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Performing the Mechanical:

Industrialism, Androids, and the Virtuoso Instrumentalist

A dissertation submitted in partial satisfaction of the
requirements for the degree Doctor of Musical Arts

by

Leila Mintaha Nassar-Fredell

2013

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2013

ABSTRACT OF THE DISSERTATION

Performing the Mechanical:
Industrialism, Androids, and the Virtuoso Instrumentalist

by

Leila Nassar-Fredell
Doctor of Musical Arts
University of California, Los Angeles, 2013
Professor Robert S. Winter, Chair

Transactions between musical androids and actual virtuosos occupied a prominent place in the music of the eighteenth and nineteenth centuries. Instrumentalists and composers of instrumental music appropriated the craze for clockwork soloists, placing music in a position of increased social power in a society undergoing rapid technological transformation.

The history of musical automata stretches back to antiquity. Androids and automata, vested by audiences with spiritual and magical qualities, populated the churches of the broader populations and the Renaissance grottos of the aristocracy. As

the Industrial Revolution began, automata increasingly resembled the machines changing the structure of labor; consequently, androids lost their enchanted status. Contemporary writers problematized these humanoid machines while at the same time popularizing their role as representatives of the uncanny at the boundaries of human identity.

Both instrumental performers and androids explored the liminal area between human and machine. As androids lost their magic, musical virtuosos assumed the qualities of spectacle and spirituality long embodied by their machine counterparts. In this process virtuosi explored the liminal space of human machines: a human playing a musical instrument (a machine) weds the body to a machine, creating a half-human, half-fabricated voice.

In the nineteenth century the virtuoso's hybrid status as exalted human and advanced machine was confronted by the far darker identity of industrial laborers tied to their rapidly modernizing equipment. Franz Schubert (1797-1828) composed his Lied, *Gretchen am Spinnrade*, a setting of a scene from Johann Wolfgang von Goethe's *Faust*, featuring Gretchen sitting at a spinning wheel amidst the rapid changes taking place in the Viennese textile industry. The piano mediates between representation of a machine and human emotion. Schubert's *Rondo in B minor*, the "Rondeau brilliant," explores instrumental mechanics as an alternate human interior.

Just as audiences negotiated these contested identities for the human machine at the onset of the Industrial Revolution, we ourselves now face transformational waves of technology. Instrumental music and traditions of virtuosic performance still engage with the core issues of an industrialized society. Performers in this tradition inevitably explore the limits of human identity, even as that identity reconfigures itself in digital media and artificial intelligences.

The dissertation of Leila Mintaha Nassar-Fredell is approved.

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2013

For my parents: Susan and Joel

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Chapter 1

A Materialized Voice: the Lost Culture of Musical Androids

The audiences of Mozart, Schubert, and Beethoven embraced two categories of virtuosi: the living and the dead. It may be more accurate to designate these non-human performers—to borrow from E.T.A. Hoffmann—as “wonderful living-dead figures.”¹ Not only did musical androids tour Europe to considerable acclaim, but mechanical performers played and competed with their human counterparts.

To be sure, the press sometimes found the blurring of boundaries between human and machine unsettling. Responding to an 1809 concert featuring a famous trumpet android in Munich, a critic for the *Allgemeine Musikalische Zeitung* wrote “[i]ndeed it is somewhat strange to see a young artist appearing in alternation with an automaton.”² The young singer referred to by the *AmZ* sang arias during the android’s onstage costume changes; the latter soloist’s modesty was preserved via an onstage

¹ “[W]underlichen lebendigtoten Figur...” from “Die Automate.” E. T. A. Hoffmann, *Sämtliche Werke*, ed. Wulf Segebrecht and Ursula Segebrecht (Frankfurt am Main: Deutscher Klassiker Verlag, 2001), 4: 396. All translations are mine unless otherwise noted.

² *Allgemeine Musikalische Zeitung* 11, no. 23 (1809): 365. Also see Rebecca Wolf, *Friedrich Kaufmanns Trompeterautomat: Ein musikalisches Experiment um 1810* (Stuttgart: Franz Steiner Verlag, 2011), 152.

tent.³ The android's creator was the official inventor of the metronome, Johann Nepomuk Mälzel.

In 1812 another publication at the forefront of musical thought, the *Leipziger Allgemeine Musikalische Zeitung*, presented an enthusiastic review of a mechanical trumpet player by Friedrich Kaufmann; this automaton, according to the article,



(Figure 1) Kaufmann's trumpet player, still in good condition in Munich. Courtesy Deutsches Museum, Munich.

³ Ibid., 152.

constituted a great improvement on Mälzel's soloist.⁴ The review appears at the very front of the issue, and proclaims that Kaufmann's "new creations are so extraordinary and curious, especially for those concerned with acoustics, that they deserve to be known as much as possible throughout the world."⁵

The author then explains that while Mälzel was the first to find a way to reproduce the natural embouchure of a trumpet, Kaufmann's automaton, which can play in thirds, fifths, and octaves, offers significant advantages. Clothed in old Spanish dress, the figure has a clock in its head so that the owner can choose at which hours the android will come to life. The article concludes by commending Kaufmann in the language of the Romantics: "may this active, genius-full young man find the support and encouragement that his praiseworthy strivings merit!"⁶ The author of this review is none other than the composer Carl Maria von Weber.

⁴ Rebecca Wolf's recent and comprehensive study features Kaufmann's automaton. See Rebecca Wolf, *Friedrich Kaufmanns Trompeterautomat: Ein musikalisches Experiment um 1810* (Stuttgart: Franz Steiner Verlag, 2011). For a fascinating discussion of the many concerts of both Mälzel's and Kaufmann's trumpeters, see pp. 147-154.

⁵ "Seine neuern Schöpfungen aber sind so ausgezeichnet, merkwürdig, besonders für den Akustiker, dass sie verdienen der Welt so viel als möglich bekannt zu werden." Carl Maria von Weber, "Der Trompeter," *Allgemeine Musikalische Zeitung* 41 (1812): 663.

⁶ "Möge dieser thätige, genievolle, junge Mann die Unterstützung und Aufmunterung finden, die seines rühmlichen Strebers würdig ist!" Ibid., 666.

Yet in the end it was the entrepreneurial Mälzel whose automaton would be most noted by history. At Beethoven's academy of December 8th, 1813, between the premières of his Seventh Symphony and *Wellington's Victory*, the clockwork trumpet player performed marches by Pleyel and Dussek accompanied by full orchestra.⁷

Viennese newspapers reported laconically about the appearance of this device: "At this occasion the official court mechanic Herr [Johann Nepomuk] Mälzel let us hear his mechanical field-trumpeter as an intermezzo."⁸

These performances by trumpet androids are neither isolated quirks of history nor eccentric footnotes of marginal cultural impact. While the mechanical

⁷ Thayer discusses Mälzel's automaton and the trumpet player's reception in Vienna. See Alexander Wheelock Thayer, *The life of Ludwig van Beethoven volume II*, ed. Henry Edward Krehbiel, Hermann Deiters, and Hugo Riemann (New York: The Beethoven Association, 1921), 255.

⁸ "Grosse musikalische Akademie" *Allgemeine Wiener Musik-Zeitung*, ed. August Schmidt, (Hildesheim: New York: G. Olms, 1976): 750/390. Patrick Joseph Donnelly states that the trumpet player was actually made by Mälzel's brother Leonard. See Patrick Joseph Donnelly, "The Battle for the 'Battle of Vittoria,'" (Master's Thesis, Peabody Conservatory of Music, 2008): <http://pcm.peabody.jhu.edu/~pdonnelly/theses/DonnellyFinal.pdf>. Rebecca Wolf writes "Sources on the instrument are bad, there are no known images. We are not certain whether Johann Nepomuk or his brother Leonhard Mälzel (1783-1855) constructed this trumpeter; conceivably it could also be a collaboration [between the brothers]." ("Die Quellenlage zu diesem Instrument ist schlecht, weder Abbildungen sind bekannt, noch ist letztlich ganz sicher, ob Johann Nepomuk oder sein Bruder Leonhard Mälzel (1783-1855) diesen Trompeter konstruierte, denkbar wäre auch eine Gemeinschaftsarbeit.") Rebecca Wolf, *Friedrich Kaufmanns Trompeterautomat: Ein musikalisches Experiment um 1810* (Stuttgart: Franz Steiner Verlag, 2011), 105.

instrumentalists of Pierre Jaquet-Droz (1721–1790) and Jacques de Vaucanson (1709–1782), which included flute and keyboard players, are the most frequently cited musical androids, countless other automata performed music. This includes a keyboard trio of clockwork musicians performing at the court of Louis XV (Figure 2).⁹ Groups of androids also performed together in European music’s most intimate form of expression, the chamber ensemble.

My study of musical androids has led me to conclude that instrumental music—that is, music without words—became a crucial outlet after 1750 for maintaining philosophies of materialism in the face of violent suppression expressed in published books and pamphlets. The notion that humans are nothing more than biological machines, a thought not uncommon to twentieth-century scientific disciplines, was new and threatening. Enlightenment thinkers gave both celebrated automatons and human musical skills as examples to support new, daring, claims.

⁹ These androids were later exhibited publicly; a report in *Le Mercure de France* of August 1771 announces two performances a day by the trio with tickets priced at three *livre*. *Le Mercure* states that “this concert is executed by a number of very natural automata, each playing their part on a different instrument.” (Ce concert est execute par plusieurs figures automates de grandeur naturelle, fasiant chacune leur partie sur un instrument different.) “Concert mécanique [*sic*] de l’invention & execution du Sr Richard, rue de Richelieu, dans une sale de la bibliothèque du Roi, en entrant à gauche, au rez de chaussée.” *Le Mercure de France* (1771): 152-154.



(Figure 2) *Concert mécanique inventé par R. Richard, exposé à la Bibliothèq. du Roi, 1769.* © The Trustees of the British Museum.

By the early eighteenth century, René Descartes' theory that animals are automata, and that the human body is itself an automaton with a soul, circulated

widely. But no writer dared to state outright that the soul itself might be a machine until Julien Offray de La Mettrie published *L'homme machine* (Machine Man) in 1748.¹⁰ La Mettrie's hilarious yet compelling treatise hints with remarkable perspicacity at evolutionary and biological laws, arguing that, among other proofs, the soul must be material since a violinist can play so fast.¹¹

Yet as soon as the ideas of La Mettrie were printed he prompted a major uproar. Even the publisher of *L'homme machine*, Elie Luzac, who included a careful introduction explaining he was only publishing the work so it could be proven false, was compelled to deliver all copies of the pamphlet for burning, and forced to leave Holland.¹² Justin Leiber writes:

It is hard to think of a more successful job of disappearing than that done to La Mettrie, who in the 1740s forged the biologically oriented materialism, evolutionism, and ethical naturalism hesitatingly, often secretly, expressed by the *philosophes* of the 1770s . . . Thus, until the last few decades, La Mettrie was disappeared from histories

¹⁰ Julien Offray La Mettrie, *Man a Machine and Man a Plant* [1748], trans. Richard A. Watson and Maya Rybalka, introduction Justin Leiber (Indianapolis: Hackett, 1994).

¹¹ *Ibid.*, 66.

¹² The publisher musing on the danger of *Machine Man* leading the faithful astray writes that "I know prudence advises that we should never provide opportunities for the seduction of weak minds. But I saw on first reading that there is nothing here to fear even if they were seduced. And anyway, why should we be so vigilant about suppressing arguments contrary to the ideas of divinity and religion? Might this not make people think we are *deceiving* them?" (Italics in original) *Ibid.*, 18. For the circumstances of the printing and the burning of the first edition see Justin Leiber's introduction in Julien Offray La Mettrie, *Man a Machine and Man a Plant*, trans. Richard A. Watson and Maya Rybalka (Indianapolis: Hackett, 1996), 4.

of the Enlightenment, except for some humorous lines about his chatter with Frederick [the Great of Prussia] and his untimely death.¹³

The persistence of the interest in the human as a complete machine, not a machine body with a soul, continued despite widespread attempts to repress it—*L'homme machine* stayed popular as a pamphlet on the black market—but clearly any further attempt at public radical materialist discourse was dangerous and fraught with risk.¹⁴

Nonetheless, as machines began to enter people's lives in ever more visible and pivotal ways, the cultural need to examine deeply troubling questions of materialism only strengthened after the scandalous publication of *L'homme machine*. Radical manifestations of materialism continued in a non-linguistic arena—music—where representations of the spiritual and the mechanical could coexist. Materialist urges too dangerous to express in language sprang up in the flying fingers and superhuman passage work of instrumental virtuosi. Hence in the midst of the mechanization of labor and early stages of industrialism, an important group of performers, both human and android, aroused awe, terror, and worship in audiences.¹⁵

¹³ Ibid., 5-6.

¹⁴ Ibid., 6.

¹⁵ The earlier part of the period I am working with, the second half of the eighteenth century, predates large-scale continental industrialism. However, the mechanization of labor was in full swing throughout Europe. I am not concerned here with the scale of industrialism, but rather with the tensions surrounding human labor and machines. In Marxist terminology the end of the eighteenth-century is called the

Composers responded to the success of material virtuosity with a new instrumental idiom that broke away from the imitation of verbal rhetoric so central to eighteenth-century instrumental music. A careful reading of chamber works by Schubert and Beethoven frequently reveals passages of technological turmoil. We need not ignore the darker meanings embedded in this repertoire. While I may argue that machines sometimes inhabit beloved canonic works these machines do not control, determine, or diminish the esthetic totality of these works. This repertoire's juxtaposition with mechanicity only adds to its scope and depth. Mechanical discourse involves machines, but ultimately probes the nature of the human body. As performers we know intimately how our bodies operate in this music, yet have little framework to discuss how the mechanistic nature of the performer's body relates to larger cultural issues.

The period from 1750-1830 proved fascinating for the development of European music precisely because it witnessed the collision of two sharply differing attitudes toward automata. Late Enlightenment thinkers reacted against the model of a

"manufacture period;" more recently historians of technology and economy use the term "proto-industrialization." One of these historians, Adelheid Voskuhl, asserts that the "concept of 'proto-industrialization' has served as an attempt to revise and extend this historical understanding of the transition from agricultural subsistence economies to industrial capitalism." See Adelheid Voskuhl, "The Mechanics of Sentiment: Music-Playing Women Automata and the Culture of Affect in Late Eighteenth-Century Europe" (PhD diss., Cornell University, 2007), 93. This thesis will focus on European musicians and audiences undergoing the transition to industrialism, and so some of the time period covered could be called "proto-industrial" and some "early industrial."

clockwork universe, pointing to sensibility as the essential component of humanity and mocking individuals who resembled automata. By the end of the eighteenth-century the clockwork virtuoso had emerged as a figure awash in contradictions: ominous yet powerful, magical yet lifeless.

Defining automata and androids

The distinction between an automaton and an android is a somewhat obscure piece of knowledge and worth defining. In general, an automaton is a “self-moving” device; the term automaton includes clocks and mechanical organs as well as any android. An android, however, must be human in form and must imitate the activity of a human being to some discernible degree. In other words, androids are subsets of automata.

