Anticipating the Chevalier's disguise in *L'automate de Vaucanson*, Florio soon joined their act, taking on the role of the mechanical flutist. Yet, if the Chevalier was liberated by the automaton's identity to pursue (and assault) Marie, Florio was made miserable by the pantomime: Divina eventually departed the group, leaving the flutist and invisible girl in the service of the doctor. The depressed Florio retreated to his books—which prompted Arnika to burn them. After that, Florio stopped speaking, only playing music and singing his odd, sad songs.

Although Arnika and Florio are not actual machines, they become machine-like, reduced to the reproduction of emotional labor. Florio, as an automaton, monotonously

plays the flute for those passing by, while Arnika, the invisible girl, charms them with conversation and wit. Trapped amongst the Doctor's mechanical menagerie, the pair are reduced to the service they render for the household, alienated from their bodies, agency, and humanity in the process. Even at Germany's early stage of industrialization, Arnim recognized the automaton's proximity to labor and alienation, and he conflates Florio and Vaucanson's flutist to reinforce the tragedy of mechanization. Indeed, throughout this chapter, all characters lament the social and emotional costs of living in a technological world. The producing Florio and Arnika are depressed and deprived of fundamental human freedoms, while the consuming Doctor and Count feel socially impoverished amidst the manor's wealth of technology. Surrounded by machines and mechanical labor, everyone feels uneasy, isolated, and alone.

This helplessness drives Florio's saccharine lament, which, in retrospect, becomes a singular act of reclamation and rebellion. Unable to effectively cultivate his own humanity, the musical man-machine compensates with song, spurning the perfection of mechanical reproduction for the messiness of artistic representation. In sacrificing syntactic clarity, Florio's songs gain immediacy and emotionality, eliciting an intense emotional response from its listeners; it provokes Arnika into mourning and the Count into self-recriminating thoughts about his wife, Dolores. Only the Doctor seems unaffected by Florio: yearning for novelty, artifice, and self-aggrandizement, Arnim's Beireis—a holdover of the enlightened *philosophe*—is deaf to Florio's affective power. Through these songs, Arnim imagines Vaucanson's automaton as a Romantic subject struggling against the mechanisms of fate; clockwork innards symbolizing the unceasing,

never wavering, reproducibility of duty and depression. Florio never finds respite in *Gräfin Dolores*, but his elegy inspires others to take action, eliciting a visceral response to automation that, more than fifty years later, Karl Marx would dub class consciousness.

Conclusion

On the surface, Florio's performance might resemble what Condorcet's eulogy of Vaucanson called the *usage utile*, bettering society by changing the hearts and minds of the citizenry, but Arnim understood the human cost of that transformation.[64] By the time of the publication of *Gräfin Dolores* in 1810, Condorcet's technological utopia—a world of bounty, equity, justice—was no longer understood to be free; the French and Industrial Revolutions had come at an enormous human price: citizens slaughtered, morals betrayed, labor indentured. Indeed, although Arnim stages Vaucanson's flutist as an essential steppingstone in Europe's efforts to modernize, he fixates on the costs of that effort. Like the stories by Nogaret and Leuven, Arnim's novel emphasizes the humanity of the machine's music, observing the automaton as it assuages and affects others. Yet, where the other writers focused on the automaton's external reception, speculating on its capacity to accomplish virtue or harm, Arnim is concerned with internal production: What is the relationship between interior mind and external art? How do we relate to and connect with others through art? Does artistic connection come with a social or emotional price? As Florio masquerades as Vaucanson's flutist, we hear art arise from

[64] Jean-Antoine-Nicolas de Caritat Condorcet, "Eloge de Vaucanson," in *Œuvres Complètes de Condorcet.*, vol. 2, 21 vols. (Paris: Chez Henrichs, 1804), 643–60.

Florio's suffering—from the trauma of his heartbreak, loss, and alienation. Although Arnim values Florio's self-expression, the author also warns against its abuse. With the Count as his proxy, Arnim balks at society's apathy towards labor and laborers, drawing attention to Europe's delusion that reproduction has no costs. Helmholtz made a similar claim in "On the Interaction of Natural Forces" (1854), arguing that Vaucanson's automata were founded on a flawed understanding of human energy expenditure. In his view, materialists like Vaucanson imagined life as a perpetual motion machine, striving to create automata driven entirely by an infinite store of internal energy—with utter indifference to the external influence of food or sustenance. This view, claimed the physician, fueled a theory of labor as an infinite, inexhaustible resource—one that toils without consumption, moving automaton-like workers "energetically and incessantly as long as they lived." "Never wound up," concludes Helmholtz, human laborers were conceived as automata producing work "out of nothing."[65]

Catherine Liu and Jean-Claude Beaune have each noted how Vaucanson's flutist functioned as a *mediating double*: by making a machine that acts like a human, Vaucanson enabled a mechanical ideology that treats humans like machines.[66] *Gräfin Dolores, Miroir des événements,* and *L'automate de Vaucanson* each show how the original automaton was inscribed with the multifarious hopes and anxieties of the next

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[65] Karl Marx makes a similar claim in *Das Kapital* (1867), castigating Vaucanson's silk loom (along with inventions by Richard Arkwright and James Watt) for negating the necessity for skilled laborers or artisans in the factory. Such machines, claimed Marx, alienate workers by redirecting their attention away from the direct manufacturing of goods and towards the maintenance and upkeep of the machines themselves. For both Helmholtz and Marx, the reproducibility of Vaucanson's machines represent the shortsightedness materialism to account for the diverse forces motivating individuals and groups. Karl Marx, *Capital: A Critique of Political Economy*, trans. Ben Fowkes, vol. 1, 2 vols. (London: Penguin Books with New Left Review, 1981), 503.

[66] Liu, *Copying Machines*; Jean-Claude Beaune, *L'automate et ses mobiles* (Paris: Flammarion, 1980).

technological age. Vaucanson's machine traversed the universe of early Romantic fiction: it appeared in Greek mythology to defend Syracuse from would-be invaders; it negotiated the sexual politics of a bourgeoisie farce; and it lamented its status in a preindustrial dystopia. With each adaptation, one witnesses a Romantic reaction to Vaucanson's materialist philosophy, as nineteenth-century thinkers pondered the future of humanity in a world of machines.

CHAPTER THREE

ON THE MUSICALLY INTELLIGENT:

AESTHETICS, ANALYSIS, AND THE HERMENEUTICS OF AI

> Question: Will a computer program ever compose beautiful music?
>
> Speculation: Yes, but not soon. Music is a language of emotion and until programs have emotions as complex as ours, there is no way a program will write anything beautiful.[1]
>
> Douglas Hofstadter,
> *Gödel, Escher, Bach: An Eternal Golden Braid* (1979)

> Though I felt there were a few little glitches here and there, I was impressed, the piece seemed to express something…It was new, it was unmistakably "Chopin-like" in spirit, and it did not feel emotionally empty. I was truly shaken. How could emotional music be coming out of a program that had never heard a note, never lived a moment of life, never had any emotions whatsoever.[2]
>
> Douglas Hofstadter,
> "Staring Emmy Straight in the Eye—And Doing My Best Not to Flinch" (2004)

Near the end of his Pulitzer Prize-winning book, *Gödel, Escher, Bach: An Eternal Golden Braid* (1979), the cognitive scientist Douglas Hofstadter pondered whether a computer

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[1] Hofstadter, *Gödel, Escher, Bach*, 676–77.
[2] Douglas Hofstadter, "Staring EMI Straight in the Eye—and Doing My Best Not to Flinch," in *Virtual Music: Computer Synthesis of Musical Style*, ed. David Cope (Cambridge, MA: The MIT Press, 2004), 38.

would ever compose "beautiful" music.[3] For Hofstadter, music's beauty expressed a central paradox of cognition. On the one hand, its unfathomable depths alluded to the ineffable experiences of being human, and yet that ineffability originated from a modest mechanical process: a brain reducible to binary neurons that are either on or off, zero or one. Hofstadter marveled at the deceptive simplicity of these neurons, noting how their coordination enables subtle gradations of language, emotion, thought, imagination, and music. For a computer to compose beautiful music, Hofstadter thought that it would have to possess a human-like capacity to genuinely feel emotions.

In 1995, just fourteen years after publishing *Gödel, Escher, Bach*, Hofstadter's conviction in music's humanity was shattered when one of his students introduced him to the algorithmic composer "Experiments in Musical Intelligence" (EMI, pronounced "Emmy").[4] EMI was created by UC Santa Cruz composer David Cope in the 1980s to analyze a composer's music and extract stylistic rules to generate entirely new pieces. Between 1991 and 2004, EMI shocked the classical music world with a series of concerts, recordings, and compositions that challenged the assumed humanity of Western art music. In April 1997, the machine premiered Mozart's "Forty-Second Symphony" with the University Orchestra at UC Santa Cruz, contributing an additional symphony to Wolfgang Amadeus's original forty-one—two hundred years after Mozart's death.[5] Six

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[3] The word "beauty" appears sixty-two times throughout Hofstadter's text, although he professes that its definition is "extremely hard to pin down." Throughout the book, he variously describes "beauty" as truth, simplicity, mystery, and "extreme depth of emotion." Hofstadter, *Gödel, Escher, Bach*, 580.

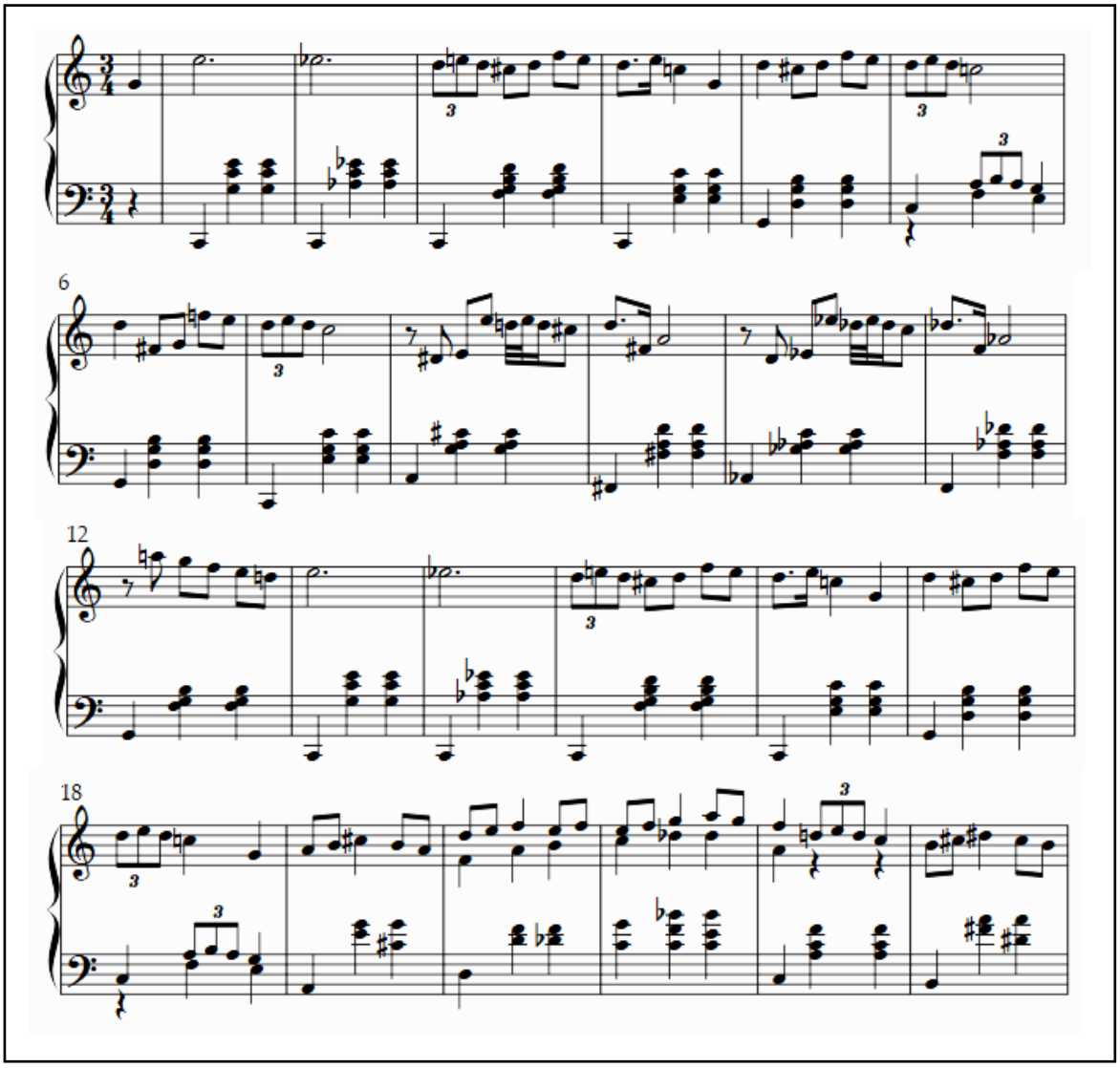
[4] Douglas Hofstadter, "Staring EMI Straight in the Eye—and Doing My Best Not to Flinch," in *Virtual Music: Computer Synthesis of Musical Style*, ed. David Cope (The MIT Press, 2004), 37.