Denis Diderot (1713-1784), in his article “Androïde” for the *Encyclopédie* (1751), clarified this distinction: an automaton is a “device that moves by itself, or a machine that carries in itself the principle of its motion,” and an android is an “automaton with a human figure, equipped through the means of a certain spring drive to act like and conduct functions that apparently resemble those of humans.”¹⁶ Diderot based his

¹⁶ (Voskuhl’s translation.) Adelheid Voskuhl, “Motions and Passions: Music-playing Women Automata and Cultural Commentary in Late 18th-Century Germany,” in *Genesis Redux: Essays on the History and Philosophy of Artificial Life* Jessica Riskin, ed. (Chicago: Chicago University Press, 2007), 293 and 312 f. Automate: “engine qui se meut de lui-même, ou machine qui porte en elle le principe de son mouvement.”

article on his knowledge of the famous automata of Jacques de Vaucanson. More recently, one of the few experts on musical automata, Adelheid Voskuhl, outlines precise requirements for an automaton to qualify as an android:

First, the mechanism driving and conducting the automaton's motions must be entirely contained within the automaton's body; second, android automata performing cultural techniques must do so just as humans would: a piano-playing automaton, for example, would move its hands across a real keyboard and press the appropriate key . . . and a flautist would produce a melody by blowing air from the lips into the instrument and moving fingers on the flute.¹⁷

The great historian of clockwork, Alfred Chapuis, identifies the automata of Hanns Büllmann (d. 1535) as the first known androids.¹⁸ These automata walked, beat a drum, and played on a lute. Even though strumming a tiny lute does not represent a high level of sophistication and perhaps only loosely meets Voskuhl's requirements, Chapuis's characterization of Büllmann's automata as androids seems appropriate. Historical sources use the broader term "automaton" for human forms more frequently than "android." The term "robot" does not appear until the twentieth century:

Diderot, Denis, *Encyclopédie; ou Dictionnaire raisonné des sciences des arts et des métiers* (Paris: Braisson, 1751), 1: 896-97. Androide: "automate ayant figure humaine & qui, par le moyen de certains resorts, &c. bien dispose, agit & fait d'autres fonctions extérieurement semblables à celles de l'homme." Denis Diderot, *Encyclopédie; ou Dictionnaire raisonné des sciences des arts et des métiers* (Paris: Braisson, 1751), 2: 625.

¹⁷ Adelheid Voskuhl, "Motions and Passions: Music-playing Women Automata and Cultural Commentary in Late 18th-Century Germany," in *Genesis Redux: Essays on the History and Philosophy of Artificial Life* Jessica Riskin, ed. (Chicago: Chicago University Press, 2007), 312f.

¹⁸ Chapuis, *Le Monde*, 181.

The word ‘robot’ (which has outstripped ‘automaton’ as the most commonly used word denoting a self-moving machine that mimics a living creature) was first coined by the Czech artist and writer Josef Čapek from the Slavic word *robata*, ‘drudgery,’ derived from its medieval sense of the unpaid labor a vassal was obliged to perform for his feudal lord. It was adopted by his brother Karel for his celebrated 1921 play *R.U.R.: Rossum’s Universal Robots*.¹⁹

Criticism on Musical Androids and Early Music Machines

The study of musical androids can hardly claim aspirations to be a field, yet a small and increasingly vibrant body of literature exists on the subject. These inquiries into humanoid instrumental automata suffer from being scattered across academic disciplines, ranging from the history of technology to German literature and musicology. Indeed, even though the human body serves as such a powerful touchstone in recent theory and criticism, the literature on mechanical musical instruments is much more extensive than publications on musical automata in human form.²⁰

We are quite familiar with the mechanical reproduction of sounds, yet a machine mimicking the motions of the body in the production of music—sounds said to reveal the interior soul—still creates equal parts fascination and unease. Yet why would we

¹⁹ Kang, *Sublime Dreams*, 279.

²⁰ Often sources on mechanical music will include a short discussion of androids, and some publications on non-human form musical automata are valuable to my work. As I am primarily interested in performances resembling a human body and dynamics of concert hall performance my discussion of the literature of mechanical music will not be exhaustive.

not wish to address the creatures who shared the stage with the first performance of Beethoven's Seventh Symphony, and who captured the imagination of the eighteenth century? They raise issues still of the utmost relevance to contemporary society. We also gain insights about the continuing power of the "classical" repertoire within the gears and levers of androids.

The literature dealing with the meanings of historical musical androids has been greatly enhanced by the recent publication of two studies focusing on specific musical automata. Rebecca Wolf's 2011 book *Friedrich Kaufmanns Trompeterautomat: Ein musikalisches Experiment um 1810* [Friedrich Kaufmann's Trumpet Automaton: A Musical Experiment from 1810] is to my knowledge the only musicological monograph dealing exclusively with a musical android.²¹ Wolf's book examines one automaton in great depth, drawing conclusions about interiority and the role of musical androids in scientific investigation. Adelheid Voskuhl, a scholar of the history of technology, addresses two female keyboard-playing automata in her 2007 Cornell dissertation, seeing their performances as expressions of new bourgeois behavioral codes.²²

²¹ Rebecca Wolf, *Friedrich Kaufmanns Trompeterautomat: Ein musikalisches Experiment um 1810* (Stuttgart: Franz Steiner Verlag, 2011).

²² Adelheid Voskuhl, "Motions and Passions: Music-playing Women Automata and Cultural Commentary in Late 18th-Century Germany," in *Genesis Redux: Essays on the History and Philosophy of Artificial Life* Jessica Riskin, ed. (Chicago: Chicago University Press, 2007), 293-320. The topic of this article is also treated in Voskuhl's dissertation, which will be published in 2013. Adelheid Voskuhl, "The

Voskuhl and Wolf have begun the important task of providing a framework for the role of androids in music.²³ Voskuhl focuses on the behavior of women in eighteenth-century social settings. Wolf centers her thinking on a trumpet automaton and the fascinating social and philosophical contexts surrounding it. There is still work to be done in applying the work of Wolf and Voskuhl to human instrumental performance and repertoire.

A few critics have investigated the compositional response to mechanical fervor, exploring the relations of eighteenth-century repertoire to mechanical contraptions.²⁴ Composers regularly fashioned works for popular musical clocks, a trend that predates twentieth-century electronic composition. Annette Richards addresses Mozart's work for the musical clock, and argues that Mozart employed fugues as a mechanical trope

Mechanics of Sentiment: Music-Playing Women Automata and the Culture of Affect in Late Eighteenth-Century Europe" (PhD diss., Cornell University, 2007).

²³ Elisabeth Le Guin brings automata into play in her book on Boccherini; she writes that a rondo theme from the Cello Sonata in C Major, G. 17 iii "mechanizes the player's body in an explicitly theatrical way, forcing it to visibly mimic hammers, levers, fulcrums." Elisabeth Le Guin, *Boccherini's Body: An Essay in Carnal Musicology* (Berkeley and Los Angeles: University of California Press, 2006), 117. Le Guin is one of the most sensitive critics handling performance, the eighteenth-century conception of the body, and virtuosity. I will discuss her work further in chapter three.

²⁴ A less recent book by Reinhold Hammerstein is a fantastic resource on the use of mechanical music in the ancient world and Middle Ages, time periods mostly outside the scope of this dissertation, however. Reinhold Hammerstein, *Macht und Klang: tönende Automaten als Realität und Fiktion in der alten und mittelalterlichen Welt* (Bern: Francke, 1986).

when writing for the clock.²⁵

David Yearsley, Richards's colleague at Cornell University, also explores counterpoint as mechanism; in one chapter of his book, *Bach and the Meanings of Counterpoint*, he examines machines for producing counterpoint in the era of Bach.²⁶

Both Richards and Yearsley add to the already overwhelming evidence that musicians viewed counterpoint as an expression of the universal mathematical, and hence followed mechanical laws. This parallels seventeenth- and eighteenth-century thinkers who imagined similar laws governing both the human body and the planets.

Yearsley not only discusses counterpoint, but he notes that the biographer Johann Nikolaus Forkel (1749–1818) described Bach's performance in language fit for an automaton.²⁷ Along with wielding quasi-divine contrapuntal skills, Bach was also a keyboard virtuoso. Virtuosity figured prominently in discussions surrounding materialism and the soul, including the provocative philosopher La Mettrie mentioned earlier in this chapter. Yearsley writes that "[n]ot only for [materialist philosopher Julien Offray de] la Mettrie but for his critics as well, it was musical performance that most

²⁵ Annette Richards, "Automatic Genius: Mozart and the Mechanical Sublime," *Music and Letters* 80, no. 3 (1999): 366-389.

²⁶ David Yearsley, "Bach the Machine," in *Bach and the Meanings of Counterpoint* (Cambridge, 2002), 173-209.

²⁷ *Ibid.*, 173

dramatically problematized the relationship between mind and body.”²⁸ Yearsley’s time frame ends with Bach’s death in 1750, and many of the points he raises beg for elaboration in regard to later periods.

Carolyn Abbate provides the most important recent treatment of virtuosity and androids by a musicologist. She takes on both androids and historical musical machines, explaining the phenomenon of automata as an early striving towards recordings.²⁹ She argues that the uncanny human quality of automata presages to the eventual victory of recordings in box form. Abbate sees the square record or music box as imitating the form of a monument; the recording, in Abbate’s opinion, is the tombstone of the live performance. She argues that when the human voice is channeled into an instrument, “all instrumental versions of voice are by contrast suspect with regard to the origin of sound. They construe the medium as dead.”³⁰

A dead medium is not far from a robotic lack of life. For the period from approximately 1750-1830, however, I argue that non-vocal sounds did not simply represent death. Instrumental music, whose beautiful sounds originate from strange wooden boxes, exudes a magical aura. Instrumental music, with its disjunction from

²⁸ Ibid., 173.

²⁹ Carolyn Abbate, *In Search of Opera* (Princeton University Press: 2001).

³⁰ Ibid., 201.

language, skirts the border between human and non-human.

Abbate addresses the dynamics of an audience watching a live performer playing a work composed by another, in which the instrumentalist becomes as lifeless as the musical instrument. The musician is manipulated by an external force—the composer:

From the audience's point of view, performance can engender an equally strong sense for a musical voice separate from the body executing its commands, the performer-piano that is dead or mechanical and clearly did not write the concerto. Parallels between performers and musical automata were articulated in fiction and theoretical writings beginning in the eighteenth century, paying tribute to this phenomenon. These truly inanimate performers – the ones done in porcelain or wood – represent an endgame, a final comment on the dead-object problem, simultaneously utopian and grotesque.³¹

Abbate sees musical androids occupying a cultural space in which the live performer and the instrument are united in “the dead-object problem.” While Abbate has accurately captured the “utopian and grotesque” attitude of Modernists toward performers, the axes of debate among writers of the Romantic movement and earlier thinkers stress wonder and uncertainty. For these earlier writers—who watched with both admiration and trepidation the emergence of new technologies such as electricity, railroads, and mechanized looms—machines did not yet suffer from the Modernist disenchantment with industrial culture.³² Their fascination with human performers

³¹ Carolyn Abbate, *In Search of Opera* (Princeton University Press: 2001), 10.

does not stem from perceiving an instrumentalist as dead, but from the questions raised by their human and superhuman abilities.

E.T.A. Hoffmann and the uncanny instrumentalist

E.T.A. Hoffmann (1776-1822) confronts the shifting relationships between humans and machines well beyond the “living-dead” dimensions of androids themselves. In the stories of Hoffmann, a crucial figure in the musical culture of the period, we see a fascination with musical instruments and their uncanny status. Hoffmann’s work provides one of the clearest links between a musical culture that produced the still dominant repertoire of chamber ensembles and orchestras, and androids: he composed, worked as a music critic, and wrote extravagant stories featuring musical androids. One of Hoffmann’s archetypical characters is an inventor/organ builder/magician, a figure who, in *Der Sandmann*, builds a singing automaton and, in *Rat Krespel*, obsessively disassembles Cremonese violins to

³² Max Weber’s use of disenchantment (*Entzauberung*) alludes to the loss of a sense magic in the world with the advent of modern Capitalism, building on a term by Friedrich Schiller (1759-1805): *Entgötterung* or de-divinization. Schiller’s term responds to the fascination surrounding the pantheism of Baruch Spinoza (1632-1677), a *Spinozastreit* [Spinoza quarrel] that flourished in late eighteenth-century Germany. Automata gradually leave the category of natural magic in the nineteenth-century and indeed become more “scientific.” We could say that automata are disenchanted if we accept disenchantment and that Weber believed disenchantment has occurred. For a discussion of Weber and disenchantment, see Bruce Robbins, “Enchantment? No, Thank You,” In *The Joy of Secularism*, edited by George Levine, Princeton, 2011: 74-94.

understand their mechanics.

Werner Keil, the most sensitive and inspired expert on the thought and music of E.T.A. Hoffmann, parses Hoffmann's story *Rat Krespel*, in which a female singer, Antonie, faces the danger of death if she sings; she also hears her voice in the sound of a valuable old violin played by Krespel:

Thus Antonie, the female singer, was inspired by an incorporeal note, and Krespel, the instrumentalist, by a mocking, devil-like figure. Such dualism is characteristic of Hoffmann, and is fundamentally no different from Schelling's dualism of the artificial versus the natural, or of the mechanical versus the organic.³³

The instrumentalist who appropriates the human voice in uncanny fashion remains an uneasy and problematic character for Hoffmann. Keil writes that "[w]ith Hoffmann, instrumental music always has something one-sided about it, something of the "Krespel," something that evokes terror and fear, something artificial and mechanical.³⁴"

Hoffmann's conflicted relationship with instrumental music involves unease with the implications of the mechanistic qualities of musical instruments and performance. This unease still exists to the present day, in conflicting attitudes towards virtuosity. Even the most skilled performers sometimes still treat virtuosity like a guilty,

³³ Ibid., 155.

³⁴ Ibid., 156-7.

yet necessary, pleasure. Keil's work is essential to understanding the attitudes toward music and mechanics in E.T.A. Hoffmann and other key Romantic figures. Keil notes that "[a]ccording to Friedrich Schlegel, the 'greatness' of music lies in its mechanical nature: for example, the device of fugue in sacred music can be compared to a screw or lever, or a similar device."³⁵

Keil does an excellent job exposing the Romantic movement's relationship to both the mechanical and music. The critical implications behind Keil's revival of overlooked aspects in the musical writings of Friedrich Schlegel, Wilhelm Heinrich Wackenroder, Ludwig Tieck, and Jean Paul are still largely unexplored. Keil states that "[b]y and large the early Romantics understand 'artificial' from a historical-philosophical point of view as the hallmark of the modern age. They saw instrumental music with its complex and motivically linked formulations as a corollary of the novel—the paradigm of Romantic art."³⁶ I will pursue the implications of this argument further in my Chapter 4 as the language of artifice built by complex interlinking motivic blocks describes the construction of a machine as well as a well-crafted work of music.

Emily Dolan, a musicologist also publishing on Hoffmann and mechanical

³⁵ Werner Keil, "The Voice from the Hereafter: E. T. A. Hoffmann's Ideal of Sound and Its Realization in Early Twentieth-Century Electronic Music," trans. Siobhan Donovan and Andrew Johnstone in *Music and Literature in German Romanticism* (Rochester: Camden House, 2004), 144.

³⁶ *Ibid.*, 144.

music, views the story “Automata” by Hoffmann as a declaration of equal importance to his famed reviews, despite a lack of discussion among musicologists.³⁷ Here Hoffmann engages directly with musical automata and provides his most extended discussion of music and mechanics:

The descriptions of grotesque automata and Ludwig’s spirited rants against artificial intelligence are so striking that it is easy to overlook the extended and detailed discussions of music; indeed, “Automata” has a greater presence in histories of science and technology than in musicology. The story is not included in David Charlton’s collection of Hoffmann’s musical writings, nor is it discussed in Abigail Chantler’s recent study of Hoffmann’s aesthetics. But just as the Turk drew upon a public fascination with artificial intelligence, Hoffmann’s discussion of music also reflected abiding concerns of contemporary musical culture: the earliest published version of “Automata” focused primarily on Ludwig’s and Ferdinand’s discussion of music; Ludwig’s extended tirades against other kinds of automata and the tale of Ferdinand’s lost love were not central themes and only appear in the longer versions.³⁸

Certainly “Automata” counts as Hoffmann’s major statement on musical androids. The contradictions found in the story reveal how complex and focal a problem musical automata were for Hoffmann and his contemporaries.

³⁷ Dolan explores in a different article the question of late eighteenth-century orchestra machines, and concludes that these contraptions represent a shift in thinking about timbre. Certainly timbre may be a factor, yet I question whether a new approach to issues of timbre alone propelled such striking production of orchestra machines. The prevalence of orchestra machines provides another clue to the immensity of the fascination with mechanical musical contraptions, a fascination in need of a compelling cultural explanation. Emily Iuliano Dolan, “The Origins of the Orchestra Machine,” *Current Musicology* 76 (2003): 7-23.

³⁸ Emily Dolan, “E. T. A. Hoffmann and the Ethereal Technologies of ‘Nature Music,’” *Eighteenth Century Music* 5 (2008): 8.

Dolan writes:

[t]he inability to harness an ideal voice surely proved the otherworldly nature of that voice; in Benjaminian terms, the difficulty of mechanically reproducing the sounds of nature imparted the aura of authenticity to the idea of those sounds: it confirmed that they were indeed ideal, untameable by man, and that music was not wholly of this world.³⁹

Here Dolan mirrors Benjamin's famous association of preindustrial human rituals with the aura of authenticity, an authenticity lost in "mechanical reproduction."⁴⁰ In this reading the musical voice of the period leaves the human performance space and, indeed, human culture entirely, to reproduce the sound of an edenic Nature's Paradise.

Yet by invoking Benjamin, Dolan, like Abbate, accepts a Modernist narrative of the machine age as fostering a loss in human culture and identity, another Fall of humanity into a machine-like and aura-free state of consciousness best represented by the Eisensteinian jump cut in cinema. In this narrative, orchestral "nature sounds" are attempts to retrieve the spiritual authenticity of the Benjaminian aura.

While this view harmonizes well with Modernist anxieties about industrial machines and mass culture, it clashes with the very different fascination with musical androids in the late eighteenth- and early-nineteenth centuries—a fascination whose

³⁹ Ibid., 26.

⁴⁰ Walter Benjamin, "The Work of Art in the Age of Mechanical Reproduction," in *Illuminations: Essays and Reflections*, ed. Hannah Arendt, trans. Harry Zohn (New York: Schocken Books, 1969), 217-251.

roots go back to the clockwork figures and animated organs of the European Middle Ages. The otherworldly sound in Hoffmann's "realm of the spirits" is the sound of natural magic as channeled by instruments and the voices of uncanny automata. Natural magic as expressed through mechanics, and automata—representatives of industrialism as well as natural magic—occupy in Hoffmann's world a paradoxical ground.

Hoffmann's "spirit world" encapsulates the concept of natural magic. Natural magic was intimately bound up with the technological advances rocking society. Hence the spirit world was hardly a transcendent and discrete entity disconnected from humans, bodies, and social hierarchy.

Hoffmann's writing inhabits a strange moment in the history of androids. As the machinery of these creatures moved from staging theatrical wonder to enabling mass production, androids found themselves the subjects of intellectual distrust even while these same automata were adored by crowds of urban dwellers. While Hoffmann's lifetime represents a peak in the problematization of the musical android, the history of humanoid musical automata spans many centuries.

As no overview of the history of musical machines in human form currently exists, Chapter 2 traces the outlines of this extensive legacy, setting the stage for Paganini, Schubert, and Beethoven.

Chapter 2

A History of the Clockwork Soloist

“‘One hears that bad musicians are never bored with themselves.’ This is a good adage for an automaton. But if some of the androids we are going to study are indeed bad and persistent musicians, there are also others who perform with graceful gestures and remarkable talent.”⁴¹

The Enchanted Android

A web of negative associations surrounds the term “robot.” We think of soulless abjection, stiff awkward motion, and mass production. In an historical irony, before the twentieth-century introduction of the word “robot,” many European languages referred to a machine in human form as an “automaton” — a term that highlights independence as the defining feature. Indeed, automata, while celebrating the striving of human intelligence to mimic the heavenly cosmos, represented the mystery of life and divine creation.⁴²

Carolyn Abbate states “[w]e think of the eighteenth as *the* great century of automata, when genius in invention and the production of astonishing toys suddenly

⁴¹ “‘Les mauvais musiciens - a-t-on dit – ne sont jamais ennuyeux à eux-mêmes.’ Voilà un adage qui pour un automate, a toute sa valeur. Mais si quelques-uns des androids que nous allons étudier, sont en effet de mauvais et perseverant musiciens, il en est d’autres au contraire, dont la grâce des gestes est aussi remarquable que le talent.” Alfred Chapuis and Edmond Droz, *Le monde des automates; étude historique et technique*, 2 vols. (Paris: E. Géli, 1928), 263.

⁴² Christian Moevs covers the territory of early clocks in the church and Dante in “Miraculous Syllogisms: Clocks, Faith and Reason in Paradiso 10 and 24,” *Dante Studies* 117 (1999): 59-84.

collided with mechanist thinking on the nature of body and soul.”⁴³ The musicological focus on the eighteenth century as “the era of automata” obscures the larger significance of performing clockworks in the history of music.⁴⁴ It is important to bear in mind that automata were not a spectacle limited to the eighteenth-century Enlightenment. Indeed, an important wave of mechanistic thinking did indeed flourish then, and several androids reached celebrity status during that period.

The false binary of creatures begotten by cold, scientific Enlightenment thought causes us to forget that for centuries automata were imbued with the aura of alchemy. In the later eighteenth-century intellectuals celebrated rational thought and human sensitivity and used the term automaton as an insult for people lacking agency. After this late-Enlightenment attempt to disenchant the automaton Romantics, gazing to the past, combined the new unease with androids’ lack of agency with the magic infused in automata for centuries. Androids, and the man-machine concept, while extensively discussed during the Enlightenment, hardly originated in this period. The history of musical automata in human form is vast and complicated, and to date no study tracing

⁴³ Carolyn Abbate, “Outside Ravel’s Tomb,” *Journal of the American Musicological Society* 52, no. 3 (1999): 475.

⁴⁴ Abbate, Dolan, Richards, Wolf, and Yearsley all explore eighteenth- or early nineteenth-century automata. For a discussion of this literature, see Chapter One.

the succession of performing humanoid machines exists.⁴⁵ Although this survey will be far from exhaustive, it offers an outline of such an account. The history of scholarly inquiry into automata and the world-as-machine stretches back to antiquity. We find strands of mechanistic thinking on the body and soul already in Dante Alighieri's *Paradiso*. The Dante scholar Christian Moevs points out that "[t]hough the notion of 'machina mundi' is as old as Lucretius, and was common in the Middle Ages, it is not until Nicholas Oresmus, who dies in 1382, that we find the first explicit metaphor of the

⁴⁵ Alfred Chapuis's *Le monde des automates* remains the foundational work for any historical survey of automata; however he includes all automata, musical and non-musical, and does approach the subject from a musical perspective. While Chapuis's coverage is extensive, even his latest publications are more than a half-century old. I will present a number of examples not included in Chapuis that help illustrate the meanings of humanoid mechanical music. See Alfred Chapuis, and Edmond Droz. *Le monde des automates; étude historique et technique*, 2 vols. Paris: E. Géli, 1928. Alfred Chapuis and Edmond Droz, *Automata: A Historical and Technological Study*, trans. Alec Reid (Neuchâtel: Editions du Griffon, 1958). Alfred Chapuis, *History of the musical box and of mechanical music* [1955], trans. Joseph E. Roesch (Summit, N.J.: Musical Box Society International), 1980. Other historical surveys of automata include articles by Silvio Bedini and most recently by Jessica Riskin. See Silvio A. Bedini, "The Role of Automata in the History of Technology," *Technology and Culture* 5, no. 1 (1964): 24-42, and Jessica Riskin, "Machines in the Garden," *Republics of Letters: A Journal for the Study of Knowledge, Politics, and the Arts* 1, no. 2 (2010): <http://rofl.stanford.edu/node/59>. Since both writers come from the history of technology, their studies do not focus on musical automata. I am especially indebted to Riskin's article for information on automata in the Middle Ages and in the church. Minsoo Kang examines the history of thinking on automata, but again not from a musical perspective. See Minsoo Kang, *Sublime dreams of living machines: the automaton in the European imagination* (Cambridge: Harvard University Press, 2011). Literature on the history of mechanical music in box form is more extensive but does not allow for conclusions relevant to human performance. See for example Arthur W.J.G. Ord-Hume, "Cogs and Crotchets: A View of Mechanical Music," *Early Music* 11, no. 2 (1983): 167-171.

universe as a mechanical clock set in motion by God, in which the wheels move harmoniously together."⁴⁶

Clockwork machines were hardly toys build for amusement. Moevs notes that "[a]lready in the thirteenth century, those who sought to create mechanical astronomical clocks and perpetual motion machines were seeking to recreate the perfect and continuous motion of the spheres . . . "⁴⁷ To understand fully the meanings of musical automata we must gaze back to the ancestors of Mälzel's trumpeter, living on the edge of a fifteenth-century choir book and in the workshops of Renaissance Nuremberg.

Evolving Automata

The dream of an automaton musician is an old one; no period of history can claim to have initiated the close relations between music and machines. In ancient China androids performed for rulers while Western classical philosophers envisioned self-performing lyres. Aristotle speaks of a musical machine in the same sentence where he proposes a loom that could weave on its own—a prophetic foreshadowing of pre-industrial inventions:

For if every instrument could accomplish its own work, obeying or anticipating

⁴⁶ Christian Moevs, "Miraculous Syllogisms: Clocks, Faith and Reason in Paradiso 10 and 24," *Dante Studies* 117 (1999): 65.

⁴⁷ Ibid., 64.

the will of others, like the statues of Daedalus, or the tripods of Hephaestus, which, says the poet, of their own accord entered the assembly of the Gods; if, in like manner, the shuttle would weave and the plectrum touch the lyre without a hand to guide them, chief workmen would not want servants, nor masters slaves.⁴⁸

Aristotle references the famed moving statues created by Daedalus—early mythic “androids” known as perfect servants except that, according to Plato, they tended to run away if not kept tethered.⁴⁹

Here we already find automata treated as an embodiment of existential contradictions, an object without consciousness who nonetheless longs for freedom. The constant instability and uncertainty surrounding mechanical human figures (do androids possess free will like us, or are our souls material like robots?) made these creatures the source of sustained fascination.

Hydraulic Machines (5,000 BCE – c. 1350)

Actual mechanical musicians appear more than a thousand years before the era of the famed eighteenth-century inventor Jacques de Vaucanson.

⁴⁸ Aristotle, *Aristotle politics*, trans. Benjamin Jowett (Cambridge: Harvard, 1977), 5.

⁴⁹ Plato, *Plato's Meno*, trans. Dominic Scott (Cambridge: Cambridge University Press, 2006), 178.



(Figure 1) Mechanical musicians on a barge of al-Jazari. Folio from an *Automata* by al-Jazari (A.D. 1206); Early 14th century (1315), Copied by Farrukh ibn Abd al-Latif. Freer Gallery of Art, Smithsonian Institution, Washington, D.C.: Purchase, F1930.73.

In China an orchestra of about automatic twelve musicians dressed to resemble living contemporaries performed around 206 BCE.⁵⁰ We find a similar instance of a group of mechanical musicians exactly a thousand years later in a book by the Mesopotamian engineer al-Jazari (1150-1220), who in 1206 drew plans for a water-powered band of

⁵⁰ Joseph Needham, *Science and Civilization in China*, vol. 4, *Physics and Physical Technology*, Part 2, *Mechanical Engineering* (Cambridge: Cambridge University Press, 1965), 158.

mechanical musicians (Figure 1).⁵¹ The engineer whose work would inspire the mechanics of the Italian Renaissance, Hero of Alexandria (ca. first century CE), left designs for singing birds and a mechanical puppet theater in his treatises, *Pneumatics* and the *Automatic Theater*.⁵² These early examples confirm that throughout human history musical performance remained intimately bound to mechanics and technology. Musical instruments fabricate the human voice. An instrumentalist, producing a voice through both the human body and machine evokes the fabrication of the human as well.⁵³

While verifying the existence of musical automata proves difficult for earlier periods, the clear and relatively uncomplicated instructions for the design of water-powered musical machines left by Hero of Alexandria make it perfectly plausible that a written report describing a water-powered, trumpet-blowing angel in the thirteenth century is based on fact. This early example of a mechanical trumpeter was apparently

⁵¹ Alfred Chapuis and Edmond Droz, *Le monde des automates; étude historique et technique*, 2 vols. (Paris: E. Géli, 1928), 54.

⁵² Alfred Chapuis and Edmond Droz, *Le monde des automates; étude historique et technique*, 2 vols. (Paris: E. Géli, 1928), 36-42. Also see Minsoo Kang, *Sublime Dreams of Living Machines: The Automaton in the European Imagination* (Cambridge: Harvard University Press, 2011), 16.

⁵³ Abbate writes that “nowhere is our machinelike status more clear than in a musical performance in which someone plays someone else’s work (playing one’s own work, or singing, as we shall see, may be a different matter).” Carolyn Abbate, “Outside Ravel’s Tomb,” *Journal of the American Musicological Society* 52, no. 3 (1999): 477.

executed by a Frenchman who had traveled far from home. On a diplomatic mission to the Mongols, William of Rubruck (ca. 1220-1293) found a “mechanical liquid-dispensing tree with automata of lions, serpents, and a trumpet-blowing angel,” built by William Buchier, a Parisian expatriate at the Mongolian court in Karakorum.⁵⁴ In Buchier’s angel, sophisticated mechanics recreated the seemingly miraculous movements of an angel.

At the cathedral museum in Lucca, Italy, I was delighted to encounter on the edge of beautifully illuminated late fifteenth-century choir book an illustration of a little trumpet-blowing angel on a statue pedestal (Figure 2). This angel matches the description of both Buchier’s angel and Hero’s instructions. At the base of the statue is a pool of water, and the column on which the figure stands could serve as an air shaft. The illustration in the Lucca choir book could have been painted by an artist familiar with the reports of Buchier’s automata, or based on an actual automaton trumpet player. Either way, it is fascinating to imagine a choir gazing at this image of a mechanical musician as they performed.