[5] Mozart wrote symphonies that are not included among the traditional forty-one symphonies. EMI's creation of Mozart Forty-Second Symphony conjures the impression of the deceased Mozart springing back to life to add to his existing

months later, Cope released EMI's second album with new compositions in the style of Bach, Beethoven, Chopin, Scott Joplin, Mozart, Stravinsky, and even Cope himself. Against his better judgment, Hofstadter was charmed by the computer's music after noting the expressiveness in EMI's Op.1, a plaintive piano mazurka in the style of Chopin (reproduced in Example 3.1). He later described that first encounter expressing disbelief that emotional music could be "coming out of a program that had never heard a note, never lived a moment of life, never had any emotions whatsoever."[6]

catalogue. As Charles Arthur, a science editor at The Independent remarked in 1997, "Can a decomposing composer compose? In the modern world, yes - with the help of a computer." Charles Arthur, "Dead Composers Live Again as Computer Gets Their Measure," *The Independent*, August 7, 1997, sec. News, http://www.independent.co.uk/news/dead-composers-live-again-as-computer-gets-their-measure-1244134.html.

[6] Hofstadter, "Staring EMI Straight in the Eye—and Doing My Best Not to Flinch," 38.



Example 3.1: Experiments in Musical Intelligence and David Cope, Mazurka Op. 1, No. 2, mm. 1-23 (1987). SOURCE David Cope, Virtual Music: Computer Synthesis of Musical Style (Cambridge: MIT Press, 2004), 501.

Given Hofstadter's materialist convictions, his unease at EMI's music is itself a surprise. After all, if he had truly accepted a materialist theory of the brain, then why should the prospect of EMI's expressiveness be so disturbing? Compare, for instance, Hofstadter's analysis to one by the philosopher Daniel Dennett, who accepted the computer's expressiveness with a shrug. "Here is a recipe, then for making the *St. Matthew Passion*," explained Dennett discussing EMI's imitation of J. S. Bach,

> First, make a Bach, and educate it, installing all the best products of the contemporary culture. Then sit back. Pretty soon it will be punching out cantatas one a week, for years. From there it is a large but not miraculous step to a more ambitious work like the *St. Matthew Passion*. J. S. Bach was prolific, but not as prolific as the Experiments in Musical Intelligence program—but then Bach was running on a much slower architecture, using old-fashioned technology.[7]

Hofstadter, by contrast, was pulled in two directions. On the one hand, he yearned to preserve musical expression as a special conveyance of the interior, while on the other, he prescribed to the Dennett-like reducibility of all minds to software. EMI revealed the irreconcilability of Hofstadter's beliefs. Lacking musical knowledge, emotions, or lived experience, it imitated Chopin's expressiveness with just "twenty thousand lines of code," reproducing a nostalgia and interiority that Hofstadter had thought unique to Chopin alone.[8] Devastated at hearing his beloved Chopin wholly resurrected by the computer, Hofstadter faced an impossible choice between his romantic ideals of music and materialist convictions of the brain; between a music intimately connected with the immaterial aspects of the mind, or a music and mind that together reduce to brain alone. Hofstadter grudgingly sided with the latter, swayed by the empirical evidence of the computer's code and composition. Nevertheless, in embracing the materialism of EMI's music, Hofstadter was spurred to an existential crisis over what he believed were the only three logical conclusions: "(1) Chopin…is a lot shallower than I had ever thought. (2)

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[7] Daniel Dennett, "Collision Detection, Muselot, and Scribble: Some Reflection on Creativity," in *Virtual Music: Computer Synthesis of Musical Style*, ed. David Cope (Cambridge, MA: The MIT Press, 2004), 285.
[8] Hofstadter, "Staring EMI Straight in the Eye—and Doing My Best Not to Flinch," 39.

Music is a lot shallower than I had ever thought. (3) The human soul/mind is a lot shallower than I had ever thought."[9]

Although Douglas Hofstadter holds idiosyncratic views among materialists and music lovers alike, his extreme reaction to EMI staged a broader predicament between humanistic criticism and materialist empiricism that has emerged in the age of artificial intelligence: What does music mean if a computer can simulate it? How does computer music alter our understanding of music-making and music-makers? Is Chopin's style, music, or mind truly reducible to computational processes, or are there aspects unaccounted for by algorithms? Materialism objectifies composer, music, and soul alike, reducing them to neurons that can be observed firing with computational exactness. In Hofstadter's deference to code, he accepted a positivistic account of musical practice that set aside the actual practices of music, siloing the composer from not only other music-makers, but from instruments, audiences, history, emotional resonances, listening practices, bodily affordances, and the other immaterialities that enable (and empower) music-making. The result was a naïve realism in which music becomes a mere symptom of code, as the immaterial bonds of culture, communication, and affect become virtual. No wonder, then, that EMI's programmer David Cope refers to EMI's compositions as "virtual music," automated imitations of musical style.[10]

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[9] Ibid., 80.

[10] Cope argues that virtual music has existed for centuries. Besides other examples of computer and algorithmic composition, he cites the *Musikalische Würfelspiel*, musical dice games that randomly generate music from a pre-devised matrix. David Cope, *Virtual Music: Computer Synthesis of Musical Style* (Cambridge, MA: MIT Press, 2004), 3.

This chapter, however, reconsiders EMI's reception—not as a radical break from earlier theories of musical intelligence but as a continuation of them. EMI's music was heard to participate in a hermeneutics that banished musical meaning to the algorithmic analysis of musical scores and syntax. This analytic approach to music, I argue, enabled the modern reception of EMI as a materialist subject, exchanging the comforting certainty of the musical score for the discomforting (re)producibility of the source code, and leading many to accept, if grudgingly, computational processes as the new locus of musical intelligence. However, just as critical musicology has voiced skepticism of positivistic accounts of music, this same intervention enables a new understanding of EMI's reception and artificial intelligence. By taking the musical experiences of listeners like Hofstadter seriously, I argue that EMI's artificial intelligence becomes less a statement of cognitive fact and more the performative utterance of a cognition *effect*—something of the kind the critic Carl Freedman used to describe the ideological dimensions of a mind that reproduces itself through discourse.[11] Or to put it another way, EMI staked its artificial intelligence on simulating a musical practice that always already portrays the mind in ideological terms and is recognized as such—a mind-body problem solved not by a materialist observing cognition at its "source," but inferred from the everyday experiences of listeners habituated to the musical actions of bodies in motion.

In this chapter, then, I bring back musical hermeneutics as a viable form of philosophizing about the mind. Music—as the effect of cognition *and* as a cognition

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[11] Carl Howard Freedman, *Critical Theory and Science Fiction* (Hanover, PN: Wesleyan University Press, 2000),18.

effect—attunes audiences to the virtual dimensions of an intelligence dualistically cordoned from, yet connected to, the material processes that permit cognition and modern computing alike. Although computer code may have enabled EMI's utterances, neither code nor composition were autonomous entities. Instead, they implicate each other. Software is inseparable from music's broader social and cultural networks: the expectations of listeners, the bodily affordances of musicians and instruments, and even the historical and cultural contingencies of composition itself. By taking EMI's listeners seriously, I dispel what Wendy Chun calls "sourcery," the fetishization of source code as an objective statement of fact rather than a performative utterance.[12] Indeed, EMI encapsulates Carolyn Abbate's call for a musicology borne of "drastic" actions rather than "gnostic" idealism, a musicology centered on performance, on "the labor" of musical sounds and meanings that arise from the "irreversible experiences of playing, singing, or listening" (or I would add, composing).[13] By allowing Hofstadter's hearing of EMI to supersede his explicit interpretation of EMI, we re-enchant the computer's music, perceiving a musical subjectivity distributed and interpreted amongst music-makers. In short, even the drastic remains contingent on the gnostic (computational or otherwise)—and vice versa.

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[12] Wendy Hui Kyong Chun, "On Sourcery and Source Codes," in *Programmed Visions: Software and Memory* (Cambridge, MA: The MIT Press, 2011).
[13] Abbate, "Music—Drastic or Gnostic?," 505.

EMI and the Matters of Mind

EMI's critics were fixated on a conveyance of interiority that should have been inaccessible to a materialist experiment like EMI: how could the perfect reproducibility of an algorithm imitate the ineffable depth of the artist? The German-American musicologist Edward Lowinsky discussed this very incompatibility in his 1964 essay, "Music Genius—Evolution and Origins of a Concept," where he castigated "musical and technical developments" (he referenced integral serialism and electronic music) for robbing genius of its capacity to influence the modern age. He lambasted a future in which "mathematical formulas and computer machines or 'chance' may take over essential area of musical creativity...Both rule out the free act of creation that we ordinarily associate the nature of genius."[14] In positioning "genius" as a remedy to "machine," Lowinsky simplified a nineteenth-century dialectic between mechanical action and humanistic creation: the former, he believed, is automatic, contrived, and unable to innovate or evolve; the latter is authentic, adaptable, and unconcerned with mere conventions or rules.

Lowinsky's denigration of the mechanical and celebration of genius has been oft-repeated throughout music history. It surely was a sign of Lowinsky's idealist lineage: notably the proto-Romantic notion of *Genieästhetik*, which reverberates in German *Musikwissenschaft* through the 1970s, including the structuralism of Carl Dahlhaus. Even Theodor Adorno admonished the "pseudo-individualization" of popular music's repeating

[14] Edward E. Lowinsky, "Musical Genius--Evolution and Origins of a Concept," *The Musical Quarterly* 50, no. 3 (1964): 321.

rhythms, a metrical reproducibility that he called "machine music."[15] A generation earlier, Heinrich Schenker praised music for mirroring the organic wholeness of "the human soul," which he positioned against the atomism of technology. While a machine might simulate the organic, noted Schenker, "its parts are directed toward only a partial goal, a partial achievement, its totality is only an aggregate which has nothing to do with the human soul."[16] For these thinkers and theorists, the opposition between the machine and the genius not only represented two extremes of musical aesthetics but also allowed them to hear musical aesthetics participate in a wider epistemological, ontological, spiritual, and moral conversation about human beings and culture. They were uneasy about the prospect of music being mere matter, easily reproduced by unthinking and uncaring mechanisms. Thus, these scholars continued to think within the framework of a Romantic aesthetic that accepted music as a conveyance of idealized and immaterial truth. The poet Friedrich Schlegel articulated this philosophy most clearly in his *Athenaeum Fragments*, stating simply, "Understanding is mechanical, wit is chemical, genius is organic."[17]

Nevertheless, while it is tempting to imagine the Romantic musical mind as an expression of pure, transcended idealism, late-Romantic critics and analysts often collapsed that idealist soul into the material reality of the score. In his influential 1980

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[15] Adorno explains, "For the machine is an end in itself only under given social conditions — where men are appendages of the machines on which they work. The adaptation to machine music necessarily implies a renunciation of one's own human feelings and at the same time a fetishism of the machine such that its instrumental character becomes obscured thereby." Theodor W Adorno, "On Popular Music," in *Current of Music: Elements of a Radio Theory*, ed. Robert Hullot-Kentor (Cambridge, UK: Polity Press, 2009), 317.

[16] Heinrich Schenker, *Free Composition*, ed. and trans. Ernst. Oster, vol. 3, New Musical Theories and Fantasies (New York: Longman, 1979), xxiii.

[17] Friedrich Schlegel, "Athenaeum Fragments," in *Philosophical Fragments*, trans. Peter Firchow and Rodolphe Gasché, NED-New edition (St. Paul: University of Minnesota Press, 1991), 75.

essay "How We Got into Analysis, and How to Get Out" Joseph Kerman admonishes critics and analysts (like Schenker) for not merely propagating the idealistic claims of Romanticism's musical genius, but uncritically accepting, in turn, formalism as the most effective means of deciphering that idealism. The result, says Kerman, was an organicism that uncritically accepted the autonomy of organized sound while ignoring the central role that listeners, performers, and other music-makers play in organizing it. Consider, for instance, Eduard Hanslick's defense of music's autonomy in his *On the Musically Beautiful* (1854). Although he did not deny music's capacity to engage the listener's emotions, Hanslick decried these emotional resonances as too subjective or contingent to accurately describe the universal characteristics of musical beauty. Instead, he proffered an aesthetics built "simply and solely of tones and their artistic combination": "purely musical characteristics" that listeners can observe disinterestedly.[18] To be clear, Hanslick did not consider himself a materialist, and he rebelled against the mechanistic aesthetics articulated by eighteenth-century philosophers.[19] His notion of music as *"Arbeiten des Geistes in Geistfähigem Material*" ("working of spirit in material capable of incorporating spirit") was idealistically Hegelian through and through, but it already articulated music's cognitive dimension as well as its manifest materiality (its "sonically moving forms"): "Every musical factor," he explained, "has a distinctive feature of its own and its individual mode of action. Though the composer's mind be a mystery, its product is quite within the

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[18] Eduard Hanslick, *On the Musically Beautiful: A Contribution towards the Revision of the Aesthetics of Music*, trans. Geoffrey Payzant (Indianapolis, Ind.: Hackett Pub. Co., 1986), 28..

[19] Burford argues that Hanslick had a very particular definition of materialism as a sympathetic resonance in which listeners "are moved by music in just the same way as our windows and doors begin to vibrate when in proximity to powerful musical sounds." Ibid., 52.

grasp of our understanding."[20] Hanslick's aesthetics, then, were a surprising synthesis of what we may now recognize as two seemingly incompatible philosophies: a Romantic idealism in music's communion with the soul, joined by a scientific materialism founded on the observation of autonomous matter—an aesthetic synthesis that Mark Burford calls "idealist materialism."[21]

Douglas Hofstadter was familiar with Hanslick's aesthetics of music, dismissing "Hanslick's sad thesis" that "music refers to nothing but itself."[22] Nevertheless, it is in the intellectual tradition of idealist materialism that Hofstadter's metaphysics is best understood. Recall his experience of listening to EMI's Chopin-like mazurka. From the computer's algorithmic rendering of Chopin's style, Hofstadter imagined Chopin's mind musically reconstituted before him, as if style were a purely musical manifestation of mind. In a later publication, Hofstadter later dubbed this music-mind connection a "soul shard," recalling the experience of observing Chopin from a book of etudes;

> The marks on those sheets of paper are no less than soul-shards — scattered remnants of the shattered soul of Frédéric Chopin. Each of those strange geometries of notes has a unique power to bring back to life, inside our brain, some tiny fragment of the internal experiences of another human being—his suffering, his joys, his deepest passions and tensions—and we thereby know, at least in part, what it was like to be that human.[23]

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[20] Ibid., 75.
[21] Mark Burford, "Hanslick's Idealist Materialism," *19th-Century Music* 30, no. 2 (November 1, 2006): 166–81, https://doi.org/10.1525/ncm.2006.30.2.166.
[22] Hofstadter addresses Hanslick tangentially in his New York Times review of Joseph Swain's *Musical Languages*. Douglas Hofstadter, "Semantics in C Major," *New York Times*, October 12, 1997, sec. Books, http://movies2.nytimes.com/books/97/10/12/reviews/971012.12hofstat.html.
[23] Douglas R. Hofstadter, *I Am a Strange Loop* (New York: Basic Books, 2007), 12.

The "soul shard" is unquestionably an object of idealist materialism, consisting of both the idealist acceptance of the soul and the materialist yearning to objectify and observe that soul. This strange mixture of matter and nonmatter was a compromise of sorts, as Hofstadter struggled—unconsciously perhaps—to satisfy the humanist and scientist within himself. As a music lover, he longed to validate music's unique status as an expression of the interior, honoring a conception of the musically beautiful that outstripped mere syntax to "move" or overwhelm the listener's emotions. Nevertheless, as a scientist, his worldview was expressly materialist, premised on a world reducible to observable matter. A similar materialism drove much of *Gödel, Escher, Bach* (henceforth the *GEB*), where he sought to explain the algorithmic reducibility of even the most complex human actions—Bach *ricercars*, Escher optical illusions, and Gödel theorems. He summarized this premise with a materialist revision of Descartes's dualistic credo, "I think, therefore I *sum*," reducing thought to a calculating brain.[24] The soul shard, then, represented Hofstadter's latest attempt to redress seemingly irreconcilable aspects of his worldview, attaching an idealist trace to materialism in a bid to finally reconcile the mind-body problem in a way that conformed to his romantic beliefs about music.[25]

EMI, however, upset Hofstadter's careful balance between materialism and idealism by imitating Chopin's musical style with "just twenty-thousand lines of code," thus negating the internal depth that he believed enabled musical expression. In the *GEB*,

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[24] Hofstadter, *Gödel, Escher, Bach*, 376.

[25] The negotiation between idealism and materialism is a defining struggle in Hofstadter's writing. *Gödel, Escher, Bach* engages that concept through his notion of the "eternal golden braid," an algorithmic complexity that creates seemingly non-algorithmic products. More recently, Hofstadter has turned to the notion of metaphor in Douglas R. Hofstadter and Emmanuel. Sander, *Surfaces and Essences: Analogy as the Fuel and Fire of Thinking* (New York: Books Books, 2013).

Hofstadter had romanticized the materialist processes of all brains, using the external tumult of "beautiful music" to rationalize the algorithmic processes that enable thought and action. EMI, however, showed that the musically beautiful could originate from straightforward syntactic rules. The machine need not "wander around the world on its own, fighting its way through the maze of life and feeling every moment of it," as Hofstadter has suggested in the *GEB*, nor must it "feel" emotions or "hear" music in the first place.[26] Instead, these complex cognitive experiences could be simulated with a few simple, automatic procedures for organizing sound. In an interview with the computer scientist Melanie Mitchell, Hofstadter voiced this dilemma in stark terms, "Ever since I was a child, music has thrilled me and moved me to the very core. And every piece that I love feels like it's a direct message from the emotional heart of the human being who composed it...The idea that pattern manipulation of the most superficial sort can yield things that sound as if they are coming from a human being's heart is very, very troubling."[27]

In connecting the machine's reception to a broader intellectual tradition of idealist materialism, I suggests that EMI seems to have caused less of an upheaval than an intensification of nineteenth-century aesthetics and hermeneutics, as positivist strategies for engaging autonomous works gave way to positivist strategies for engaging automatic code. To be fair, there are apparent differences between the sensuous materiality of organized sound and the digital actions of computation. Where sound traffics in subtle gradations of analogical meaning, computation translates analogical meaning into digital

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[26] Hofstadter, *Gödel, Escher, Bach*, 676–77.
[27] Douglas Hofstadter, quoted in Melanie Mitchell, *Artificial Intelligence: A Guide for Thinking Humans* (New York: Farrar, Straus and Giroux, 2019), 188.

information.[28] These contrasting ontologies partially explain why music became so strongly associated with the transcendent ephemerality of the mind, while algorithms seemed to imitate the mundane materiality of the brain. Still, if musical practices defy the absolute purity of computation, musical formalism resembles it. Here, the mind is reified as art, as listeners accept the autonomous musical work as evidence of the composer's cognition. And at the same time, EMI presented art as code, as the machine probabilistically modelled the large-scale form and note-to-note surface of a given composer's style, computationally automating an artistic process that listeners like Hofstadter accept (and celebrate) as unexplainable.[29] Ergo, the ensuing slippage from cognition through art to computation exemplifies the circular reasoning that lies at the heart of all AI: we perceive a musical measure of intelligence that we have ourselves defined. In this light, Hofstadter's concerns about EMI were less rooted in the objective similarities of computers and cognition, and more steeped in the limits and constraints of musical formalism itself.

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[28] For more on the relationship between analog and digital, see: Jake Buckley, "Believing in the (Analogico-)Digital," *Culture Machine* 12, no. 0 (2011); Anthony Wilden, "Analog and Digital Communication: On the Relationship between Negation, Signification, and the Emergence of the Discrete Element," *Semiotica* 6, no. 1 (2009): 50–82; Brian Massumi, "On the Superiority of the Analog," in *Parables for the Virtual: Movement, Affect, Sensation* (Durham: Duke University Press, 2002), 133–42.

[29] David Cope has written extensively about these algorithms, explaining some of the mechanism he used to extract style. These include probabilistic models for note-to-note relationships (what he calls "syntactic meshing), large-scale form ("semantic meshing"), reoccurring melodic patterns ("signatures"), and intertextual meta-level structures ("templagiarism" or "template plagiarism"). For a small sampling of these writings, see David Cope, *Computer Models of Musical Creativity* (Cambridge, MA: MIT Press, 2005); David Cope, *Computers and Musical Style* (Madison, WI.: A-R Editions, 1991); David Cope, *Virtual Music: Computer Synthesis of Musical Style* (Cambridge, MA: MIT Press, 2004); David Cope, *Experiments in Musical Intelligence* (Madison, WI.: A-R Editions, 1996). Note that the composer has also released several CDs and hosts much of the algorithm on his personal website.

Gaming Intelligence

The formalist conceit of EMI's musical intelligence was ubiquitous throughout the machine's reception. For almost two decades, Hofstadter and Cope showcased EMI's narrow musical intelligence with a short competition Cope simply called "The Game."[30] Framing The Game as an exercise in "investigative musicology," they presented audiences with a series of unattributed works—some by EMI, and the rest by canonical composers—and, from music alone, challenged them to identify between the pieces by the human and by the machine. The Game was thus set up like a psychological study with different conditions, but because it lacked the scientific rigor of a falsifiable hypothesis, its "results" were mostly anecdotal and should be taken with buckets of salt. This illusion of science manifested in The Game's rules for minimizing any non- or extramusical reflection. Overt prior knowledge, decreed Cope, was disqualifying: the audience could not "review music by the original composers," and any "who recognize one or more of the examples should disqualify themselves from playing that particular round of The Game."[31] Indeed, a sense of paranoia ran through Hofstadter and Cope's descriptions of The Game, as the pair were wary of listeners' biases against computer music; "I don't like dishonesty," explained Hofstadter after almost a decade of adjudicating The Game, "but perhaps it is best to misinform people about what they are about to hear, in order that they not listen with a pre-closed mind."[32]

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[30] In virtual music, Cope maintains the capitalization of "The" throughout his book, which I have chosen to retain.
[31] There are three stated rules to The Game: (1) "Game players may listen to each work as many times as desired," (2) Players may not "review music by the original composers", and (3) "Players who recognize one or more of the examples should disqualify themselves from playing that particular version of The Game" Cope, *Virtual Music*, 13.
[32] Hofstadter, "Staring EMI Straight in the Eye—and Doing My Best Not to Flinch," 39.