⁵⁴ Merriam Sherwood, “Magic and Mechanics in Medieval Fiction,” *Studies in Philology* 44, no. 4 (1947): 572. Also see Chapuis, *Le Monde*, 63 and Kang, *Sublime Dreams*, 64.



(Figure 2) Antifonario no.5, late fifteenth century. Photo by Lucio Ghilardi. Courtesy Complesso Museale e Archeologico della Cattedrale di Lucca.

Pre-Android Clockwork Automata (1300-1500)

Automata were fairly rare in Europe before the advent of clock-making in the later middle ages.⁵⁵ Minsoo Kang, the author of a recent and comprehensive survey of

⁵⁵ Sherwood, *Magic and Mechanics*, 576. Sherwood refers to a “Mechanical rebirth” in the thirteenth century.

the history of automata, states that “[i]n the medieval period there is no significant report of an actual automaton or mechanical description of one . . . in western Europe until the thirteenth century.”⁵⁶ Soon, however, automata were sprouting all over Europe. Medieval mechanical devices included moving angels, saints, and of course devils.

Jessica Riskin discusses machines of the later medieval period, pointing out that in the fourteenth and fifteenth centuries automata were entertaining, unpredictable, and common.

These machines fell into two main categories: the great many devices to be found in churches and cathedrals, and the automatic hydraulic amusements on the grounds of palaces and wealthy estates. Neither category of contraptions signified, in the first instance, what machine metaphors for living creatures later came to signify: passivity, rigidity, regularity, constraint, rote behavior, soullessness. Rather, the machines that informed the emergence of the early modern notion of the human-machine held a strikingly unfamiliar array of cultural and philosophical implications, notably the tendencies to act unexpectedly, playfully, willfully, surprisingly, and responsively [. . .]

Automata were therefore theologically and culturally familiar, things with which one could be on easy terms. They were funny, sometimes bawdy, and they were everywhere.⁵⁷

⁵⁶ Kang, *Sublime Dreams*, 61.

⁵⁷ *Ibid.*, 16-17.

However, it was possible to go too far. During the Reformation, automata in churches suffered a predictable backlash; a moving figure of Jesus, for instance, raised fears of idolatry.⁵⁸

The technology of clockwork was deeply bound to music from its infancy; organ builders were among the first to build mechanical clocks. Christian Moevs describes early mechanical clocks in monasteries: “Sets of tuned bells, sometimes set in wheels (as a *rota tintinnabulis plena*), had been in use for at least three centuries, perhaps as wake-up signals; by the opening years of the 1300s they were being attached to clocks to produce music, and clocks themselves were being attached to clocks to produce music, and clocks themselves were being built by organists.”⁵⁹ Music inhabited clocks, and mechanical figures populated organs.

Europeans in the period before the Reformation were accustomed to mechanical figures as an integral part of the performance of sacred music. Automata were often attached to church organs; indeed, along with clocks, organs were the main site to encounter moving figures of humans or angels.⁶⁰ Another strange and fascinating

⁵⁸ Jessica Riskin, “Machines in the Garden,” *Republics of Letters: A Journal for the Study of Knowledge, Politics, and the Arts* 1, no. 2 (2010), <http://rofl.stanford.edu/node/59>, 27-28.

⁵⁹ Christian Moevs, “Miraculous Syllogisms: Clocks, Faith and Reason in Paradiso 10 and 24,” *Dante Studies* 117 (1999): 61.

⁶⁰ “Apart from church clocks, the other prime spot for mechanical figures was church organs.” Riskin, “Machines in the Garden,” 22.

phenomenon involved heads or figures that would react to organ music, creating a theatrical spectacle for a congregation at prayer. Again we find innate connections between musical experience, spiritual experience, and the mechanical.

Edwin H. Zeydel writes that “[a]s late as 1494, when Sebastian Brant wrote his *Narrenschiff*, the cathedrals of Strassburg and Orleans proudly displayed their bearded organ ape, a mannikin attached to the organ pipes, who, as the sonorous, heavenly music welled aloft, took in and emitted some of the air pressure from the pipes and thus mechanically indulged in the wildest antics that amused the pious even as they prayed.”⁶¹ Riskin finds numerous examples of these emotive yet mechanized figures who responded in some human-like sense to the organ music in churches.

Other organs sported disembodied heads that frowned, contorted their faces, rolled their eyes, stuck out their tongues and opened and closed their mouths as the music played. A colossal automaton head animated the church organ in Neustadt-an-der-Harth in Bavaria, and others were to be found across Germany and the Low Countries from the fifteenth century. From the organ gallery of the cathedral in Barcelona, the head of a moor hung by its turban. It made mild facial expressions when the music played softly; when the strains grew louder, it rolled its eyes and grimaced as though in pain. And in the Cloître des Augustins in Montoire, in the Loire Valley, a mechanical head on the organ gallery gnashed its teeth with a noisy clatter.⁶²

⁶¹ Edwin H. Zeydel, "Were Hrotsvitha's Dramas Performed during her Lifetime?" *Speculum* 20, no. 4 (1945), 453-454.

⁶² Riskin, "Machines in the Garden," 23.

The congregation's emotional reaction to the music, coupled with the spiritual experience of the mass itself, would therefore be mediated by these mechanical heads. To be sure, these heads do not themselves produce music; instead, these automata mimic—and in some manner perform—the emotional response of audience members.

Androids (1500 – 1830)

The tradition that led to the creations of Vaucanson and the Jaquet-Droz family—a free-standing instrumental automaton in human form—can be traced back to Renaissance Nuremberg. Clockwork androids entered the world already performing music. Hanns [*recte* Jacob] Büllmann (d. 1535), a padlock-maker in Nuremberg, created androids that walked on their own and plucked a lute.⁶³ Chapuis states that “the two premier pioneers that we know of from the sixteenth century among those that constructed actual androids are Hans BULLMANN (*sic*) and Gianello dela TORRE

⁶³ Recent information on Büllmann relies exclusively on an eighteenth century text by Johann Gabriel Doppelmayr. Doppelmayr virtually copied Neudörffer's entry on Büllmann word for word in his 1730 *Historische nachricht*, 285. Every modern source mentioning Büllmann that I have seen cites Doppelmayr and does not mention Neudörffer or Lochner's notes on Neudörffer, including Chapuis *Le Monde*, Riskin *Machines in the Garden* and Silvio A. Bedini, “The Role of Automata in the History of Technology,” *Technology and Culture* 5, no. 1 (1964): 24-42. Apparently Neudörffer erred in calling Büllmann “Hanns.” Dr. G. W. K. Lochner, the city archivist of Nuremberg who produced a printed edition of Neudörffer's work, cites documents proving that Büllmann's first name was in fact Jacob. Lochner also unearths another fascinating document: apparently Büllmann's widow was involved in a monetary dispute over a *gehend Jungfraubild*, a moving image of a girl. Johann Neudörffer, *Des Johann Neudörffer Schreib-und Rechenmeisters*, 65-66. This document, a source independent of Neudörffer, corroborates the existence of walking clockwork androids created by Büllmann.

[Turriano].”⁶⁴ Büllmann predates Turriano, who was born in Cremona between the years 1500-1515. Hence Büllmann’s lute and drum-playing figures the oldest verifiable free-standing clockwork androids.⁶⁵

Johann Neudörffer (1497-1563), an important scribe who wrote a book about artists and artisans in Nuremberg, reported as follows on Büllmann and his automata:

This Büllmann [*sic*], although he was not practiced in writing and reading, nonetheless became skilled in Astronomy, he produced a model of the movement of the planets in clockwork of 80 pound weight, a kind that no one before him had done. He also made images of men and women from clockwork that went around and beat time on the lute and drums. King Ferdinand, for who he did much work, called him to Vienna, only so he could show his majesty a piece of clockwork.⁶⁶

⁶⁴ “Les deux premiers chercheurs que nous conaissons au XVIe siècle parmi ceux qui paraissent avoir construit de véritables androids, sont Hans BULLMANN et Gianello dela TORRE.” Chapuis, *Le Monde*, 181. Historical sources spell “Juanelo Turriano” in many ways.

⁶⁵ Elizabeth King, “Clockwork Prayer: A Sixteenth-Century Mechanical Monk,” *Blackbird* 1, no. 1 (2002), http://www.blackbird.vcu.edu/v1n1/nonfiction/king_e/prayer_print.htm.

⁶⁶ “Dieser Büllmann, ob er gleich Schreibens und Lesens nicht geübt gewest, ist er doch in der Astronomie fast künstlich und gelehrt gewest, derhalben er auch mit 80 Pfd. Gewicht die Theoriam planetarum in Gang und Uhrwerk bracht hat, welches dann vor ihm Niemand hat thun mögen. Er macht auch für Uhrwerk Manns und Weibs Bilder die umgingen und schlugen ihre Mensur auf der Lauten und Pauken. König Ferdinandus, dem er viel Arbeit gemacht, liess ihn in seinem hohen Alter auf einer Sänften zu ihm gen Wien bringen, allein darum, dass er seiner Majestät ein Uhrwerk zeigte.” Johann Neudörffer, *Des Johann Neudörffer Schreib-und Rechenmeisters*, ed. Georg Wolfgang Karl Lochner (Wien: W. Braumüller, 1875), 65-66.



(Figure 3) A lute-playing lady likely built by Turriano, one of the oldest androids still in existence (later 16th century).⁶⁷ Kunsthistorisches Museum, Vienna.

Büllmann did not simply design toys for the amusement of the wealthy; this self-educated artisan built a clock that modeled the movements of the planets. Just as Büllmann assumed in his clocks the guise of a creator reconstructing the order of the universe, he recreated similarly the form and independent movement of a human

⁶⁷ For more about the two existing automata attributed to Turriano see Elizabeth King, “Clockwork Prayer: A Sixteenth-Century Mechanical Monk,” *Blackbird* 1, no. 1 (2002), http://www.blackbird.vcu.edu/v1n1/nonfiction/king_e/prayer_print.htm. The Kunsthistorisches Museum does not label the work as by Turriano but states that the lute player dates from the second half of the sixteenth century and may be Spanish.

being. Fashioning a model of human movement and engaging questions of the self and the human body, proved just as serious a cultural pursuit as building a model universe.

That his automata also played instruments would have reminded listeners of the celestial harmony underlying the order of the cosmos. As Christian Moevs explains, since the time of Dante “clocks were associated not only with monastic life, but also with human intellect and artistry, as an image or model of divine intelligence and cosmic artistry.”⁶⁸

Renaissance/Early Baroque Grottos (1580-1700)

Just after Büllmann the gardens of the great European houses staged spectacles of a mechanical and musical microcosm. These Renaissance grottos—the veritable opera of automaton musicians—featured a range of scenes based on classical mythology performed on contemporary musical instruments. Alfred Chapuis explains that “[i]n general these machines were connected with fountains or organs, making human figures and animals move, sound trumpets, and produce bird songs.”⁶⁹

⁶⁸ Christian Moevs, “Miraculous Syllogisms: Clocks, Faith and Reason in Paradiso 10 and 24,” *Dante Studies* 117 (1999): 59.

⁶⁹ Alfred Chapuis and Edmond Droz, *Automata: A Historical and Technological Study*, trans. Alec Reid. Neuchâtel: Editions du Griffon, 1958: 40.



(Figure 4) The Grotto of Orpheus drawn by Salomon de Caus, 1624. ETH-Bibliothek Zürich, Alte und Seltene Drucke.

The hydraulic mechanism, often an organ, gave life to the miniature worlds of the grottos. A drawing in a work by Salomon de Caus (1576-1626) depicts plans for a mechanical Orpheus playing a bass viol (Figure 4).⁷⁰ *Le Monde des Automates* describes the scene: “at the center of the grotto, Orpheus plays his instrument while all the

⁷⁰ Salomon de Caus, *Les Raisons des forces mouvantes, avec diverses machines tant utiles que plaisantes* (Paris: Hierosme Drouart, 1624), 142.

charmed animals around him move in diverse ways via the power of the machine that activates the organ.”⁷¹ In another grotto a nymph with moving fingers played the organ.⁷² A drawing of de Caus shows a satyr playing a shawm, the satyr figure similar to Jacques de Vaucanson’s canonic flute player of 1738 (Figure 5).⁷³

Many of the automata discussed previously (the mechanical heads on organs, or the androids of Büllmann) are either presented in the context of the church, or as small replicas of divine creation. These grotto automata evoke Classical mythology instead of Christian tradition. The aristocratic owners of these grottos enchanted visitors with a spectacle of classical antiquity not only brought to life but endowed with a musical voice.

⁷¹ Ibid., 110. “Au centre de la grotte, Orphée joue de son instrument pendant qu’autour de lui les animaux charmés se livrent à divers mouvements par l’effet de la machine qui actionne l’orgue.” Chapuis, *Le Monde*: 81.

⁷² Alfred Chapuis and Edmond Droz, *Automata: A Historical and Technological Study*, trans. Alec Reid (Neuchâtel: Editions du Griffon, 1958), 44.

⁷³ Ibid., 40.

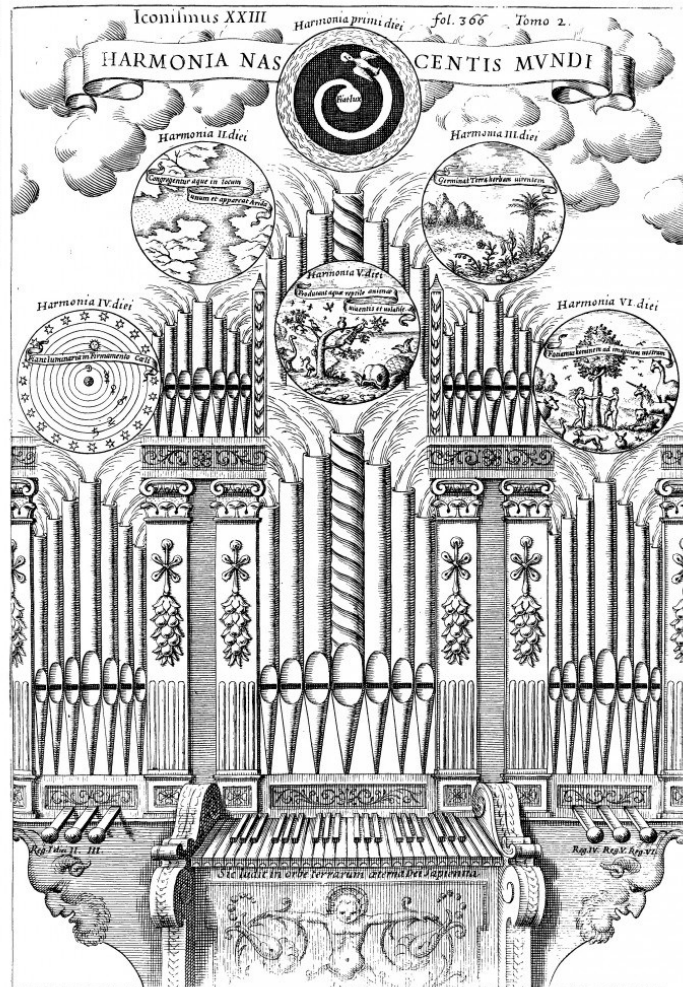


(Figure 5) Shawm-playing satyr drawn by Salomon de Caus, 1624. ETH-Bibliothek Zürich, Alte und Seltene Drucke.