The Game's first recorded occurrence was in 1991 when Cope challenged eighteen sophomore music theory students to discern twenty-five phrases by either Mozart or the machine. Sixty percent of students, reported Cope, misattributed EMI's music to Mozart.[33] He produced similar results when he repeated the experiment in 1992 at the Association for the Advancement of Artificial Intelligence with a much larger sample size (two thousand participants spread over three days). A decade later, Hofstadter ran The Game at the Eastman School of Music with an auditorium filled with conservatory-trained students and faculty. As in earlier iterations, only half of the expert audience was able to spot the fake. The composer, Kala Pierson, who attended this performance, describes the aftermath of the test,

> When the pianist played the two "Chopin" mazurkas, we were…confident. The first mazurka had grace and charm, but not "true Chopin" degrees of invention and large-scale fluidity; there were very local-level, "shallow"-feeling modulations—just the type, I reasoned, that a computer would generate based on more sophisticated examples of the real thing. The second was clearly the genuine Chopin, with a lyrical melody; large-scale, graceful chromatic modulations; and a natural balanced form…When [Hofstadter] announced that the first piece was Chopin and the second was EMI, there was a collective gasp and an aftermath of what I can only describe as delighted horror. I've never seen so many theorists and composers shocked out of their smug complacency in one fell swoop (myself included)![34]

Perhaps the most widely reported iteration of The Game was staged at the University of Oregon in 1997 with three two-part inventions: an authentic one by J.S. Bach, a

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[33] Cope acknowledges that this test is far from scientifically rigorous but argues that there is some salience in the results. David Cope, *Experiments in Musical Intelligence* (Madison, WI.: A-R Editions, 1996), 81–82.
[34] Pierson comments that, in contrast to their attention to EMI's Chopin mazurka, few of the audience were fooled by the machine's Bach inventions. Kala Pierson quoted in Cope, *Virtual Music*, 67.

counterfeit by EMI, and a new composition by the music theorist Steve Larson. To Larson's chagrin, the audience's judgment was far from accurate: most listeners attributed EMI's piece to the German master, while Larson's was believed to have originated from the computer.[35] Larson was devastated by this result—not at his defeat, but Bach's. Afterward, he lamented that "My admiration for [Bach's] music is deep and cosmic. That people could be duped by a computer was very disconcerting."[36]

In the context of The Game, misidentification (or as Larson called it, "being duped") was often perceived as a "victory" for the computer. Musical imitation signaled musical intelligence, as listeners were asked to judge sound as evidence of the immaterial mind. For this reason, EMI was oft heard as a threat to the perceived genius of composers like Bach or Chopin. In 1997, to honor the premiere of Mozart's Forty-Second Symphony by EMI, *New Scientist* wrote a profile of Cope's software titled "Requiem for the Soul," which considered the machine's significance to the legacy and history human music-making; "If creating sublime music is the highest of human achievements," they pondered, "how come a pile of computer code writes better music than most people?"[37] *The New York Times*, likewise, heard EMI's computational music as a challenge to an authorial originality long thought to drive music criticism. After all, if listeners can infer meaning from EMI's unthinking algorithms, where does that leave the "deep and cosmic"

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[35] Bob Holmes, "Requiem for the Soul," *New Scientist*, August 9, 1997.; George Johnson, "Undiscovered Bach? No, a Computer Wrote It," *The New York Times*, November 11, 1997, sec. Science, http://www.nytimes.com/1997/11/11/science/undiscovered-bach-no-a-computer-wrote-it.html; George Johnson, "Ideas & Trends; The Artist's Angst Is All in Your Head," *The New York Times*, November 17, 1997, sec. Ideas and Trends, http://www.nytimes.com/1997/11/16/weekinreview/ideas-trends-the-artist-s-angst-is-all-in-your-head.html?mcubz=0.

[36] Steve Larson quoted in Johnson, "Undiscovered Bach?"

[37] Bob Holmes, "Requiem for the Soul," *New Scientist*, August 9, 1997.

meaning that they expect from Bach or Chopin; "Producing good art turns out to be vastly easier than appreciating it… programs [like EMI] are a celebration of the creativity of the audience, and the ability of the human mind to squeeze out meaning even when none is there."[38] Like Dorothy's Toto revealing the man behind the wizard's curtain, the de-acousmatized EMI seemed to expose the algorithms supporting Bach's cognition, as if the Baroque master were just as artificially intelligent to our ears.

Nevertheless, if The Game tested EMI's capacity to compose, it equally tested listeners' capacity to listen. In his memoirs, David Cope explained The Game's origins in his childhood efforts to identify unknown pieces on the radio. "I have, since my youth," he reminisced, "played what I call The Game."

> The Game requires players to identify styles, composers, and even names of works of music that they have never heard before. While this may seem improbable, I have on several occasions identified all three of these categories for as yet unheard works, basing my educated guesses on knowledge gained through listening to a composer's music and having read about other of the composer's works.[39]

For the young Cope, The Game was an opportunity to hone his musical ear, allowing him to discover new works by listening and deciphering their "shared style." The result was a forensic mode of listening for familiar melodic, rhythmic, and formal details, what Rose Subotnik calls structural listening, "a process wherein the listener follows and comprehends the unfolding realization, with all of its detailed inner relationships, of a

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[38] Johnson, "Ideas & Trends; The Artist's Angst Is All in Your Head."
[39] David Cope, *Tinman Too: A Life Explored* (New York: iUniverse, 2012), 39.

generating musical conception."[40] As an adult, Cope built EMI to enact these structuralist principles. The machine created new music by digesting a database of similar compositions, algorithmically extracting relationships between pitches, rhythms, and formal structures. Like the young Cope listening by the radio to understand the structures of unknown works, the older Cope coded algorithms for observing those very structures. In this sense, EMI was the ideal structuralist, perfecting the automaticity that formalists like Hanslick celebrated in their listening experiences. This structuralist impulse united Cope and EMI, who each privileged a conception of musical style as modular and transportable; it was structural listening that enabled Cope to identify unheard works on the radio, and EMI to generate new compositions automatically. Small wonder that Cope oft expresses a sense of familial kinship for his machine: in many senses, they shared the same analytic DNA.

The Game's rules were designed to focus the listener's attention on these musical structures. To discourage the audience from studying or drawing from their prior listening, Cope and Hofstadter selected lesser-known and "average" pieces.[41] By keeping these pieces relatively unremarkable, The Game stripped the compositions of their context, echoing Adorno's reservations about disclosing "even the name of the composer or the composition in question," which "could muddy the purity of the desired process."[42] Nevertheless, while structural listening suggests a modular, science-oriented stance

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[40] Rose Rosengard Subotnik, *Deconstructive Variations: Music and Reason in Western Society* (Minneapolis: University of Minnesota Press, 1996), 150.
[41] Cope, *Virtual Music*, 30.
[42] Subotnik, *Deconstructive Variations*, 150.

towards musical works, Cope has disavowed The Game as an objective measure of EMI's musical intelligence. Writing in 1991, he portrayed The Game as an informal exercise, with little of the control or rigor one would expect from a scientific study. He cautioned participants of The Game not to overinterpret their intuitions of man or machine. Instead, skilled listeners (especially those with formal musical training) "should try and identify those characteristics which gave the machine-composed example away," while less successful listeners "might try to discover what led the machine-composed examples to sound as if they were human-composed."[43]

Nevertheless, as an exercise in structural listening, The Game also appropriated the traditionally positivistic impulses of formalist music analysis, which presupposes an ideal listener who strikes a rational, machine-like orientation towards music. Bounded by The Game's rules, such an audience hears all music as absolute music, disinterestedly rejecting the cultural, social, and ideological contexts that modern musicology celebrates. Under the auspices of structural listening, the audience is encouraged to receive music as sound, and sound as a kind of "score" that can be objectively "read," not subjectively "felt." While this structural stance takes the pressure off the audience's interpretation of the composer's intentions or identity (judging between man or machine), it is at the expense of the listener's agency, as if music's "meaning" were a quality of the work and not qualia from the listener. As Andrew Dell'Antonio explains, structuralism presupposes "a disciplined listener who is prepared and willing to receive the composer's coherent

[43] Cope, *Virtual Music*, 21.

structural message in its full detail."[44] In this sense, The Game denies the ludic openness often associated with game-playing, lacking the reciprocity or hermeneutic flexibility of a traditional game. Instead, it presented the musical experience like a puzzle to be solved—one with a single correct answer.

By attending to The Game, one senses the yearning to judge EMI with EMI's analytic toolbelt, as if the audience and computer could be made to share in the computer's automatic, disembodied dissection of music. The problem was that listeners resisted that structuralist impulse. EMI's "victory" at Eastman and Oregon showcased the listeners' unwillingness to accept a strictly formalist interpretation of EMI's music. Tantalized by the dissonance between the music's implied context and the materiality of EMI's algorithm, listeners embraced a hermeneutic mode that united structure and ideology, rationalizing the ineffability of EMI's music with the knowability of EMI's algorithms.

To this day, Cope expresses bitterness over the public's misperception of EMI. In an oft shared anecdote, he recounts his disappointment when a colleague who first received the computer's music positively abruptly reversed judgment after discovering the composer's origins; "he came up to me after…and announced that [the computer's] music clearly had not emanated from the human spirit but from a machine, for he found it cold and without emotion."[45] After years of deciphering music over the radio, Cope's

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[44] Andrew Dell'Antonio, ed., *Beyond Structural Listening?: Postmodern Modes of Hearing* (Berkeley: University of California Press, 2004), 2.

[45] Cope, *Tinman Too*, 477. It should be stated that this anecdote involves one of Cope's later algorithmic composers, named Emily Howell, which he premiered in 2013.

structuralist perspective put him at odds with much of his listening public. "We are so damned biased," he exclaimed in a recent interview,

> even those of us who spend all our lives attempting not to be biased. Just the mere fact that when we like the taste of something, we tend to eat it more than we should. We have our physical body telling us things, and we can't intellectually govern it the way we'd like to...The question isn't whether computers have souls, but whether humans have a soul[46]

One senses his yearning that all listeners were more like EMI.

Musical Mind Games

Today, many musicologists express dismay at this mode of structural listening, accepting the musical "biases" that so infuriated Cope as valuable evidence of listeners' musical practices. Suzanne Cusick, for instance, castigates what she calls music's "mind-mind game," the seeming transference of the composer's mind through "patterns of sound" to a deciphering listener. The problem with this conception of music, explains Cusick, is that it ignores many of the practices that listeners celebrate in their everyday listening practice; "We have changed an art that exists only when, so to speak, the Word is made Flesh, into an art which is only the Word. Metaphorically, we have denied the very thing that makes music music, the thing which gives it such enormous symbolic and sensual power."[47]

EMI and The Game made the dangers of this mind-mind game explicit. It not only objectified personal aesthetic taste but mistook that taste as evidence of a universal

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[46] David Cope quoted in Ryan Blitstein, "Triumph of the Cyborg Composer," *Pacific Standard*, June 14, 2017, https://psmag.com/social-justice/triumph-of-the-cyborg-composer-8507.
[47] Cusick, "Feminist Theory, Music Theory, and the Mind/Body Problem," 16.

biological fact of cognition. To be fair, EMI is not the first musical object to suggest the mind's presence to analysts. Music studies have long used aesthetics to justify the musical intelligences of some (almost always those coded white, male, and European) and deny it to others. Jazz historians like Bernard Gendron and Ted Gioia, for instance, have studied how French modernists like Darius Milhaud exoticized African and Afro-American musics by denigrating the intelligence of black jazz musicians. Jazz, these composers believed, was a music sprung "from the heart, not the mind"—a conviction in the primitivism of black minds (and brains) that Gendron calls "negrophilia."[48] EMI's materialist champions, however, distinguished its musical intelligence from past cases by deferring to its algorithms, which they embraced as a seemingly objective measure of the musical mind. Listeners like Hofstadter could compare their aesthetic experience of sound to their perception of code, counting each line to quantify the cognition of composers like Chopin (and by extension, EMI). The result was an experience of music conceived as a "white box," a transparent window for observing cognition as it unfolds in real-time.[49]

The problem with accepting code as a proxy for cognition is that it denies cognition the contexts that enable its actions in the first place, relying instead on a discourse of computational objectivity that the media theorist Wendy Chun calls

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[48] Bernard Gendron, "Negrophilia," in *Between Montmartre and the Mudd Club: Popular Music and the Avant-Garde* (Chicago: University of Chicago Press, 2002), 103.; Ted Gioia, "Jazz and the Primitivist Myth," in *The Imperfect Art: Reflections on Jazz and Modern Culture* (Oxford, UK: Oxford University Press, 1990).

[49] The notion of the white box originated as a term in software engineering to describe a subsystem whose operation can be objectively observed but not altered. The economist and philosopher Marcel Boumans describes them as "statements as to how real systems actually operate in some aspects. Generating an accurate outbehavior is not sufficient for model validity [as it would be in a black box model]; the validity of the internal structure of the model is crucial too." A white box model then, does not merely reproduce the behavior of a system but "explains how the behavior is generated." Marcel Boumans, "Measurements in Economics," in *Philosophy of Economics*, ed. Dov M. Gabbay et al. (Amsterdam: Elsevier, 2012), 420.

"sourcery." Fusing *sorcerous* enchantment with disenchanting *source code*, Chun portrays sourcery as a form of materialist magic, a fetishized objectification of code as a "visibly invisible essence" that obfuscates its own programmer, contexts, and users. Sourcery transforms "program" from a verb to a noun, entrenching executable software as a kind of hardware that is simultaneously transient and objective; "To know code" writes Chun, "is to have a form of 'X-ray' vision that makes the inside and outside coincide, and the act of revealing sources or connections becomes a critical act in and of itself."[50] EMI illuminates the continuities between Chun's theory of sourcery and Kerman's account of criticism, as "X-ray vision" arrives in the form of both software analysis and music analysis—a view from the outside-in of aesthetics and the inside-out of computation. In collaboration, the two perspectives yielded an oddly objective measure of musical intelligence, an intelligence that strikes observers as immediate and unbounded by context, culture, or meaning. From this perspective, EMI lived up to its name as an *experiment* in musical intelligence, its algorithms suggesting the objectification of an intelligence that listeners could hear, measure, and *know* with scientific clarity.

The problem with this interpretation of musical intelligence, however, was that it formalized a behavior that is, by nature, informal. Intelligence has no mass or physical presence in the world. Although materialists like Hofstadter or Daniel Dennett reduce intelligence to cognitive processes enacted by the brain, no researcher has directly observed intelligence with the same certainty they can measure blood coursing through a

[50] Chun, "On Sourcery and Source Codes," 316.

pumping heart or air flowing through the lungs. Even the subjective experience of intelligence is contested. In Chapter One, I discussed David Chalmers's "great divide," in consciousness studies, between those materialist researchers (like Dennett) who disappear consciousness into neurochemistry, and those tackling the "hard problem" by preserving internal qualia.

Psychometrics, a scientific field dedicated to psychological measurements, has long sought to define intelligence objectively, but even psychometricians disagree on which metrics to privilege and how to evaluate them: Is a subject intelligent if they can memorize facts and trivia? If they recognize patterns, process images, or solve problems? Is intelligence a creative process? A social process? An embodied process? Does it manifest all at once, or is it learned over time? There are no definitive answers because the everyday experience of intelligence is irreducible to a single trait or measurement. Instead, "intelligence" thwarts simple objectification because it has yet to be entirely reduced to cognitive mechanisms. What appears intelligent in one situation or from one perspective might be unmarked or unintelligent in a different context. With no objective measures of musical intelligence, listeners retreat to the very biases that Cope so detested.

As a concept, then, Hofstadter's understanding of "musical intelligence" is riddled with contingencies and plagued by a legacy of inequity that pits the "geniuses" of Western music against its less prodigious musical others. These ascriptions of musical intelligence invoke a strain of analytic positivism beset with racial, gender, and class connotations that

the field has rightly rejected.[51] Figures like Cope and Hofstadter might distance themselves from that history of inequity, but, through EMI, they embraced an objectified model of music entangled with these discourses. It is no coincidence that EMI achieved its most significant notoriety by simulating canonical figures like Chopin, Bach, or Mozart, imitating a culture that the nineteenth-century poet and critic Matthew Arnold once described as "the best that has been thought and known."[52]

In place of affirming or denying claims of "musical intelligence," many music scholars have instead turned to more equitable theories of intelligence that rebalance the dynamic between the singular composer and other music-makers. Since Barthes's famous pronouncement of the author's death, many music scholars have instead recontextualized music's meaning to implicate transcendent acts of performance and listening—music *as* experience. Carolyn Abbate, appealing to Vladimir Jankélévitch's distinction between drastic and gnostic, calls for a musicology focused on drastic actions and attention to "live" details. She rejects the comforting materiality of the musical establishment (those "recordings and scores and graphic musical examples") to instead deal with the contingencies of "real music in real-time:" of bodies and movement, listening and interpretation, emotions and affects—in short, the embodied reality of musical experiences as they unfold in distinct cultural, social, and aesthetic milieus.[53] Indeed,

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[51] As Alexander Cowan and Lindsay Wright have written, music has long been considered a marker of heritable intelligence. Lindsay Jordan Wright, "Discourses of Musical Talent in American Culture" (Ph.D., United States -- Illinois, The University of Chicago, 2018).; Alexander Cowan, "Eugenics at the Eastman School: Music Psychology and the Racialization of Musical Talent" (Paper Presentation, Annual Meeting of the American Musicological Society, Rochester, New York, November 9, 2017).
[52] Matthew Arnold, *Culture & Anarchy* (London: Macmillan and Co., Ltd., 1924), 38.
[53] Abbate, "Music—Drastic or Gnostic?," 511.

Abbate later proposed a name for music's inextricable connection to lived social reality: enchainment.[54]

Abbate imagines enchainment less as an experience of human musicmaking and more as the musicmaking of human experience—the capacity of organized sound, whether produced by a human or a technology, to itself create new "audile regimes, or cultures of listening," that reorder human perception, attentiveness, and the senses. For musicologists like Abbate, the senses are contingent and imperfect windows into the world—a fact long exploited by artificial life to simulate the ever-changing conditions of humanity. Consider, for instance, the illusion perpetuated by EMI's musical algorithms in The Game, a deception that not only signaled to listeners *this* machine's capacity to compose but suggested the mechanical origins of all compositions. As an act of enchainment, the spectacle of its music fueled a broader claim about cognition, so that the sound of EMI's Chopinesque mazurka (for example) reverberated into wider proclamations about style, Chopin, all music, and all minds. For Abbate, there is "efficacy" in sound's capacity to reorder the world, granting even immaterial cognition a seeming materiality. Musical intelligence both enables and is enabled by that efficacy, as music conveyed EMI's subjectivity while EMI's subjectivity was subsequently heard to convey its music. To listeners, then, EMI was both the *composer of* and *composed by* music.

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[54] Carolyn Abbate, "Sound Object Lessons," *Journal of the American Musicological Society* 69, no. 3 (December 1, 2016): 794.

Embodied Intelligence

Perhaps nowhere do the social and ideological dimensions of musical intelligence manifest more clearly than in music analysis and criticism, written genres that continuously struggle to capture evanescent music as prose. The music theorist Seth Monahan offers a detailed survey of this musical intelligence (although he does not explicitly use this term) in his 2013 article, "Action and Agency Revisited," a meta-analysis of the agential conceits that music theorists impose in their analytic writing. Monahan finds that many analyses imply some form of creative agent originating in the music. He sorts these agencies into four categories: the analyst acknowledging their own perception ("I hear the music moving…"); a "fictional composer" coordinating the music behind the scenes ("Beethoven moves…"); the anthropomorphized actions of the musical work itself, a "work persona" ("the piece moves…"); or the individual or combined efforts of strictly musical elements ("the dominant harmony in the strings moves…").[55]

Although Monahan carefully avoids ascriptions of musical intelligence, an assumption of intelligence undergirds his meta-analysis. By attending to these agential conceits, Monahan's study reveals the compelling potency of organized sound to entice even scrupulous analysts with the impression of an originating intelligence. Many other musicologists have documented similar musical agencies: the "sonic self" (Cumming), "virtual agents and agencies" (Hatten), the "composer's voice" (Cone), "aesthetic subjects"

[55] Technically, Monahan briefly discusses a much narrower fifth category, in which no agency is implied, what he calls "nonpurposive chronology," but he devotes little critical attention to this category. To Monahan, "nonpurposive chronology" is the exception that proves the rule. Seth Monahan, "Action and Agency Revisited," *Journal of Music Theory* 57, no. 2 (September 21, 2013): 321–71.

(Dahlhaus).[56] Although these terms differ in their particularities, they together recognize the aesthetic efficacy of music to signal extramusical subjectivity; "The decisive thing," explained Dahlhaus in 1987 "is…the fact that composer, interpreter and audience agree to recognize self-expression…as an aesthetic postulate which depends for its fulfilment not on psychological or biographical fact but on aesthetic evidence, acknowledged as an authority in its own right."[57]

EMI, however, is no mere beneficiary of music's enchaining of intelligence, but an ideal test case for musicologists to consider, in concrete terms, the intelligence that listeners bestow on creative artists. After all, if musical intelligence is as bounded by "biases" as Cope had feared, then what precisely are those biases? What does EMI's musical intelligence *sound like* when one sets aside the disappointed hand-wringing and exuberant celebrating that often resulted from listeners' uncritical deference to its sourcery? Consider, for instance, EMI as it was presented by the music theorist Steve Larson in a series of tongue-in-cheek letters titled "Dear Emmy: A Counterpoint Teacher's Thoughts on the Experiments in Musical Intelligence Program's Two-Part Inventions."[58] Larson wrote his analysis of EMI's music from the perspective of a counterpoint instructor giving feedback to his pupil. From counterpoint exercises alone, he imagined the science fiction of his student *listening* and "intuitively" *understanding* Bach's style, to *learning* and

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[56] See for instance, Cumming, *The Sonic Self*; Robert S. Hatten, *A Theory of Virtual Agency for Western Art Music* (Bloomington, IN: Indiana University Press, 2018); Carl Dahlhaus, *Ludwig van Beethoven: Approaches to His Music* (Oxford, UK: Clarendon Press, 1993), 31.; Edward T. Cone, *The Composer's Voice* (Berkeley: University of California Press, 1974).
[57] Carl Dahlhaus, *Ludwig Van Beethoven: Approaches to His Music* (Oxford, UK: Clarendon Press, 1993, 33.
[58] Note that Cope, Larson, and Hofstadter often refer to EMI as "Emmy." Cope gives two reasons for this alteration. On the one hand, the Emmy spelling humanizes the computer system, and brings it in line with other algorithmic system like "Emily Howell" and "ALICE." On the other hand, he renamed EMI after receiving a cease and desist notice from EMI Records Ltd., the British music publishing company.

experimenting with musical material, and holding *desires* to compose. Larson even identified with that imagined desire, expressing kinship for his virtual student writing; "You clearly share the desire that my students and I develop in studying Bach's inventions…to write music that sounds like Bach!"[59]

While Larson never fully embraced Hofstadter's conceit that EMI had fully reproduced Bach's style or mind, he nonetheless accepted the machine's humanity, hearing in his student a compromise between the two extremes of computer and composer. By disentangling the Romantic dialectic between machine and genius, Larson made space for a middle ground that heard the machine's "errors"—moments of failed cadence, or overlong sequence—not as mechanical breakdowns but necessary mistakes towards better understanding. Larson portrayed EMI as a subject capable of learning and growing from feedback. Throughout his letters, the professor praises his student for copying wholesale sequences, resolutions, and entire episodes from Bach's music, noting faults in these imitations (which he dutifully corrects) but still accepting musical imitation itself as viable evidence of intelligence.[60]

For Larson, EMI's compositions were the result of an analytic process imbricated with the analyst's body. He described a mode of music analysis that united the bodily processes of hearing, playing, and singing music on the one hand, with the cognitive

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[59] Steve Larson, "Dear Emmy: A Counterpoint Teacher's Thoughts on the Experiments in Musical Intelligence Program's Two-Part Inventions," in *Virtual Music: Computer Synthesis of Musical Style*, ed. David Cope (Cambridge, MA: The MIT Press, 2004), 237.

[60] Indeed, as a pedagogical act, Larson's letters draws attention to the continuities between mechanical reproduction and music education, as syntactic imitation yields semantic mastery. In this regard, Larson's discussion of EMI resembles Robert Fink's discussion of the Suzuki method in *Repeating Ourselves*. See Robert Fink, *Repeating Ourselves: American Minimal Music as Cultural Practice* (Berkeley: University of California Press, 2005).

actions of analyzing, experimenting, and composing music on the other. This reciprocity between body and mind suggests an understanding of thinking that reaches outside itself through the body's sensorium, a theory of *cognitive extension* that expands cognition outside what Chalmers and Clark called "demarcations of skin and skull."[61] Indeed, it was music's capacity to traverse both mind and body that prompted Suzanne Cusick to imagine the mind-body problem solved by actual acts of making music:

> We as listeners and critics can hear much of what musical bodies do, and in so hearing we more fully know the Mind/Body resolution which music promises—even if we know it only with our minds. We escape the limitations of the mind-mind game by acknowledging in our descriptions (analyses, hearings) the mediations and meanings of bodies. Thus, we stand to know music more intimately if we know it as a complex conversation of (situated) minds and (situated) bodies.[62]

Although EMI is a surprising conduit for Cusick's embodied music theory, Larson envisioned the AI composer participating in an analytic practice shaped and transformed by transcendent acts of listening.[63] To be clear, Larson was not expressing willful ignorance of the machine's status as AI; throughout "Dear Emmy," Larson visibly and

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[61] The theory of an extended mind was first proposed by David Chalmers and Andy Clark in a groundbreaking 1997 paper. More recently, theorists like Lawrence Zbikowski have begun to incorporate these theories of cognitive extension to understand the ways that musical objects implicate musicking and analytical bodies. See David John Chalmers and Andy Clark, "The Extended Mind," in *The Extended Mind*, ed. Richard Menary, Life and Mind (Cambridge, MA: MIT Press, 2010). Lawrence Zbikowski, "Cognitive Extension and Musical Consciousness," in *Music and Consciousness 2: Worlds, Practices, Modalities*, ed. Ruth Herbert, David Clarke, and Eric Clarke (New York: Oxford University Press, 2019).