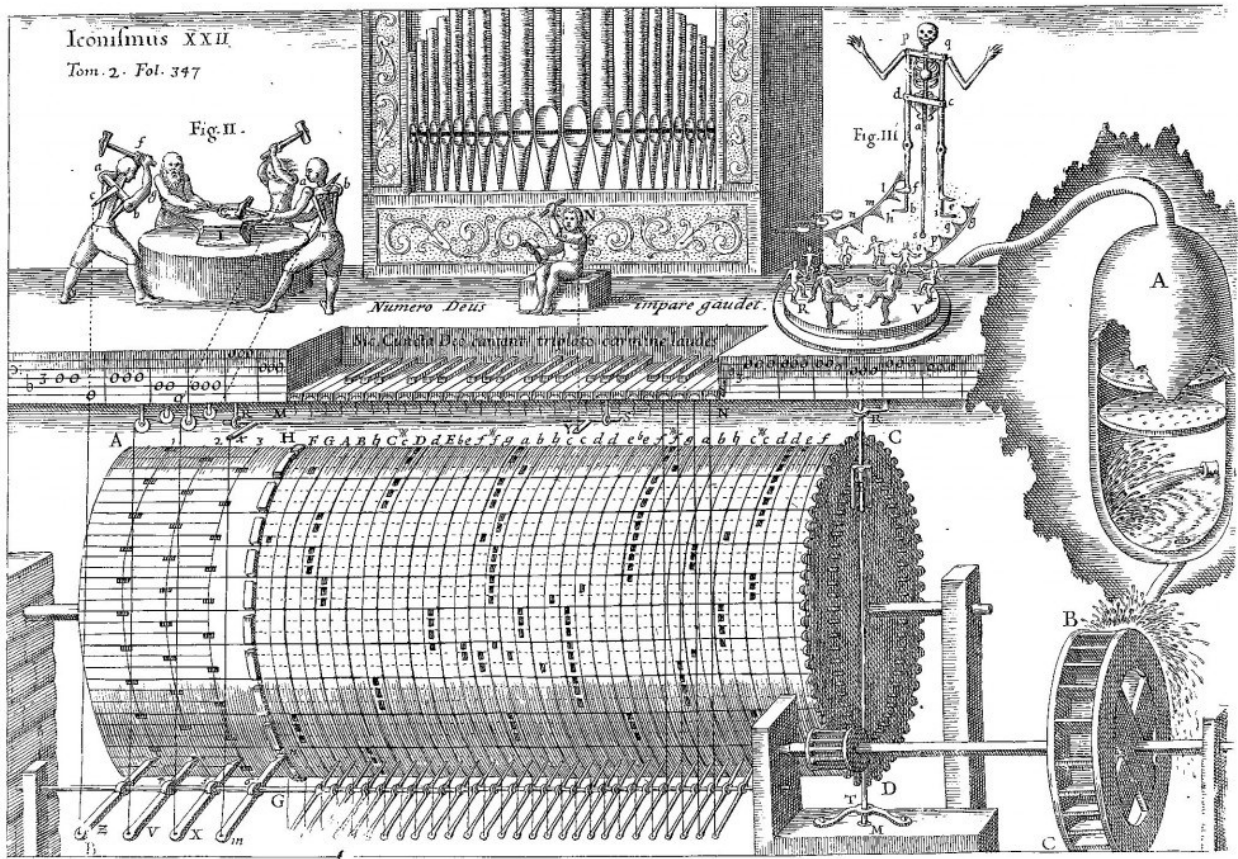
The Automaton's Intellectual Reign

Grottos immediately preceded a new wave of seventeenth-century thinking in which intellectuals actively promoted the concept of a mechanical world. Acoustics and music were deemed essential to deciphering the complex machinery of life. The Jesuit Athanasius Kircher (1602-1680) famously conceived of the world as an organ (Figure 6).

This trope represented a poetic version of the governing conception of the earth as a clock, and he places music at the center the world's generative powers. Kircher



(Figure 6) Harmony of the birth of the world, *Musurgia universalis*, vol.2, p. 366. Courtesy Department of Special Collections, Stanford University Libraries.



(Figure 7) One of Kircher's mechanical organs as recorded by Schott. Kaspar Schott, *Mechanica Hydraulico-Pneumatica*, p. 428, Courtesy Department of Special Collections, Stanford University Libraries.

himself built hydraulic organs, complex mechanical machines driven by water, sometimes with human figures attached (Figure 7). He also wrote extensively on mechanical musical instruments and acoustics.

Kircher's disciple Gaspar Schott (1608-1666), another Jesuit, explored the practical and spiritual sides of mechanical music, illustrating some of Kircher's creations in writing as well as describing a Büllmann-esque android:

[W]e have seen in Palermo in Sicily at the house of the most reverend lord Abbot Gieze among other rare and cunningly made things a girl in the form of a statue, who played the lute (cithara) and pulsed harmoniously and danced to the melody, roaming around the table, and when the song ended greeted those present with a bow.⁷⁴

In an influential work on science the Englishman John Wilkins (1614-1672), bishop of Chester, also addresses automata. In the chapter titled “[o]f the Moveable and Gradient Automata, representing the Motions of Living Creatures, various Sounds, of Birds, or Beasts, and some of them Articulate,” Wilkins states that “[t]here have been some artificial Images, which besides their several Postures in walking up and down, have been made also to give several sounds.”⁷⁵ Wilkins also refers to the work of Kircher.⁷⁶

However much Kircher’s conception of a world organ enthrones music as the fundamental emanation of our earthly sphere, the idea of the human body as a machine develops in the hands of secular philosophers. The most famous mechanist thinker of this period is René Descartes (1596-1650), who describes the human body using the

⁷⁴ “Vidimus & nos Panormi in Sicilia apud Reverendissimum D. Abbatem Giezi inter alia multa, rara, atque artificiosa, puellari formâ statuam, quae citharam concinnè atque harmonicè pulsabat, & ad numeros saltabat, per mensam discurrendo, & cantilenâ cum saltu finitâ ad circumstantes conversa eosdem cum inclinatione salutabat.” Translation by Joel Fredell. Gaspar Schott, *Magia Universalis Naturae Et Artis* (Bamberg: Schönwetter, 1677), 24-25.

⁷⁵ John Wilkins, *The mathematical and philosophical works of the Right Reverend John Wilkins late Lord Bishop of Chester* (London: J. Nicholson at the King’s-Arms, 1707), 102-104.

⁷⁶ *Ibid.*, 103.

term automaton, though with a soul attached to it (in Cartesian thinking, animals are simply automata).⁷⁷

Writing in 1748—almost a century after Descartes—the most notorious of the mechanist philosophers, Julien Offray de La Mettrie, questions the notion of a managerial soul delivering rational instructions to the body, believing even the soul to be mechanical. In response to the thesis that the executive soul controls the automaton of the body—an idea at odds with Descartes—La Mettrie offers a practical refutation to materialism as philosophy. Arguing against the thinking of Georg Ernst Stahl (1659 - 1734), La Mettrie writes:⁷⁸

To refute Stahl's hypothesis, one need not go to the lengths of our predecessors.
All you need to do is watch a violinist. What suppleness! What agile fingers!
They go so fast that they almost seem not to move at all. Now I ask, or rather

⁷⁷ See for instance article six of *The Passions of the Soul*. "Therefore, so that we may avoid this error, let us consider that death never occurs through the fault of the soul, but only because one of the principal parts of the body disintegrates. And let us judge that the body of a living man differs from that of a dead man as much as a watch or other automaton (that is, other self-moving machines), when it is wound and contains the bodily principle of the movements for which it is constructed, along with everything required for its action, [differs from] the same watch or other machine when it is broken and the principle of its movement ceases to act."

René Descartes, *The Passions of the Soul* [1649], trans. Stephen H. Voss (Indianapolis: Hackett, 1989), 21.

⁷⁸ Georg Ernst Stahl (1659-1734) studied "medicine, anatomy and botany" at the University of Jena between 1679 and 1683. In his 1684 doctoral thesis "Stahl distinguished between 'animated bodies' that have a regulating soul, the *Dirigens microcosmicum*, and 'aggregates' of a more or less confused order." Stahl was one of many thinkers of the period engaged with Descartes's soul/body dualism. See Tobias Cheung, "From the Organism of a Body to the Body of an Organism: Occurrence and Meaning of the Word 'Organism' from the Seventeenth to the Nineteenth Centuries," *The British Journal for the History of Science* 39, no. 3 (2006): 328-9.

defy those Stahlans who know so much about our soul's abilities, to tell me how the soul could possibly command the execution so quickly of so many movements at a distance in so many different places in the body. If this were possible, it would imply that a flute player could execute brilliant trills on an infinity of stops he does not even know and could not even finger.⁷⁹

La Mettrie points to instrumental virtuosity in the production of music as a revelation of our true mechanical nature. Rational thought cannot be in control of our body since a violinist can play much faster than anyone can think. Instrumental virtuosity represents human expression outside the control of reason; that extraordinary expression, endowed with the highest "virtue," is itself mechanical.

A recent spectacle in Paris also thrilled La Mettrie: two incredible musical automata and a mechanical duck built by an inventor whom Voltaire hailed as the rival of Prometheus.⁸⁰ Jacques de Vaucanson (1709-1782) replicated a statue by Antoine Coysevox entitled *Shepherd Playing the Flute* (now at the Louvre) for his first automaton; the duck and a fife and drum player soon followed.⁸¹ The *Flûteur automate* played

⁷⁹ Julien Offray La Mettrie, *Man a Machine and Man a Plant*, trans. Richard A. Watson and Maya Rybalka (Indianapolis: Hackett, 1996), 66.

⁸⁰ "Le hardi Vaucanson, rival de Prométhée,/ Semblait, de la nature imitant les ressorts,/ Prendre le feu des cieux pour animer les corps." Voltaire, "Discours en vers sur l'homme" [1738], *Oeuvres complètes* (Paris: Garnier Frères, 1877), 9: 420. Other celebrated literary works surrounding the Prometheus myth in this period include Goethe's *Prometheus*, fraught with revolutionary overtones, set by Schubert (D. 674) and Mary Shelley's *Frankenstein; or, The Modern Prometheus*.

⁸¹ Jessica Riskin, "The Defecating Duck, or, the Ambiguous Origins of Artificial Life," *Critical Inquiry* 29, no. 4 (2003): 613.

melodies by breathing air through a conventional flute and gained so much fame that the production of sophisticated musical automata continued well into the nineteenth century.⁸² Vaucanson analyzed the physics of flute playing and was able to imitate the sound of a human playing the flute so precisely that his shepherd astounded Paris. The *Mercure de France* reported in April 1738 that:

[o]ne 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. Variations [Doubles], so attractive on this instrument, have not been omitted, and everything, including crescendi, diminuendi, and even sustained notes, is executed with the most perfect good taste.⁸³

The android's fingers played a real flute and varied the amount of air coming through the embouchure. Even the royal censor raved in approbation when Vaucanson published a treatise on his study of flute playing and the techniques employed in producing his automata:

M. Vaucanson explains in his memoir [sic] the physical principals [sic] that he used to invent and execute his automaton, which is one of the most marvelous productions of art. It imitates so perfectly a real flute player that the public continues to see and hear it with admiration. Thus we believe that the impression

⁸² For a recent discussion of Vaucanson see Jessica Riskin, "The Defecating Duck, or, the Ambiguous Origins of Artificial Life," *Critical Inquiry* 29, no. 4 (2003): 599-633. The production of automata is covered in detail in Alfred Chapuis and Edmond Droz, *Le monde des automates; étude historique et technique*, 2 vols. (Paris: E. Géli, 1928).

⁸³ Kang, *Sublime Dreams*, 103.

of the memoir of M. Vaucanson will be very useful for satisfying the curiosity of the public. Paris, June 1738. H Pitot.⁸⁴

Vaucanson's clockwork grew out of an artisan tradition closely linked to the making of keyboards.⁸⁵ In this pre-industrial stage, clocks and keyboards represented the forefront of technological innovation. Indeed, clocks and keyboards were hardly separate entities: makers inserted little harpsichords and organs into clocks, while Handel, Haydn, Mozart, and Beethoven all composed for the musical clock.⁸⁶

Hence as we enter the eighteenth century, machine-men occupy the minds of intellectuals, and acoustics are imbued with spiritual mystery. This cursory survey of clockwork musicians before the "age of automata" sets the stage for the period from 1740-1830. The last half of the eighteenth century witnessed increasing fascination with, and anxiety over, the perceived mechanical nature of music. Instrumentalists harnessed

⁸⁴ "M Vaucanson, expose dans son Memoire les principes Phisiques qui'il a employés pour l'invention & l'exécution de son Automate, qui est une des plus merveilleuses productions de l'art; il imite si parfaitement le vrai Joueur de Flute, que le Public continue de le voir & de l'entendre avec admiration; ainsi, nous croyons que l'impression du Mémoire de M. Vaucanson sera très utile pour satisfaire pleinement la curiosité du Public. Fait à Paris ce Juin 1738. H Pitot." Jacques de Vaucanson, *Le Mécanisme du Fluteur Automate: An Account of the Mechanism of an Automaton or Image Playing on the German-Flute*[1742], ed. David Lasocki, trans. J.T. Desaguiliers (Buren: Frits Knuf, 1979), unpaginated.

⁸⁵ Vaucanson's input into textile machinery will be discussed in chapter four.

⁸⁶ George Frideric Handel, Seven Pieces for Musical Clock HWV 598-604; Josef Haydn, 32 Pieces for Flute-Clock, Hob. XVIII: 1-32; W.A. Mozart, Fantasie K. 608, also K. 594 and K. 616; Ludwig van Beethoven, Musical Clock Pieces WoO 33 no 1 & 2. Also see Annette Richards, "Automatic Genius: Mozart and the Mechanical Sublime," *Music and Letters* 80, no. 3 (1999): 366-389.

both the mystical power of the android and the distrustful fervor born of industrialism,
speaking in a musical dialect that moved far beyond the imitation of language.

Chapter 3

Liminal Heroes of the Concert Hall

Late eighteenth- and early nineteenth-century repertoire is intimately linked to instrumental performance and technological advancement. Just like people at the onset of the Industrial Revolution, we face transformational waves of technology along with the continued problematization of robots in industry and androids in art and fiction. We instrumental performers need to understand how instrumental music engages with the core issues of an industrialized society and explores the limits of human identity. Otherwise we will cede needlessly much of the cultural power we hold.

A violinist in 1825 performed a ritual within a newly-industrialized community. Audiences watched an instrumentalist who was, in essence, “programmed” by a composer, and the programmed performer created a product—the performance—through the mediation of the instrumental machine.⁸⁷ With its demands for machine-like speed and accuracy, a virtuoso technique heightened these connections by surpassing the abilities of the human voice and challenging human limits.