[62] Cusick, "Feminist Theory, Music Theory, and the Mind/Body Problem," 21.

[63] Larson explains his pedagogical method to EMI, which is closely aligned with training the mind and body together. "Typically, I ask students to play or sing their work in various ways, listening for the strongest and weakest parts. Then we experiment with techniques of revision that exploit those features that make the strong parts work well and that improve the weak parts. For me, this opportunity to refine our listening is one of the biggest payoffs of imitating the style of another composer. I think that this is the essence of where creativity lies: in the ability to listen discerningly." Larson, "Dear Emmy: A Counterpoint Teacher's Thoughts on the Experiments in Musical Intelligence Program's Two-Part Inventions," 256.

frequently lampshades EMI's status as a computer program.[64] Instead, Larson's essay consciously draws attention to the autopoietic conceit of EMI's capacity to self-inscribe its intelligence through music.

Like many good science fiction stories, Larson's analytic essay operates on two levels: one that accepts the central conceit of EMI's musical intelligence as a form of learning, embracing the student-like character of its compositions; and another that problematizes the unspoken assumptions of EMI's musical intelligence, using the fantasy of an AI composer to challenge reader's expectations of the normal—a problematization of the everyday that the critic Darko Suvin calls "cognitive estrangement." Thus, at face value, "Dear Emmy" tells a story about an absent-minded instructor and his AI pupil; but as an act of cognitive estrangement, "Dear Emmy" becomes about the musical expectations that enable artificial intelligence and machine learning in the first place—expectations of style and aesthetics that lead listeners to infer musical intelligence.

By staging EMI's musical intelligence in this manner, Larson tacitly acknowledges the power of musical and literary spectacles to function as sites of knowledge production. Here, the fiction of Larson's "Dear Emmy" seems less like a radical break from traditional analysis and more like an intensification of the agential conceits tracked by Monahan in "Action and Agency Revisited." By presenting musical intelligence from the perspective of the listener, Larson rejected the white box ontology of EMI's sourcery and turned instead towards a black box ontology that accepted his lived experience of hearing and analyzing

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[64] Larson remarks "Although he didn't say why, Professor Cope suggested that it might be difficult for you to drop by." Larson even plays the absent-minded professor, apologizing for forgetting if they had ever met: "I assume that you are a student at our university. Please forgive me if I am mistaken, but I don't recall having met you." Larson, 237.

its music—privileging his unconscious feelings about EMI rather than the seeming objectivity of its code. In *The Cybernetic Brain*, the sociologist Andrew Pickering discusses how early AI and cybernetic creators embraced the black box as a heuristic for theorizing a mind free from the material constraints of cognitive theory. Unable to objectively peer inside the black box of the human mind, cyberneticians staged cognition as "ontological theater," studying "the go" of the brain without worrying over the unknown neurobiological minutiae that govern human intelligence. Ontological theater, explains Pickering, refers to a literal theater of the mind, as early cyberneticists built simple feedback systems designed to showcase intelligence as it evolved in a dynamic environments.[65] In 1948, for instance, the neurophysiologist William Grey Walter began building robotic "tortoises," three-wheeled machines with sensors that allowed them to avoid obstacles. The tortoises modeled "intelligence" as an embodied process of action—not knowledge. They possessed no top-down algorithms for navigating all obstacles. Instead, they merely perceived and responded to each obstacle as it arrived. As white boxes, the machines offered an impoverished model of intelligence, but when treated as a black box, the machine seemed as complex and dynamic as an actual tortoise.

Ontological theater, however, pertains to more than just clever mechanical simulation. Instead, it represents a radically different way of organizing the mind, reorienting its study away from the inside-out hegemony of modern scientific observation and towards an outside-in attention to actions and utterances—embracing the methods

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[65] Pickering, *The Cybernetic Brain*, 17–33.

we use every day to understand all kinds of subjectivities. In doing so, ontological theater reorders the autonomous mind as a relational mind, a mind socially and culturally distributed amongst other minds. As a form of ontological theater, Larson's chapter enfolded the computer into a pedagogical practice tied to these social and embodied realities. He praised EMI's "ear" for detecting not only Bach's musical surfaces but the deeper syntactic structures lurking beneath. "Have you *studied* Schenkerian analysis?" asked Larson; "Even if you are not consciously *aware* of Schenker's theories, aspects of your pieces suggest to me that some of the structures he described play an important role, at least at the *intuitive* level, in your compositional process, too."[66] (Emphasis added) Larson showed how criticism of EMI's music is inseparable from inferences of EMI's musical intelligence, as if imitation invoked a form of imagination: someone who *desires* to make music, *intends* to be understood, and *understands* music's history and structures.

In the end, Larson draws attention to a virtual experience of music-making that is no less *real* than other musical practices: less the false veneer of *virtual reality* and more an encounter with the forceful immateriality that Gilles Deleuze calls the *reality of the virtual*, an experience of a virtual world that is entangled with, rather than separate from, material reality.[67] According to Brian Massumi, this virtuality occurs between subjects, within the affective and relational folds of perception—in meaningful glances, affected speech, and musical sounds. It was music's virtuality that Larson attuned to when he accepted EMI as a student, or that Hofstadter detected in the machine's nostalgic and

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[66] Larson, "Dear Emmy: A Counterpoint Teacher's Thoughts on the Experiments in Musical Intelligence Program's Two-Part Inventions," 250.
[67] Gilles Deleuze, *Difference and Repetition*, trans. Paul Patton (New York: Columbia University Press, 1994), 208.

"Polish-feeling" mazurka. In this light, Larson's "Dear Emmy" was an exercise in what Massumi calls a "parable of the virtual," engaging musical intelligence less as an inert computational process, and more as an ontological theater that unites listener and spectacle in an aesthetic experience.[68] Indeed, by attuning himself to the ontological theater of EMI, Larson revealed the complicated ways that all musical intelligences are imbricated in the relationships, perceptions, and expectations of modern musicmaking. If Hofstadter feared the computational nature of human intelligence, Larson perhaps revealed the human nature of computer intelligence.

Imitating Intelligence

Pickering's theory of ontological theater acknowledges the connection between aesthetics and ontology. By accepting the subject's exterior as a viable path to the interior, he reclaimed perception itself as a philosophical practice. Notice, however, how the perception of ontological theater differs from the objective observation prized by the modern sciences. If scientific observation is directed towards neutral, falsifiable observations, ontological theater not only embraces the contingencies and biases of perception but celebrates those biases themselves as crucial sites of meaning-making.

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[68] Acknowledging that the traditional methods of understanding fall short in explaining the virtual, Massumi advocates for a study of the virtual founded on the affective, immediate expectations of the body. "When innovations in art or craft or technology elaborate upon our 'natural' talents for object perception to invent new experiential effects that have never seen before, they are not 'extending' our bodies away from its natural conditions into the realm of the artificial (the 'prosthetic' theory inherited from Marshall McLuhan). Our experience is already a stretch of potential. It is self-prosthetic. What art and technology do is extend the body's existing regime of natural and acquired artifice, already long in active duty in producing the "virtual reality" of our everyday lives. The life of the body is naturally crafty." Brian Massumi, "Envisioning the Virtual," in *The Oxford Handbook of Virtuality*, ed. Mark Grimshaw (New York: Oxford University Press, 2013), 64.

For commentators in the sciences and humanities alike, ontological theater is a counterintuitive practice, necessitating what many regard as willful ignorance of observed reality. EMI's ontological theater required a listener like Larson who could hold his knowledge of the computer's code separate from his perception of music, honoring the separation between white and black box ontologies. I have already discussed how Hofstadter rejected his first perceptions of EMI's mazurka, choosing instead to lament the computational origins of its musical intelligence. Music critics also struggled with the machine's musical spectacle. The conductor Noah Weber, for instance, derided EMI and other AI-composers for simulating musical sounds without genuinely "feeling" the underlying emotions. He likened the listener's experience of EMI to the false intimacy of a prostitute, a relationship defined by its deceptive intentions: "emotional interactions are based on a perceived understanding of shared reality, and if one side is disingenuous or misrepresenting the situation, the entire interaction has changed *ex post facto*. The value we give to art is mutable."[69] Likewise, Mark Lawson, a culture critic for *The Guardian*, chided the machine for its inability to authentically participate in a genuine artistic exchange between composer and listener; "'From the heart – may it go to the heart,' wrote Beethoven on the manuscript of his *Missa Solemnis*. From the byte to the brain can never be equivalent to that."[70]

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[69] Noah Stern Weber, "Your Computer Is Listening. Are You?," *NewMusicBox*, April 12, 2017, https://nmbx.newmusicusa.org/your-computer-is-listening-are-you-2/.

[70] Mark Lawson, "This Artificially Intelligent Music May Speak to Our Minds, but Not Our Souls | Mark Lawson," *The Guardian*, October 22, 2009, sec. Opinion, https://www.theguardian.com/commentisfree/2009/oct/22/music-computer-compose-copy. There is a long history of this view being expressed in aesthetic discourse. The philosopher Anthony O'Hear offered the most well-known articulation of it, defining art as a human to human transmission. See O'Hear, *The Landscape of Humanity*, 18.

For proponents of artificial intelligence, however, Weber and Lawson offered a false dichotomy between a human's authentic feelings and a computer's inauthentic imitation. Alan Turing addressed this division in his landmark essay, "Computing Machinery and Intelligence" (1950), citing a short passage by a British neurologist, Geoffrey Jefferson, criticizing the computer's lack of interiority. Jefferson wrote, "Not until a machine can write a sonnet or compose a concerto because of thoughts and emotions felt, and not by the chance fall of symbols, could we agree that machine equals brain—that is, not only write it but know that it had written it."[71] As an early advocate of artificial intelligence, Turing rejected Jefferson's romantic notion of human cognition, chiding the doctor for running afoul of solipsism; "the only way…someone could be sure that a machine thinks," complained Turing, "is to *be* the machine and to feel oneself thinking." Anticipating Thomas Nagel's 1974 essay, "What Is It Like to Be a Bat," Turing noted the impossibility of objectively witnessing or evaluating another's thoughts, whether man or machine. Instead, Turing believed that intelligence should be judged solely by external actions, prompting him to propose an evaluation that he called "the imitation game," or more colloquially, "the Turing test."

Turing based his test on a game involving three individuals: a man, a woman (Players A and B respectively), and an impartial interrogator (Player C). The game unfolds as Players A and B are separated from Player C as C attempts to deduce their identities by posing questions to the players. Any question is fair game. Player B wins if the judge

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[71] Jefferson, "The Mind of Mechanical Man," 1110.

correctly guesses their identity (likely by giving truthful answers), while Player A wins if they are misidentified. To avoid biasing the judge with tone and appearance, Turing suggests that the dialogue be staged through an intermediary, ideally a chat interface, which will focus Player C's attention solely on the content of each competitor's utterances. To evaluate machine intelligence, Turing amends the original game by replacing Player A with a computer. In this configuration, the teleprinter is more critical than ever, as the computer's appearance and tone will invariably bias the judge's deliberation. Turing noted, "We do not wish to penalize the machine for its inability to shine in beauty competitions, nor to penalise a man for losing in a race to an airplane. The conditions of our game make these disabilities irrelevant."[72] Instead, the imitation game focuses the judge's attention on the likenesses between competitors. It reduces both human and artificial intelligence to linguistic communication and prizes the functional similarities between their utterances over any structural differences.

Although Cope and Hofstadter largely avoided making overt comparisons between The Game and the Turing test, there is no denying their resemblances. Both were designed as assessments of mechanical intelligence. They each recognized the judges' inability to resist deferring to engrained bias between computer algorithms and human brains, so they devised rules for policing the connection between "intelligence" and utterance. Thus, just as Turing's Players A and B convince Player C through *text*, the composers in The Game make a similar case to the audience through *music*. And rather

[72] Turing, "Computing Machinery and Intelligence," 435.

than adjudicating the players' identities by *reading* a printed transcription, the audience now *listens* to the music performed by a pianist onstage. The composer Christopher Ariza, however, notes that these differences are not superficial.[73] Turing proposed the imitation game as a test of general intelligence. The judge questioned each player on any topic in real-time, feeling out the limits of their knowledge about the world. Hofstadter and Cope's game, on the other hand, was much narrower: the human and machine composers created their music before the test, and any interaction between them and the judge was mediated by a performer (either live or recorded).

Indeed, The Game more closely resembles the modified Turing tests that have been proposed by philosophers like Ray Kurzweil, psychometric tests that strategically focus on narrower domains of knowledge. Kurzweil has argued that such tests are a necessary stepping-stone towards passing the "Total Turing Test," a moment of computer-human equivalence that he calls "the singularity." He explains, "We have…reached the point where computers *can* successfully imitate human performance within narrowly focused areas of human expertise…The era of computer success in a wide range of domain-specific Turing tests is arriving."[74] For Kurzweil, domain-specific tests are not merely evidence of domain-specific knowledge (evincing what Nick Bostrom calls the "microworld").[75] Instead, these tests evince progress towards "general artificial

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[73] Christopher Ariza, "The Interrogator as Critic: The Turing Test and the Evaluation of Generative Music Systems," *Computer Music Journal* 33 (June 1, 2009): 48–70, https://doi.org/10.1162/comj.2009.33.2.48.
[74] Ray Kurzweil, "A (Kind of) Turing Test," in *The Age of Intelligent Machines* (Cambridge, Mass.: MIT Press, 1990).
[75] Nick Bostrom, *Superintelligence: Paths, Dangers, Strategies*, First edition (Oxford, UK: Oxford University Press, 2014).

intelligence," a system that fully recreates the breadth and diversity of the human intellect, modeling not just one psychometric measure of intelligence but all of them.

The problem with Kurzweil's domain-specific testing, however, is that there is no evidence to suggest that these domains are objective evidence of human intelligence in the first place. Indeed, while no machine has successfully passed the Total Turing Test, Ariza notes that *musical* Turing tests almost always yield a positive result.[76] These false positives arise not only in The Game, but also in many other AI musical tests: tests of pre-composed music, tests of music composed in real-time from an audience prompt, tests of improvisational skill, and even tests of computer performance.[77] The problem, explains, Ariza, arises because music communicates differently from language. In the Total Turing Test, the interrogator can "ask questions about a piece of prose: a statement can be rephrased, explained, or put into other words. Even attempts at deception can be disputed or argued."[78] None of these mechanisms are available or impactful in musical judgments. Instead, music relies on an analogical system that lacks the stability or autonomy of symbolic communication. There is no analogous musical relationship to the stable connection between symbols and their referents or words and their meaning.[79] To

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[76] Ariza, "The Interrogator as Critic."

[77] Ariza distinguishes between two main kinds of musical Turing tests: Musical Directive Toy Tests (MDtT) and Musical Output Toy Tests (MOtT). The directive toy tests require direct input from an audience; they might suggest a style, genre, instrumentation, or feeling and have the competitor (the human and computer) compose something according to those instructions. The MDtT could also take the form of an improvisational call and response. An MOtT, on the other hand, is a form of discrimination test (like The Game). Here, the audience is more passive, blindly judging the works that are offered. Ibid., 55.

[78] Ibid., 64.

[79] For more on the comparison between the analogic grammar of music and the symbolic grammar of language, see Lawrence Michael Zbikowski, *Foundations of Musical Grammar*, Oxford Studies in Music Theory (New York, NY: Oxford University Press, 2017).

be fair, it is that communicative instability that enables many of music's pleasures. As I have discussed throughout this dissertation, listeners have adopted sophisticated hermeneutic strategies for plumbing music's depths, strategies designed to open the medium up to an array of interpretations. The Romantic hermeneutics of critics like Hoffmann and Heinrich Heine are a characteristic example, allowing musical sounds to speak for the ineffable complexity of the composer's mind, intelligence, and very soul. The Turing test and musical appreciation, however, are at odds: the former is seemingly designed to reduce a complex utterance to an absolute determination between human and machine, while the latter opens the utterance to an array of hermeneutic strategies.

No wonder, then, that EMI's listeners so often confused these objectives. In "passing" the test (or "winning" The Game), the machine was heard to demonstrate the equivalence between human and computer intelligence. Such interpretations collapse the dualism between humans and machines by reinforcing it, further entrenching black box and white box theories of intelligence. On the one hand, listeners hear a "human intelligence" that originates from an analogic capacity to learn, feel, and embody the world, a subject who acts and reacts from "genuine" intentions and thoughts; and on the other hand, they judge an "artificial intelligence" that originates from the computer's symbolic capacity to automatically determine the world from objective algorithmic procedures. The former is connected and affect-laden, the latter isolated and rational. When viewed from this perspective, the audience's interpretation of EMI relied on an uncannily similar distinction to the one Quantz used to castigate Vaucanson's machine almost three centuries earlier: a mechanical mind dismissed or accepted on aesthetic

grounds.[80]

Theorists of posthumanism Katherine Hayles and Donna Haraway have separately advocated for a third path, a "posthuman intelligence" in which symbolic processes enable analogic sensations, and vice versa. Posthuman studies acknowledge the contingencies of categories like human and machine, recognizing how each is indebted to long-held ideologies and anxieties about modern subjecthood. As Hayles cogently summarizes, what the Turing test "proves" is that the "overlay between enacted and represented body is no longer a natural inevitability but a contingent production, mediated by a technology that has become so entwined with the production of identity that it can no longer be meaningfully considered separate from human subjects."[81] For posthumanists, then, the study of human life is primarily ideological rather than biological. Without denying essential material differences between microprocessors and brains, a posthuman perspective recognizes how material bodies are constantly negotiated and renegotiated by networks of discourse. The organs that give rise to intelligence, creativity, and embodiment are distinct from the ideological dimensions of these attributes.[82]

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[80] Quantz, *On Playing the Flute*, 131.
[81] Hayles, *How We Became Posthuman*, xiii–xiv.
[82] Hayles, for instance, cites Turing's biographer, Andrew Hodges, who notes how the imitation game became the primary lens through which Turing experienced life. As a closeted gay man, Turing was forced to externalize the heterosexual values of conservative British society that he did not share. Hodges explains that Turing dealt with this identity crisis as a mathematician, making sense of his chaotic reality (which was tainted by irrational beliefs, anxieties and intentions) by reordering it as a formal puzzle that could be solved. Black boxes like the computer and the imitation game were important forms of that social reordering: "the discrete state machine, communicating by teleprinter alone, was like an ideal for [Turing's] own life, in which he would be left alone in a room of his own, to deal with the outside world solely by rational argument." Andrew Hodges, *Alan Turing: The Enigma: The Centenary Edition* (Princeton, NJ: Princeton University Press, 2012), 535. See Katherine Hayles, *How We Became Posthuman: Virtual Bodies in Cybernetics, Literature, and Informatics* (Chicago: University of Chicago Press, 1999), xii.

Although few musicologists would identify explicitly as posthumanist, modern musicology has attuned to the ideological questions raised by posthumanism. Music scholars like Abbate, Cusick, and Monahan have laid the groundwork for a conception of musical intelligence that is always already distributed, reconceiving the composer not as a lone "brain in a vat," but as one intimately networked with other music-makers through sensuous threads of perception and affect. From this musicological perspective, EMI's game no longer seems an objective measure of materialist intelligence, but a challenge to materialism's supposed objectivity writ large, as internal mechanisms are themselves produced and reproduced from the ideological "biases" of everyday listening. As the musicologist Lawrence Kramer explains:

> The digital revolution is obviously a watershed in the history of perception, not least because digital technology has made it impossible to ignore the fact that perception *has* a history. Perception presupposes media. Perception requires technique. Perception is cultural…The digital epoch transposes the phantasmagoria from commodities to electronic media, from mystified objects to the flow of information.[83]

By attuning to the sensuous dimensions of musical intelligence, a musicological perspective acknowledges the power of the culturally conditioned observer. EMI was a case in point. By listening to its music and playing its games, audiences received a measure of intelligence that was already laden with assumptions about cognition, embodiment, and creativity. Through musical algorithms, EMI appeared to fashion itself a mind and a body, lending itself the same materiality that listeners are trained to expect

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[83] Lawrence Kramer, "Classical Music for the Posthuman Condition," in *The Oxford Handbook of New Audiovisual Aesthetics*, ed. John Richardson, Claudia Gorbman, and Carol Vernallis (New York: Oxford University Press, 2013), 41, https://doi.org/10.1093/oxfordhb/9780199733866.013.0007.

from a Chopin mazurka or a Bach invention.

Cope inadvertently alludes to the posthumanity of musical intelligence when he denies EMI's capacity to pass the Turing test. Responding to Noah Weber (the same writer who compared EMI to a prostitute), Cope remarks that,

> ...while I greatly respect Alan Turing and his work, I don't believe his test truly identifies intelligence. For example, what credentials does the individual judging have? Can he or she really tell the difference between intelligence and non-intelligence? As far as I know, no one has ever defined intelligence in a way that we can all agree upon. Without a complete notion of "I", how can we have "A.I."?[84]

By foregrounding the contingencies of both "I" and "AI," EMI's music no longer seems to exemplify the predicament Hofstadter first heard upon encountering the program. Instead, EMI allowed listeners like Hofstadter to experience firsthand the flaws in their conceptions of musical intelligence, as the materiality of cognition evaporated to digital simulation. As an experiment in musical intelligence, EMI paradoxically revealed the futility of *experimenting* with musical intelligence, of trying to observe both music and mind with scientific exactness. Musical intelligence is not code—nor is it score, nor work, nor recording. These objects might capture aspects of musical sound, reproducing the iterable dimensions of listeners' experience, but those sounds are inseparable from the immaterial acts of perceiving music.

At the same time, EMI, showcased music's capacity to alter the terms of the mind-body problem, provoking listeners and audiences to hear an AI intimately connected with

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[84] David Cope, "Response to Noah Weber's Comments on Emily Howell," *NewMusicBox*, June 8, 2011, https://nmbx.newmusicusa.org/response-to-noah-webers-comments-on-emily-howell/.

the first-person I; an intelligence born from subjective introspection of the self rather than scientific observations of others. While few AI are as proficient at imitating musical style as EMI, EMI's musical imitations enacted a human-computer parity idealized by many AI researchers: an imitation game that staked intelligence itself on an aesthetic conundrum that music scholars have long studied. Indeed, by listening to the interiority staged by EMI's music, musicologists can themselves recognize the importance of their perspective to contemporary conversations about minds, technology, and artificial intelligence. If, as Wendy Chun notes, researchers in AI remain enamored by the sourcery of their code, many scholars of music recognize the power and contingencies of perception to make even virtual acts of mind and music seem a reality.

Rather than accept a materialist brain that inhabits a world of zeroes and ones, or a materialist intelligence divorced from embodied experience, we hear EMI participate in a posthuman musical revolution that showcased the power of discourse to organize humans and nonhumans into social and aesthetic assemblages. In this sense, EMI's "musical intelligence" was not merely imitating the individuated cognition that Hofstadter expected from Chopin but stepping into a distributed subjectivity that all music-makers negotiate every day. In sounding like a human, EMI showcased its capacity to reproduce itself not from music but *as* music.