Instrumental performance accrues critical social power by mediating the

⁸⁷ “Musical performance exists in a performance network in which a master voice animates a medium, the human performer, to reproduce his thoughts.” Carolyn Abbate, “Outside Ravel’s Tomb,” *Journal of the American Musicological Society* 52, no. 3 (1999): 477.

relationships between human and machine.⁸⁸ Androids and performers shared liminal qualities, and both mechanics and acoustics related to natural magic. A Paganini caprice invoked mechanical features of virtuosity that lay claim to a new level of power for the virtuoso.

An instrumental performer evokes a machine come to life. The musicologist Carolyn Abbate states that “nowhere is our machinelike status more clear than in a musical performance in which someone plays someone else’s work (playing one’s own work, or singing, as we shall see, may be a different matter).”⁸⁹ Our fascination with androids, as with instrumental performers, stems from the circumstance that the machinelike status of instrumentalists and their automata counterparts is unclear. Once we entertain the possibility of life and independent agency in both the automata and

⁸⁸ Grete Wehmeyer applies Max Weber’s seminal work *Die protestantische Ethik und der Geist des Kapitalismus* (*The Protestant Ethic and the Spirit of Capitalism*) to the pianist Carl Czerny’s etudes and studies. She argues that a diligent asceticism, the same spirit that Weber demonstrates originated in Protestant sects and then fueled the work ideology of capitalism, entered into the training of virtuosos. “On the foundations of diligence and work there will be technical perfection, absolutely pure and immaculate, in all details meticulously following the intention of the composer, who stands in for God’s word . . .” (“Auf der Basis von Fleiss und Arbeit wird eine technische perfekte, absolut saubere und makellose, in allen Einzelheiten minuziös mit dem Willen des Komponisten, der dann für Gottes Wort steht . . .”) While this line of argument may describe some traditions of instrumental training, dynamics in the concert hall remained more dependent on theatricality and magic than diligence. Grete Wehmeyer, “Die Einzelhaft am Klavier” in *Carl Czerny und die Einzelhaft am Klavier oder Die Kunst der Fingerfertigkeit und die industrielle Arbeitsideologie* (Basel: Bärenreiter, 1983), 163.

⁸⁹ Carolyn Abbate, “Outside Ravel’s Tomb,” *Journal of the American Musicological Society* 52, no. 3 (1999): 477.

performer, we can question whether a human performer transmits the machine voice of the composer or, like Plato's rebellious automaton, brings an illicit life to the mechanical medium.

An industrialized society witnesses a musician enacting a high-wire act between the mechanical and the human, and this performance rivets the attention of an audience already processing the tensions of modern life. The android and the virtuoso instrumentalist share a common space: the unstable threshold between human and machine, the rational and the irrational, the heroic and the demonic. They nullify the binaries that otherwise stabilize our thinking.

The notion of liminality in ritual and performance stems from an influential work by the French folklorist Arnold van Gennep. In his book, *The Rites of Passage*, van Gennep discusses

ceremonial patterns which accompany a passage from one situation to another or from one cosmic or social world to another. Because of the importance of these transitions, I think it legitimate to single out *rites of passage* as a special category, which under further analysis may be subdivided into *rites of separations*, *transition [liminal] rites*, and *rites of incorporation*.⁹⁰

The anthropologist Victor Turner used van Gennep's concept of liminality to theorize about liminality in performance and society. Turner states that "[p]rophets and artists

⁹⁰ Arnold van Gennep, *The Rites of Passage* [1908], trans. Monika B. Vizedom and Gabrielle L. Caffee (Chicago: University of Chicago Press, 1960), 10-11.

tend to be liminal and marginal people, 'edgemen' who strive with a passionate sincerity to rid themselves of the clichés associated with status incumbency . . . ”⁹¹

Turner’s work on liminality plays a central role in the current theory of performance, especially among scholars of theater.⁹²

Many of Turner’s statements on liminal characters fit perfectly a virtuoso in the mold of Paganini. Liminal people do not meld easily into the conventional structure of society. Instead “[l]iminal entities are neither here nor there; they are betwixt and between the positions assigned and arrayed by law, custom, convention. . . ”⁹³ A liminal person can be threatening and magical at the same time. Turner writes:

[o]ne may well ask why it is that liminal situations and roles are almost everywhere attributed with magico-religious properties, or why these should so often be regarded as dangerous, inauspicious or polluting to persons, objects, events, and relationships that have not been ritually incorporated into the liminal context.⁹⁴

We find the “magico-religious properties” referenced by Turner both in automata

⁹¹ Victor Turner, *The Ritual Process: Structure and Anti-Structure* (Chicago: Aldine, 1969), 128.

⁹² “The Victor Turner connection,” in Richard Schechner, *Performance Studies: An Introduction* (New York: Routledge, 2002), 16-19. Also see Henry Bial, ed., *The Performance Studies Reader* (New York: Routledge, 2004).

⁹³ Ibid., 95. For an application of this quote to androids, also classically liminal, see Minsoo Kang, *Sublime dreams of living machines: the automaton in the European imagination* (Cambridge: Harvard University Press, 2011), 35.

⁹⁴ Ibid., 108-9.

and in the enchanted virtuoso of early industrialism. Yet the spiritual power invested in automata dissipated as androids emerged as a symbol of the new era of production. Virtuosos became the living point of focus at the threshold of the human and the mechanical.

Music as Natural Magic

Musical instruments are machines, both the most common machines to appear across social classes and among the most complex machines in Europe before the nineteenth century. In the period leading up to 1826, musicians were intimately involved with the pre-industrial concept of machines as musical instruments. Francois Tourte (1747-1835), whose recurved design for violin bows continues to set the bow-making standard into the present day, apprenticed for eight years as a clock-maker.⁹⁵ Clocks and organs (as well as clock-organs) represented the pinnacle of eighteenth-century technological complexity.

Furthermore, because pre-modern thinkers did not fully understand acoustics, the nature of a wooden or metal object producing wonderful sounds possessed the aura of the divine or the magical, as was the case with early theatrical machines. Elisabeth Le Guin notes that “marvels made possible through mechanical execution . . . were

⁹⁵ Robin Stowell, *Violin Technique and Performance Practice in the Late Eighteenth and Early Nineteenth Centuries* (Cambridge: Cambridge University Press, 1985), 18.

enthusiastically welcomed into eighteenth-century esthetics for their capacity to promote the sense of wonder.”⁹⁶ David Brewster (1781-1868) points to these very features of musical instruments in his *Letters on Natural Magic, addressed to Sir Walter Scott*:

Among the discoveries of modern science there are few more remarkable than those which relate to the production of harmonic sounds. We are all familiar with the effects of musical instruments, from the deep-toned voice of the organ to the wiry shrill of the Jew’s harp. We sit entranced under their magical influence, whether the ear is charmed with the melody of the sounds, or the heart agitated by the sympathies which they rouse. But though we may admire their external form, and the skill of the artist who constructed them, we never think of inquiring into the cause of such extraordinary combinations.⁹⁷

Brewster here moves from the “magical” powers of music to the underlying question of the metaphysical source for physical sound. The human performer, and human identity itself as a mediating mechanism for musical “magic,” becomes an essential trope. The operator of the musical machine—the performer—occupies a liminal space between machine and human, as the human performer’s body becomes an instrument of musical production along with the musical instrument.

⁹⁶ Elisabeth Le Guin, *Boccherini’s Body: An Essay in Carnal Musicology* (Berkeley and Los Angeles: University of California Press, 2006), 147.

⁹⁷ David Brewster, *Letters on Natural Magic, addressed to Sir Walter Scott* (New York: Harper and Brothers, 1843), 167.

Through the mediation of a machine the human uses the body to create sound that is not language. A performing musician whose body joins with a machine in musical production is therefore the perfect subject for an android. Androids break through our binary conceptions of life and death, human and object, and raise the possibility that we are indeed machines programmed by some outside source—clockwork subjects of a clockwork universe.⁹⁸

One key to understanding this fascination in the period from ca. 1750-1830 is music's association with emerging scientific knowledge—science that also exuded an aura of magic. Uncovering the mysteries of acoustics carried the force of revelation. Rebecca Wolf explains how musical automata were regarded as experiments in the science of acoustics.⁹⁹ Jacques de Vaucanson presented his famous flute automaton to the French Academy of Science as a scientific exploration of acoustics and the mechanics of flute playing.¹⁰⁰

⁹⁸ For an excellent discussion of the liminal nature of robots, which my argument builds on, see Minsoo Kang, "The Power of the Automaton," in *Sublime dreams of living machines: the automaton in the European imagination* (Cambridge: Harvard University Press, 2011), 14-54.

⁹⁹ Rebecca Wolf, *Friedrich Kaufmanns Trompeterautomat: Ein musikalisches Experiment um 1810* (Stuttgart: Franz Steiner Verlag, 2011).

¹⁰⁰ Jacques de Vaucanson, *Le Mécanisme du Fluteur Automate: An Account of the Mechanism of an Automaton or Image Playing on the German-Flute* [1742], ed. David Lasocki, trans. J.T. Desaguiliers (Buren: Frits Knuf, 1979).

Automata and musical androids fell into the category of natural magic, which itself was the subject of intense scientific inquiry during the period. Natural magic was in fact, according to contemporary writers, a form of performance that harnessed the wonders of the earth to astonish onlookers. David Brewster claims that natural magic, such as optical illusions and automata, was used as a political tool throughout history. Rulers who were losing support of their people, Brewster states, could use natural magic to deceive the common person into believing that the ruler was backed by the supernatural: “[t]he prince, the priest, and the sage were leagued in a dark conspiracy to deceive and enslave their species.”¹⁰¹

Brewster includes a chapter centered on musical automata, and includes musical instruments in his discussion. He draws an explicit link between mechanical spectacle of the eighteenth-century and the dawn of industrialism:

The passion for automatic exhibitions which characterized the 18th century, gave rise to the most ingenious mechanical devices, and introduced among the higher orders of artists habits of nice and accurate execution in the formation of the most delicate pieces of machinery. The same combination of the mechanical powers which made the spider crawl, or which waved the tiny rod of the magician, contributed in future years to purposes of higher import. Those wheels and pinions, which almost eluded our senses by their minuteness, reappeared in the stupendous mechanism of our spinning-machines and our steam-engines.¹⁰²

¹⁰¹ David Brewster, *Letters on Natural Magic, addressed to Sir Walter Scott* (New York: Harper and Brothers, 1843), 14.

¹⁰² *Ibid.*, 258.

According to Brewster, the fascination with automata actually spurred industrial growth. Technology employed to astonish the public soon became integral to early factories. Along with clockmakers, the producers of musical instruments and androids were at the cutting edge of technological advancement, building contraptions that preceded, and in some cases even provided prototypes for, the machinery of the Industrial Revolution.

The same elaborate clockwork running these uncanny dolls evokes the machinery in factories used to replace actual human labor. The fascination exerted by automata reflected a deep seated fear about the essence of our humanity. Not surprisingly, live human performance engaged this fear, helping audiences process and overcome the threat to subjectivity posed by machines. By appropriating both the mechanical and musical subjectivity, instrumental music of this period plays with, and synthesizes, the fundamental tension between human and machine.

Paganini's Caprice no. 9

No musician presented a more striking and pivotal union of virtuosity and the supernatural than the Italian violinist Niccolò Paganini (1782-1840). As a music journalist Heinrich Heine (1797-1856) wrote on Paganini, and further mused on him in a

fictional setting.¹⁰³ In his *Florentinische Nächte* (Florentine Nights), Heine evokes both the demonic and the automatic. His character Maximilian asks if Paganini learned his presentation from an automaton:¹⁰⁴

This was Paganini in his black gala dress. The black tailcoat and the black vest were from an atrocious tailor, perhaps dictated by the hellish etiquette of the court of Proserpine. The black pants anxiously trembled on his thin legs. His long arms appeared even longer, as he had in one hand the violin and in the other the bow with such a lowered hold that it almost touched the earth, as he displayed his bow before the audience. In the angular curves of his body lay a horrible woodenness and also something almost foolishly bestial, that to us this bowing must have created a strange desire to laugh, except that his face appeared even more cadaverously white under the orchestra lighting, and had something so pleading, so nonsensically humble, that a terrible empathy suppressed our comic urge. Had he learned these courtesies from an automaton or a dog?¹⁰⁵

¹⁰³ For Heine's music criticism on Paganini translated into English see O.G. Sonneck and Frederick H. Marenz, "Heinrich Heine's Musical Feuilletons [Concluded]," *The Musical Quarterly* 8, no. 3 (1922): 447.

¹⁰⁴ Katherine Hirt discusses both Heine's music criticism and the "Florentine Nights" in a chapter titled "Virtuosity and Heinrich Heine." Hirt writes that the character Maximilian describes Paganini as a "mechanical vampire figure and an artist who, following a Faustian theme, sold his soul to the devil to become the world's greatest violinist." Katherine Hirt, *When Machines Play Chopin: Musical Spirit and Automation in Nineteenth-Century German Literature* (Göttingen: De Gruyter, 2010), 112.

¹⁰⁵ "Das war Paganini in seiner schwarzen Galla. Der schwarze Frack und die schwarze Weste von einem entsetzlichen Zuschnitt, wie er vielleicht am Hofe Proserpinens von der höllischen Etikette vorgeschrieben ist. Die schwarzen Hosen ängstlich schlotternd um die dünnen Beine. Die langen Arme schienen noch verlängert, indem er in der einen Hand die Violine und in der anderen den Bogen gesenkt hielt und damit fast die Erde berührte, als er vor dem Publikum seine unerhörten Verbeugungen auskramte. In den eckigen Krümmungen seines Leibes lag eine schauerliche Hölzernheit und zugleich etwas närrisch Tierisches, das uns bey diesen Verbeugungen eine sonderbare Lachlust anwandeln musste; aber sein Gesicht, das durch die grille Orchesterbeleuchtung noch leichenartig weisser erschien, hatte alsdann so etwas Flehendes, so etwas blödsinnig Demüthiges, dass ein grauenhaftes Mitleid unsere Lachlust niederdrückte. Hat er diese Kompliment einem Automaten abgelernt oder einem Hunde?"

In describing the soloist the prose moves smoothly from “hellish etiquette” to “horrible woodenness.” The figure of Paganini embodies uneasy magical qualities while also conjuring an automaton.

According to the research of the Japanese engineer Masahiro Mori, the more an automaton resembles a human, the more we connect emotionally to the automaton. However, when an android or prosthetic limb reaches a certain level of human resemblance, and yet still retains some non-human features, the mix of human and mechanical qualities ignites a disturbed response in the human. Mori writes “I have noticed that, in climbing toward the goal of making robots appear like a human, our affinity for them increases until we come to a valley . . . which I call the *uncanny valley*.”¹⁰⁶ Mori goes on to describe human interaction with a prosthetic limb:

However, once we realize that the hand that looked real at first sight is actually artificial, we experience an eerie sensation. For example, we could be startled during a handshake by its limp boneless grip together with its texture and coldness. When this happens, we lose our sense of affinity, and the hand becomes uncanny.¹⁰⁷

Heinrich Heine, “Florentinische Nächte” in *Historisch-kritische Gesamtausgabe der Werke*, ed. Manfred Windfuhr (Hamburg: Hoffmann und Campe, 1994), 5: 216.