EPILOGUE

WORLD KNOWLEDGE

In his 1990 essay "Elephants Don't Play Chess," the roboticist Rodney Brooks criticized AI systems like EMI for reducing intelligence to mere symbol manipulation. For Brooks, rules-based intelligences are hampered by their rigorous adherence to code.[1] Although such AI are designed to engage humans' reality, their connection to that reality is tenuous at best, driven by *a priori* rules rather than *a posteriori* observations—a worldview encapsulated by the philosopher John Haugeland's formalist motto: "If you take care of the syntax, the semantics will take care of themselves."[2] The problem, for Brooks, was that semantics do not take care of themselves. While humans are epistemologically open, constantly assimilating new information about the world, symbolic systems are epistemologically closed. The sum of their understanding of the world, or "world knowledge," is hand-coded by a programmer who invariably fails to reduce infinite reality to finite code. This inadequacy leads systems like EMI to suffer from what researchers like Brooks call the "frame problem," the impossibility of the software to assume anything that has not been explicitly coded. EMI could copy a composer's style, skillfully extracting and reproducing subtle melodic, harmonic, and formal data, but it could never act beyond those procedures—its imitation game could never become what the Romantics presented

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[1] Rodney A. Brooks, "Elephants Don't Play Chess," *Robotics and Autonomous Systems* 6, no. 1–2 (June 1990): 3–15, https://doi.org/10.1016/S0921-8890(05)80025-9.
[2] John Haugeland, *Artificial Intelligence: The Very Idea* (Cambridge, MA: MIT Press, 1985), 106.

as a creation game.

By the 1990s, Brooks was a central figure in a broader reconfiguration of artificial intelligence research, guiding the field away from autonomous, symbolic metrics of intelligence and toward more perceptual, embodied systems. This disciplinary reorientation motivated the title of Brooks's essay: just because an elephant is unable to master a formal system or game like chess does not disprove its intelligence. Indeed, writing from the perspective of robotics, Brooks instead imagined intelligence manifesting gradually, through the trial and error of machines with sensors for observing the world. This embodied system could propel itself through dynamic environments, learning and growing from observation. Relative to Cope's direct intervention in EMI's musical intelligence, the programmer could now play a far less active role. They would simply design programs for feedback and course correction—systems for learning—and let their programs loose in the wild. The result was artificial intelligences that could *perceive,* developing world knowledge by living in it. Today, Brooks's theory of embodied intelligence has become the dominant thread of AI research today, enabling neural networks that learn and grow with the user. Brooks, for his part, demonstrated the validity of embodied AI with the founding of his company, iRobot, the maker of the Roomba—a robotic vacuum that learns to effectively clean a space by mapping it with visual and haptic sensors.

Although EMI was not designed to learn in the sense described by Brooks, its rise in the eighties and nineties anticipated this new age of embodied intelligence. Its programming was expressly symbolic, using pre-scripted rules for extracting and

reproducing musical style, but its artworks were heard by many listeners as profoundly embodied. From music alone, Steve Larson could detect the machine's *desire* to sound like Bach, possessing both *intuitions* about and *appreciation* for Bach's counterpoint. Likewise, Hofstadter heard the machine's Chopin-like mazurka express melancholic *nostalgia* and a "Polish feeling" he thought was germane to the Romantic expatriate.[3] While Brooks praised embodied systems for removing the abstract code mediating software from reality, many listeners heard EMI's musical intelligence signal a parallel immediacy, one that resembled their complex experiences with moving and interacting with the world.[4] Thus, EMI's musical intelligence seemed not an intelligence *about* music but *through* music, as organized sound conveyed an embodied world knowledge forged from discrete acts hearing, seeing, feeling, and moving.

Music critics have long celebrated musical objects as a conduit for embodied world knowledge, as scores, bodies, and instruments function not only as tools for enacting music, but tools for thinking about music—a mind-body reciprocity facilitated through what Jonathan De Souza calls "epistemic tools."[5] Chopin's music, for instance, was

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[3] Hofstadter explicitly connected embodied world knowledge and musical intelligence in the *GEB* denying a computer the capacity to compose until it could "…wander around the world on its own, fighting its way through the maze of life and feeling every moment of it. It would have to understand the joy and loneliness of a chilly night wind, the longing for a cherished hand, the inaccessibility of a distant town, the heartbreak and regeneration after a human death. It would have to have known resignation and world-weariness, grief and despair, determination and victory, piety and awe. In it would have had to commingle such opposites as hope and fear, anguish and jubilation, serenity and suspense. Part and parcel of it would have to be a sense of grace, humor, rhythm, a sense of the unexpected—and of course an exquisite awareness of the magic of fresh creation. Therein, and therein only, lie the sources of meaning in music." Hofstadter, *Gödel, Escher, Bach*, 677.

[4] Brooks, "Elephants Don't Play Chess," 10.

[5] De Souza did not coin the term "epistemic tool," but he championed its use in the context of the mind-body problem staged by the common practice period, using it to explain the music of Bach, Beethoven, and Haydn. Others, like Thor Magnusson have discussed it in the narrower sense of electronic music. De Souza, *Music at Hand*, 144. Thor Magnusson, "Epistemic Tools: The Phenomenology of Digital Musical Instruments" (doctoral, University of Sussex, 2009), http://sro.sussex.ac.uk/id/eprint/83540/.

inextricably tied to the embodied feeling of *playing* the piano, of hands stretching across keys, feet manipulating pedals, and ears detecting subtle variations of tempo and dynamics.[6] Certain genres, like the polonaise and the mazurka, further situated Chopin's embodied knowledge in the vernacular of his homeland, signaling bodies that not only dance and move, but celebrate and revolt.[7] James Q. Davies has even described how disease and ailments were heard to infect Chopin's world knowledge, as the composer's poor health "somehow ground the divine charms of his music."[8] De Souza portrays these bodily affordances of music as not merely an obstacle that the musician and composer must overcome, but sites of knowledge production in themselves, an embodied cognition in which "thinking" occurs *through* the hands and instrument—not in spite of them. "Instrumental practice," he explains, "would offer not only a way of making music, but also ways of perceiving, imagining, inventing and reflecting on it."[9] In many ways, this staging of embodied knowledge through music is Naomi Cumming's sonic self in reverse: the mind that inscribes its presence on the body becomes, in turn, a body whose actions enable the thoughts of the mind.

Nevertheless, in claiming a relationship between bodily experience and musical sounds, listeners mistake subjective qualia of sensation—the materiality of Chopin's fingers and ears, pathologies and politics—as objective facts of anatomy. Sense is itself

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[6] Davies describes how Chopin was unconcerned with the evenness or equal weighting of the fingers. "For a long time," wrote Chopin, "we have been acting against nature by training our fingers to be equally powerful" Frédéric Chopin quoted in Davies, *Romantic Anatomies of Performance*, 51.
[7] Jeffrey Kallberg, "The Rhetoric of Genre: Chopin's Nocturne in G Minor," *19th-Century Music* 11, no. 3 (1988): 238–61, https://doi.org/10.2307/746322.
[8] Davies, *Romantic Anatomies of Performance*, 44.
[9] De Souza, *Music at Hand*, 24.

subjective. Sensations are not objectively felt but subjectively embodied, experienced on a sensorium that organizes and collates perception into a unified experience of self. From this perspective, the subjectivity that listeners perceive in music is not what Dahlhaus called "a box containing a ready-made meaning," or an unbounded impression of cognition but a cognition effect—a fiction enacted by score and code alike to convey the impression of a lived, embodied subjectivity as complex as the listener's.[10] Note that I am not dispelling the fictions that enable these cognition effects, nor do I admonish audiences for "being duped" by these fictions, as Larson lamented of EMI. As I have explained throughout this dissertation, the meaning, expressiveness, and coherence of music results from these effects. Nevertheless, by attending to the "cognition" that listeners hear enacted by Chopin or EMI's music, we hear a mind associated not with the objective rationality or computationalism of the brain but the actions and feelings of the body. Musical intelligence is associated with an intellect that originates not from *thought* but from *feeling*, not from *rational processing* but from *embodied action*. Indeed, these contingencies emerged even in the absence of a sentient body: the embodied world knowledge that Hofstadter heard imitated in EMI's mazurka was suffused with the same world knowledge he accepted in Chopin's score.[11]

While EMI is the only machine in this dissertation to explicitly address musical

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[10] Dahlhaus, *Ludwig Van Beethoven*, 115.

[11] To be clear, many listeners, including Larson, were unconvinced by the integrity of EMI's world knowledge. The machine, for example, struggled with aspects of Bach's counterpoint, delaying or abandoning cadences that would have been expected in Johann Sebastian's original pieces. In emulating Bach's embodied world knowledge through the score, EMI fashioned itself a second-hand body that many heard as lacking Bach's intuitive musical grammar. Others like Kala Pierson, profess that EMI's Chopin is far more convincing. See Larson, "Dear Emmy: A Counterpoint Teacher's Thoughts on the Experiments in Musical Intelligence Program's Two-Part Inventions."

intelligence, I have argued that the question of musical intelligence—and its requisite embodied world knowledge—has motivated the pursuit of artificial life since at least the eighteenth century. Sometimes the spectacle of musical intelligence was overt. Vaucanson's automaton flutist was received by many as an Enlightened inquiry into the nature of music and mind, an android on which commentators like Condillac, La Mettrie, and Rousseau could test their sensationalist theories of language and communication. At other times, questions of musical intelligence were subtler, implicitly motivating the moral quandaries raised in stories about artificial life: Nathaniel swooning at Olympia's aria, Maria recoiling from the Chevalier's advances, or Dave's stoicism towards HAL's "Daisy Bell." Together, these machines—both enacted and imagined, historical and contemporary—reveal a centuries-long study of the mind-body problem that was articulated through music criticism. Centuries before Turing, these objects played their own imitation game, confronting audiences with a musical subjectivity that suggested genuine intuition and feeling, "moving" listeners to tears in one instant and threatening them with violence or rape in the next.

Nevertheless, if A-life aspires to the perfect, undifferentiated imitation of the musical mind, these machines simultaneously foreground the challenges of imitation. No matter how stirring its music or complicated its mechanism, artificial life remains, by definition, artificial. These experiments were not only prone to mechanical breakdown and uncanny action, but their unchanging mechanisms petrified a cultural, scientific, and mechanical moment that was constantly evolving. Brooks even had a name for the changing expectations of artificial life, the "AI Effect": "Every time we figure out a piece of

it," he explained in 2004, "it stops being magical; we say, 'Oh, that's just computation.'"[12] Still, the artifice of A-life was itself a site of knowledge production: Hofstadter's attention to EMI's "twenty-thousand lines of code" lead him to an epiphany about Chopin, music, and mind; Quantz dismissed the mechanics of the automaton-flutist's embouchure for negating a "fire" that he feared other flutists might emulate; even the outdated sound of Vaucanson's automaton inspired Arnim's Count to recognize and feel the musician's indentured servitude. These machines undermined the supposed integrity of musical intelligence by foregrounding the automaticity of machinery, producing an estrangement that prompted listeners to confront their own implicit biases about the musical mind.

Artificial life, then, is not a science but a science fiction—a fiction of science. The artificial spectacle of music spurred diverse listeners to reconcile the sounds they heard against the automaticity they observed, illuminating a contradiction between self-contained *knowing* and dynamic *feeling*. These mechanical music-makers defamiliarized the everyday experience of music and forced their listeners to question (perhaps for the first time) the seeming stability of their aesthetic experience. From this perspective, artificial life is a technology of re-enchantment, illuminating a contradiction between material body and immaterial mind that has long fallen mute to habituated ears. Hofstadter, Quantz, and Arnim were not the only figures to recognize mechanical music as a challenge to their preconception of what music should *be* like. Rather, this mind-body problem has been repeated, denounced, and celebrated throughout the history of

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[12] Rodney Brooks quoted in Jennifer Kahn, "It's Alive!," *Wired*, March 1, 2002, https://www.wired.com/2002/03/everywhere/.

artificial life—a cognitive estrangement that lies at the heart of android musicology.

By taking seriously the musical spectacle of artificial life, listeners are made to recognize the artificial spectacle of musical life—an aesthetic disruption that interrupts not only the autonomy of art, but the autonomy of self. In this way, android musicology productively undercuts some of the most elemental myths of the modern Western world: the reduction of life to matter, and mind to brain; the uncritical objectification of music as genius; the separation of social belonging from biological being. The musical spectacle of artificial life reminds us that the mind only exists as something we can see, hear, or feel. This conception of music and mind—of musical intelligence—emerged not from isolation, but relationship, interpellated by the cultural, social, emotional, affective, and embodied practices of music. In this way, android musicology not only presents the mind-body problem as an aesthetic problem of listening but positions listening itself as a site for thinking critically about mind and body. To paraphrase Descartes once more: *audio ergo sum*—I listen, therefore I am.

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