¹⁰⁶ (Italics in original) Masahiro Mori, “The Uncanny Valley,” trans. Karl F. MacDorman and Norri Kageki, *IEEE Robotics and Automation Magazine* (2012): 98. The original article was published in Japanese. Masahiro Mori, “The Uncanny Valley,” *Energy* 7 no. 4 (1970): 33-35.

¹⁰⁷ Masahiro Mori, “The Uncanny Valley,” trans. Karl F. MacDorman and Norri Kageki, *IEEE Robotics and Automation Magazine* (2012): 99.

The response of Heine's Maximilian describes Paganini falling into this uncanny valley. While we usually apply the term "uncanny valley" to artificial life, a human who takes on mechanized qualities may also fall into this valley. Musical virtuosos may conjure uncomfortable images of automata and corpses. An audience watches with fascination as performers play with this space in between human and machine.

After his first European tour of 1828, the striking impact of Paganini's diabolical persona overshadowed the earlier Paganini of the Italian courts. Using his violin, the gallant Paganini was famed for his ability to mimic human voices and various instruments to create mock dialogues on a single instrument. As Dana Gooley noted recently, "[m]any of [Paganini's] legendary innovations in violin technique, though sometimes falsely attributed to him, expand the instrument's capacity for simulating or evoking the human voice."¹⁰⁸ A source of the great unease and fascination with instrumental music stems from the instrument's ability to fabricate the voice: a violin may morph between imitating a scorned woman one moment and the calls of the hunt in the next. Though Paganini's proliferation of voices originated as a charming court spectacle, the uncanniness of conjuring multiple voices prepared Paganini for reinterpretation by his northern audiences as a demonic genius.

¹⁰⁸ Dana Gooley, "'La Commedia del Violino': Paganini's Comic Strains," *The Musical Quarterly* 88, no. 3 (2005): 370-427.

In the Caprice No. 9 in E major (“The Hunt”) from his 24 Caprices, Op. 1 of 1802, Paganini directs the violinist: at first “imitando il Flauto” (imitating the flute) and then “imitando il Corno” (imitating the horn). In this *ritornello* the virtuoso not only brings to life other instruments, but commits parallel acts of ventriloquism. The violinist mimics a pair of instruments, the flute and horn, but each representation of the flute and horn multiplies through double-stops, which requires not only virtuosity but conveys the impossibility of two voices being produced by one individual. This problem of the doubled voice in virtuoso instrumental music, a common part of the virtuoso tool kit by this time, always draws our attention to the problematic fabrication of the voice.

9
ALLEGRETTO

Sulla Tastiera imitando il Flauto
dolce

.....imitando il Corneo sulla 32 e 42 corda.....
F

.....sulla Tastiera simili Tastiera
P F P F

The image displays a page of musical notation for Paganini's Caprice no. 9. It consists of ten staves of music, each containing complex, rapid passages. The notation includes various musical symbols such as treble clefs, notes, rests, and dynamic markings. The dynamics include *f* (forte), *pp* (pianissimo), and *p* (piano). There are also markings for *8va* (octave up) and *8va* (octave down). The music is characterized by its technical difficulty, with many sixteenth and thirty-second notes. The page number 19 is visible in the top right corner.

Example 1: Paganini Caprice no. 9. Milan: Ricordi.

The horns and flutes serve yet another purpose, however. In this Caprice the use of horn fifths, as well as the timbre of the horn, signifies the hunt; indeed, the caprice has long borne the nickname “The Hunt.” The B-section of the rondo form also plays into this staging, with galloping “horses” on triple stops providing weight and the staccato articulation suggesting the action.

The caprice does not begin with hunting horns, however, but with the much more gentle and domestic flutes. During this period “hunt” stood as a cypher for the aristocracy, whose power derived from owning land. The opening flutes emphasize aristocratic refinement, but also undercut the hunt as a display of power. The flutes provide a comic refrain on the dwindling prestige of the nobility; the instrument joins the horns in the music of the hunt, but in an overly polished, affected timbre. In order to produce this timbre the violinist must draw the bow with exactly the right amount of speed, and without much weight from the bow arm. The violinist, in order to mimic flutes, deliberately draws the bow at a place on the string that creates a less powerful sound. This technique hardly projects strength in the use of the performer’s body or in the tone.

Following a restatement of the horn calls, the Caprice turns to a new key—one disconnected from the music of the hunt. A declamatory fanfare separates this new idiom from the previous hunting scene (m. 52). If a violinist executes the octaves as a

trumpet fanfare, the middle section of the Caprice assumes a proud, even flamboyant air, seemingly usurping the gentle flutes of the refrain. At the top of the runs slashes of rapid scales follow and evaporate into the laughter of sprites. No longer is the listener presented with a concrete social image. This new section contains troubling yet riveting and self-conscious virtuosity. The springs and levers of the ricochet bowing (starting in the 9th bar of the new section) function as exposed mechanisms for all to see—music perfectly fit for an automaton.

The ricochet bowing does not imitate the voice or any other (non-string) instrument; instead the effect belongs uniquely to the violin. This striking technique of quick, seemingly uncontrolled bounces of the bow dispels any illusion of classical or vocal phrasing, and draws our attention to the physical production of sound. The effect is made possible by the coming into contact of two organic materials, horse-hair of the bow and the sheep gut that violinists of this period used for strings. Both the horse hair and strings are under considerable tension produced in both cases by a screw-like mechanism. The player must introduce a precisely calibrated lateral motion that causes the two materials to strike one another repeatedly and regularly. The precise mechanical action produces a skittering, popping noise tied more to material substance than vocal chords.

The Caprice frames this virtuosity with the signifiers of aristocratic power. The hunting scene, far from acting as an homage to the aristocracy, instead grabs social stature for the instrumentalist. The middle section displays mechanical prowess through the small clockwork bits of ricochet and the trumpeting of victorious fanfares in octaves. After this declaration we return to the comparatively docile sound of the hunt. Now, however, we hear the hunting music following virtuosity. The virtuoso now assumes his place at the head of the hunt—a clear statement of the new power the instrumentalist holds in an industrial society. The ability to explore critical social issues between human and machine allowed the musician to assume a new kind of authority beyond that of a mere aristocrat.

Musical virtuosity explores instrumentality in a self-conscious fashion. A vocalist can, of course, be a virtuoso. A virtuoso vocalist uses the voice self-consciously as an instrument, or even imitates an actual musical instrument. Instrumental music often mimics the language and rhetoric of the voice. Yet music also produces meaningful sounds that stray far from the structures of language or the possibilities of the human voice.

Elisabeth Le Guin argues that virtuosity presented an antithesis to the celebration of sensibility of the late eighteenth-century.

In characterizing virtuosity as Other, these high-minded French-speaking writers pointed directly at the sources of its power over late eighteenth-century minds. To audiences of this period, virtuosity was indeed the perfect antithesis of *sensibilité*, for by its nature it makes the absorptive maneuver impossible . . . The huge popularity of virtuosic performances of all types during the eighteenth-century—indeed it was a period in which many new kinds of virtuosity were invented or perfected—suggests that alienation exercised a seductive force every bit as powerful as *sensible* commonality.¹⁰⁹

Le Guin explores the meanings created by a musical score's dictations to a performer's body. This brings a range of underappreciated possibilities to light. She reads a rondo of Boccherini (from the Cello Sonata in C Major, G. 17, iii) as a play on the critical question of man-machines. "The rondo has framed the executant to the listener-observer as a quasi-automaton . . . Which is this cellist's true nature, then, man-machine or sensible kindred spirit?"¹¹⁰ Indeed, the element of uncertainty in a performer's status empowers the musician. A performer does not simply mimic an automaton, but creates liminal fascination by alternately exposing a potential freedom of spirit, and then focusing on the mechanical nature of the body.

Drawing on the thinking of the seminal French writer Michel Foucault, Maiko Kawabata also explores virtuosity as a source of power in a social context:

¹⁰⁹ Elisabeth Le Guin, *Boccherini's Body: An Essay in Carnal Musicology* (Berkeley and Los Angeles: University of California Press, 2006), 138.

¹¹⁰ *Ibid.*, 127.

In a sense, virtuosity is power, and it is meaningful as social negotiation too. Arguing against the understanding of power as something possessed or wielded by sovereign command, Foucault proposed a decentered model in which power arises only in the strategic or tactical interaction of individuals, groups, or institutions. So to conceptualize Paganini as a sovereign subject, the sole agent of his success, gives a very incomplete picture; in addition to his own musical and personal qualities, Paganini had the good fortune to arrive on the scene at a time ripe for the rise of the touring violin virtuoso.¹¹¹

Virtuosity brought fame and fortune to instrumentalists. Yet composers not participating in the life of a touring soloist also incorporated the idioms of instrumental virtuosi into their works, parsing the meanings of virtuosity in varied and fascinating ways. Since virtuosos aroused *angst* around contemporary topics such as mechanization and natural magic, composers facing the shifting structures of a society undergoing both social and industrial revolutions delved into the contradictions and contrasts of virtuosity and song.

The following chapter explores how virtuosity, now fraught with mechanical implications, mixed uncannily with song in the work of Schubert. Earlier musical techniques such as fugue and invertible counterpoint—read as expressions of the mechanical by Romantics—regain prominence in the music of Schubert and his

¹¹¹ Maiko Kawabata, “Virtuoso Codes of Violin Performance: Power, Military Heroism, and Gender (1789-1830),” *19th-Century Music* 28, no. 2 (2004): 92.

contemporaries. No longer content with asking an instrumental performer to mimic language and rhetoric, composers increasingly addressed musical instruments using non-vocal figures and disturbing virtuoso flourishes. As the mechanization of Europe gained momentum, virtuoso performers found their near-magical powers the object of intense interest, as audiences fixated on the spectacle of a performer trespassing the boundaries between human and machine.

Chapter 4

Schubert's Mechanical Lyricism: A Reading of *Gretchen am Spinnrade* and the *Rondeau Brilliant* for Violin and Piano

"Greatness in music is mechanical, the fugue, the spirit of church music, functions as a screw, a lever..." (Friedrich Schlegel: *Fragments* 1800)¹¹²

"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..."

(Frances Burney: *Evelina* 1778)¹¹³

To draw a dividing line between the technological meanings of virtuosic music and the music of canonic composers of the Viennese school would be misguided. Viennese classicism was as infused with mechanical discourse as were the spectacles of Paganini. Many composers appropriated the language of mechanization in the late eighteenth century, and the narratives and commentaries they created with this language are wide-ranging and often profound.

As androids were so commonly associated with instrumental performance, music—more so than any other art, including literature and painting—was perfectly

¹¹² "Das grosse in der Musik ist mechanisch, grade der Geist der Kirchenmusik, die Fuge; sie geht wie Schraube, Hebel pp —" Friedrich Schlegel, *Literary Notebooks 1797-1801*, ed. Hans Eichner (London: The Athlone Press, 1957), 197. Keil discusses this Schlegel fragment in "Mechanismus und Organismus: Zu E.T.A. Hoffmanns Rezension der Beethovenschen Klaviertrios Op. 70," *Neues musikwissenschaftliches Jahrbuch* 4 (1995): 91.

¹¹³ The character of Madame Duval, however, does not exemplify good taste. Frances Burney, *Evelina*, ed. Edward Bloom and Vivien Jones (Oxford: Oxford University Press, 2002), 78.

positioned to address the new social landscape created by the Industrial Revolution. Music's stature as the most modern of the arts for the Romantic movement and its ability to engage with the topos of the mechanical imbued the works of composers, including Beethoven and Schubert, with special social meanings. To illustrate this dimension, this chapter examines two works by Schubert: a song that challenges the professed distinction between human subjectivity and machine, and a rondo that interrogates the nature of interiority.

Gretchen and Weaving Anxieties

To fully understand the context of Schubert's *Gretchen am Spinnrade* [Gretchen at the Spinning Wheel] we must look to the web that connects the flute-playing android of Vaucanson to changes in the production of textiles. The anxiety concerning the substitution of machines for human labor directly relates to the spectacle of musical androids. This anxiety, accompanied by the constant spinning of the wheel, renders Schubert's song more than the monologue of an abandoned girl.

The fear that machines were capable of changing the structure of labor took hold by 1744. In England John Kay had invented a new fly-shuttle, but "[t]he weavers of Colchester, and it is said, of Spitalfields, resisted the introduction of the fly-shuttle so

vehemently that Kay removed in 1738 to Leeds . . . ”¹¹⁴ England led the way in the mechanization of spinning. During the sixteenth century women used a spinning wheel, but by “the eighteenth century spinning had become increasingly mechanized with the invention of the spinning jenny by James Hargreaves in 1770 and Arkwright’s water-powered jenny.”¹¹⁵ In the United States the “country’s first large-scale textile mill” opened in 1814, the very year that *Gretchen* was composed.¹¹⁶

Carmen Sarasúa describes how, in the second half of the eighteenth century, Spain introduced a spindle invented by Vaucanson. At this time spinning could be the work of either men or women depending on the country and type of spindle. The Enlightened Spanish government hoped that this spindle, which demanded less strenuous manual labor, would encourage women, who only earned a fraction of the wages of men, to take over the spinning of silk.¹¹⁷

While Austria did not experience the onset of industrialism as early as England, the Viennese economy underwent enormous shifts in the period immediately before

¹¹⁴ Francis Espinasse, *Lancashire Worthies* (London: Simpkin, Marshall & Co., 1874), 312.

¹¹⁵ Julie Wosk, *Women and the Machine: Representations from the Spinning Wheel to the Electronic Age* (Baltimore: John Hopkins University Press, 2001), 38.

¹¹⁶ *Ibid.*, 38.

¹¹⁷ Carmen Sarasúa, “Technical innovations at the service of cheaper labour in pre-industrial Europe. The Enlightened agenda to transform the gender division of labour in silk manufacturing,” *History and Technology* 24, no. 1 (2008): 23-39.

Gretchen. The French Revolution interrupted the import of silk from Lyon, and Vienna was transformed rapidly into a vital center of the silk industry:

The most important branch of Viennese production was the silk industry. Its great time began in 1790, when in the course of the French Revolution silk manufacturing in Lyon came to a standstill and also trade with France was halted. Domestic production had to quickly replace the imports and also reach French standards. In 1800 in Vienna there were 150 silk manufactures, which together used about 8,000 looms. In 1813 there were already 600 silk manufactures, which employed 7,000 to 8,000 female workers (employment of women!), 6,000 journeymen and 800 to 900 apprentices.¹¹⁸

Between 1800 and 1813, the number of silk manufacturers in Vienna increased more than fourfold. The young Schubert may not have spent much time contemplating weavers, yet he could hardly have been unaware of textile manufacture. By 1813—the year before *Gretchen*—a fifth of working Viennese labored in the silk industry.¹¹⁹ Women

¹¹⁸ “Der wichtigste Wiener Produktionszweig war die Seidenindustrie. Ihre grosse Zeit began um 1790, als im Zuge der Französischen Revolution die Seidenerzeugung in Lyon lahm gelegt worden war und auch der Handel mit Frankreich zum Erliegen kam. Die inländische Produktion musste rasch den Import ersetzen und auch französiches Niveau erreichen. Um 1800 zählte man in Wien an die 150 Seidenfabrikanten, die es zusammen auf etwa 8.000 Webstühle brachten. Im Jahr 1813 gab es bereits 600 Seidenfabrikanten, welche 7.000 bis 8.000 Arbeiterinnen (Frauenarbeit!), 6.000 Gesellen und 800 bis 900 Lehrlinge beschäftigten...” Bertrand Michael Buchmann, “Protoindustrialisierung,” in *Wien, Geschichte einer Stadt 3 Von 1790 bis zur Gegenwart*, ed. Peter Csendes and Ferdinand Opll (Wien: Böhlau, 2006), 132.

¹¹⁹ “Following these figures about one in five working Viennese was employed in the silk industry.” (“Nach diesen Zahlen arbeitete etwa jeder fünfte Wiener Berufstätige in der Seidenindustrie.”) Josef Ehmer, *Familienstruktur und Arbeitsorganisation im frühindustriellen Wien* (Wien: Verlag für Geschichte und Politik, 1980), 22.

were notably prominent in the textile industry; a woman at a spinning wheel would project a critical social reality to a Viennese audience.

Outside Vienna, machines in the first decade of the nineteenth century threatened and destroyed the livelihoods of rural spinners involved in cotton production. According to Bertrand Michael Buchmann, between 1801 and 1810, 100,000 jobs in cotton manufacturing were lost:

While silk manufacturing was concentrated in Vienna, the cotton manufacturers established themselves in the lowlands and from there met the demand of the big city for goods. The production proceeded without exception by a reliance on work done in the home by members of the rural lower class. For these people the introduction of the machine meant a personal catastrophe. Between 1801 and 1810 the spinning machine destroyed 100,000 home-production jobs in lower Austria. The machine-related industry accelerated its conquest after the continental blockade imposed by Napoleon over England (1806-1813) initiated a boom in new manufactures in the cotton industry. As these machines ran with water, Vienna was hardly a suitable location; moreover, for the time being the government forbade industrial establishment in and around Vienna, since they wanted to avoid any accumulation of industrial workers without means in the capital. In 1809/11 such restrictive regulations were dropped, so that economic liberalism also entered the capital.¹²⁰

¹²⁰ “Während sich die Seidenerzeugung auf Wien konzentrierte, liessen sich die Baumwollmanufakturen auf dem flachen Land nieder und deckten von dort aus den Güterbedarf der Grossstadt. Die Produktion erfolgte auch hier durchwegs im Verlagssystem, wobei die Heimarbeit von Angehörigen der ländlichen Unterschicht besorgt wurde. Für sie bedeutete die Einführung der Maschine eine persönliche Katastrophe. Zwischen 1801 und 1810 vernichtete die Spinnmaschine in Niederösterreich an die 100.000 Heimarbeitsplätze. Die maschinengebundene Industrie trat ihren Siegeszug an zumal insbesondere die von Napoleon über England verhängte Kontinentalsperre (1806 bis 1813) einen Gründungsboom der Baumwollindustrie initiierte. Da die Maschinen mit Wasser betrieben wurden, fanden sich in Wien kaum geeignete Standorte, ausserdem verbot die Regierung vorerst Industrie Gründungen in und um Wien, weil sie jede Ansammlung mittelloser Industriearbeiter in der Hauptstadt vermeiden wollte. 1809/11 fielen dann solche einschränkenden Bestimmungen, sodass der Wirtschaftsliberalismus auch in der Hauptstadt

Vaucanson did not simply create the most famous musical automata in history; he introduced a technology that genuinely impacted the pace of the Industrial Revolution. The very mechanisms employed in Vaucanson's androids soon threatened the livelihood of silk weavers. Minsoo Kang summarizes the path of Vaucanson's innovations from the *Flute Player* to Charles Babbage, an early pioneer of the computer:

Vaucanson's automata were powered by spring-driven cylinders that turned to produce motion in the artificial figures. When he went on to build the mechanical loom that gained him membership in the Académie Royale des Sciences in 1746, he used the same technology, with spokes on the cylinder determining the pattern weaved by the machine, like such a device in a player-piano (patterns could be altered by using cylinders with different configurations of spokes). During the Napoleonic era, a talented silk-weaver named Joseph-Marie Jacquard improved this device by replacing the cylinder with loops of cardboard paper with holes punched through them, making it easier to change the patterns. These punch-cards in turn provided the crucial innovation in Babbage's design of the Difference Engine, the first of his calculating machines, which was only partially built.¹²¹

The innovative technology in the *Flute Player* engendered an anxiety that fermented before 1750 to the point of violent revolt against Vaucanson:

in 1740 Vaucanson was appointed inspector general of silk works, the silk industry being a logical place for him to put his mechanical talents to good use . . . He fulfilled his early promise of genius, inventing the first automatic loom (later perfected by Jacquard), the first automatic mechanism for weaving patterns, a new type of silk reeler and a new silk thrower (two machines involved in

einzog." Bertrand Michael Buchmann, "Protoindustrialisierung," in *Wien, Geschichte einer Stadt 3 Von 1790 bis zur Gegenwart*, ed. Peter Csendes and Ferdinand Oppl (Wien: Böhlau, 2006), 132.

¹²¹ Minsoo Kang, *Sublime dreams of living machines: the automaton in the European imagination* (Cambridge: Harvard University Press, 2011), 228-229.

spinning silk thread), and a new calender (a kind of mangle to smooth finished cloth). But he lacked an attendant power of persuasion, and for a while the only thing he succeeded in conveying to either masters or workers in the French silk industry was that his machines threatened their livelihoods. The radically conservative *canuts* of Lyon, the industry's capital, chased him out of their city in 1744 and probably would have killed him if they had been able to catch him.¹²²

By 1814, the year of Franz Schubert's *Gretchen am Spinnrade* (Gretchen at the Spinning Wheel; text by Johann Wolfgang von Goethe), the image of a young woman at a spinning wheel would have been fraught with the tensions caused by industrialism.

If reading *Gretchen* in the context of industrialism seems at odds with the nostalgic medievalist setting of Goethe's *Faust*, we must remember that by the end of *Faust II* (first published posthumously in 1832) Faust has become an industrial tycoon. In the fifth act the elderly couple Philemon and Baucis watch with distress as Faust's hordes of laborers impose their will on nature and construct with demonic speed:

By day the workers labor noisily in vain,
With axe and shovel, blow by blow;
Where little fires swarmed at night,
A dam stands the next day.
Human victims must bleed,
For at night the agony of their misery rings out;
A sea of flaming coals
In the morning will be a canal.
He is Godless, he desires
Our cottage, our grove;
While he boasts he is our neighbor

¹²² Paul Metzner, *Crescendo of the Virtuoso: Spectacle, Skill, and Self-Promotion in Paris during the Age of Revolution* (Berkeley and Los Angeles: University of California Press, 1998), 164-165.

He intends to oppress us.¹²³

Goethe's poem exposes Gretchen's tormented subjectivity by pitting her against a mechanical foil, the spinning wheel. The spinning wheel appears deceptively pastoral, but here Gretchen is not framed by nature. Schubert famously employs the piano to supply a literal aural representation of a spinning wheel.¹²⁴ Schubert's use of the piano, however, challenges the binary of Goethe's human and machine.

Throughout the song, as Gretchen's musings color the harmony of the spinning wheel, the piano mediates between the subjective and the mechanical. At the opening the piano revolves around a D-minor triad for the first six bars, establishing a rhythm that remains constant whenever the spinning wheel is in motion.

¹²³ The elderly woman Baucis speaks this passage; "he" refers to Faust. Baucis and Philemon refuse to be bought out to complete Faust's large-scale development plan. "Tags umsonst die Knechte lärmten,/ Hack' und Schaufel, Schalg um Schlag;/ Wo die Flämmchen nächtig schwärmten,/Stand ein Damm den andern Tag./ Menschenopfer mussten bluten,/Nachts erscholl des Jammers Qual;/Meerab floosen Feuergluten,/ Morgens war es ein Kanal./ Gottlos ist er, ihn gelüftet/ Unsre Hütte, unser Hain;/ Wie er sich als Nachbar brüstet,/ Soll man untertänig sein." *Faust II*, lines 11123-11130, fifth act. Johann Wolfgang von Goethe, *Faust*, ed. Erich Trunz (Munich: C.H. Beck, 2007), 335.

¹²⁴ Heather Hadlock notes that the figure of Gretchen scarcely represents a pastoral ideal of womanhood: "However, the oscillations of Schubert's song do not evoke just any girl at the spinning wheel; Goethe's restless Gretchen is a profoundly undomesticated and un-bourgeois figure of sexual transgression, matricide and infanticide, quite at odds with the general domestic connotations of the *Lied* genre and the spinning-song topos." Heather Hadlock, "Return of the Repressed: the prima donna from Hoffmann's 'Tales' to Offenbach's 'Contes,'" *Cambridge Opera Journal* 6, no. 3 (1994): 227.

19. October 1814.

Nicht zu geschwind. ♩ = 72.

Singstimme.

sempre legato Mei-ne Ruh' ist hin, mein

Pianoforte.

pp sempre staccato

Herz ist schwer, ich fin-de, ich fin-de sie

cresc.

nim-mer und nim-mer-mehr!

decresc.

Example 1: *Gretchen am Spinnrade* measures 1-16. (Leipzig: Breitkopf and Härtel)

The D-minor figuration of the piano represents the spinning wheel untouched by Gretchen's passions. Each time the voice stops, the wheel reverts back to D minor as the abandoned girl's fantasies die away and she faces both the reality of absence and the monotony of the work in front of her.

The voice pulls the wheel into the world of subjectivity soon after every entrance. Gretchen starts with a matter-of-fact description of her state, "Meine Ruh ist hin/Mein

Herz ist schwer. [My peace is gone/ my heart is heavy]." In the next lines, as Gretchen's rhetoric heightens "Ich finde sie nimmer/ Und nimmer mehr [I find them never/ and no more]" the harmony of the spinning wheel shifts, following the voice, although the figuration and rhythm remain constant.

The only point where the spinning wheel's rhythmic constancy yields occurs when Gretchen first arrives at the image of union with Faust—"und ach, sein Kuss! [and ah, his kiss!]" Here the spinning stops; clearly Gretchen is too overcome to continue her work. Yet as she attempts to start up again, the spinning wheel remains under the spell of Gretchen's passion. Brief doomed silences interrupt the spinning right hand of the piano. The spinning wheel, irrationally, seems unwilling to submit to harmonic resolution. The piano's figuration does not run up and down a triad but opens with an anguished augmented second (B-flat to C-sharp) that projects an expressive unease.

Here the keyboard engages with this harmonic subjectivity in the absence of the voice. Previously in the song the keyboard only strayed from D minor under the influence of the human voice, and reverted to D minor in every interlude. The piano accompaniment's mechanical nature now encompasses human emotion.

Musical score for Gretchen am Spinnrade, measures 61-75. The score is in G major and 3/4 time. It features a vocal line and a piano accompaniment. The piano part has a continuous eighth-note rhythm in the right hand and a steady bass line in the left hand. The vocal line has lyrics in German. Dynamics include *cresc.*, *accel.*, *ff*, and *pp*.

Lyrics: Zau - ber - fluss, sein Hän - de.druck, und ach, sein Kuss! Mei - ne Ruh' ist hin, mein

Example 2: *Gretchen am Spinnrade* measures 61-75.

The continuous rhythm in the piano part underscores Gretchen's production of yarn. When Gretchen abruptly stops spinning, the quality of her product, the yarn, becomes jeopardized, the yarn may be damaged or broken by her loss of control. Gretchen's work at the wheel requires the use of her body in a repetitive motion, mechanically aligning her feet pumping the treadle and hands pulling and smoothing the wool. Her body is a medium of production, repetitively laboring with a machine.

When Gretchen stops spinning the driving constant labor of industrial manufacture also halts. Gretchen momentarily steps outside of her abject position as a worker in the capitalist system of production (and her powerlessness as a pawn in Faust's narrative).

Even though the pianist's part embodies the spinning wheel, the song's play with the boundary of human and machine suggests that the pianist need not play strictly and without emotion. Indeed, the more the pianist projects Gretchen's anxiety through a mechanical medium, the more intriguingly disturbing the performance will be. Expression of empathy for Gretchen's suffering by a whirling piece of wood leads us to question whether that machine shares our living consciousness.

For a less uncanny interpretive choice the pianist might perform the opening of the song with a cool objectivity. The spinning may then take on emotional warmth only under the influence of Gretchen's voice; her subjectivity will seemingly control the machine. In such a performance, warmth does not exist before Gretchen enters. If the piano can open without any sense of anxiety, the musicians retain greater potential to emphasize the crisis of the song, especially the rupture after "und ach, sein Kuss! [and ah, his kiss!]" The troubled augmented second in the keyboard and troubled stoppages in forward motion will then stand out as the only place where the spinning wheel expresses human distress independently.

The careening of the spinning wheel into subjectivity explicitly challenges the distinction between human and machine: Gretchen herself will soon leave behind rational thought as she loses her sanity. The piano's role as mediator between human and machine derives its force from a long history that places musical instruments at the center of technological development, if not— as in Kircher's view—at the center of the world itself.

An Android's Death: the Inner Life of a Showpiece

While Schubert's "Gretchen" maintains an uneasy division between voice and machine, violin works of this period merge them, turning the violin into an unstable figure at once demonic and heroic. Enlightenment optimists had insisted that humans are reasoning creatures, and in the best instances possessed of a beneficial internal sensibility. Schubert knew better than to accept this thesis. In this epically proportioned rondo Schubert does not simply adhere to the materialist discourse of virtuosity; he examines the issues of song and interiority in a powerful and disturbing way. Schubert makes a musical argument that confounds the Enlightenment elevation of subjective interiority. He invests song with a social, even a military, function while probing instrumental mechanics and compositional building blocks that reveal a problematic human interior.

Schubert wrote his *Rondo in B minor*, the “Rondeau brillant” of 1826, in the familiar genre of a public showpiece after hearing a virtuoso violinist. Stephen Hefling and David Tartakoff write that

[n]ine years had elapsed since Schubert had composed a duo for two of the instruments he himself played. That he returned to the violin-and-piano combination in 1826 is apparently due to the arrival in Vienna that year of the Bohemian violin virtuoso Josef Slawjk. Slawjk participated in the 1827 reading of the G Major Quartet mentioned above, and he gave the first performances of both the *Rondeau brillant* (D. 895, dated October 1826) and the C Major Fantasy (D. 934, completed in December 1827).¹²⁵

Despite the countless harmonic and other glories of the work, the *Rondo*’s popularity and prestige remain limited in comparison to many of Schubert’s other chamber compositions. Yet violinists do perform it with some regularity.

The few scholars who mention the *Rondo* do so with almost comic anxiety. In a discussion of Schubert’s use of classical models, Charles Rosen bestows a single sentence on the *Rondo* that nonetheless illuminates the problems surrounding its twentieth-century critical reception. Rosen expresses his unease by suggesting that the work parodies a more authoritative composition by Beethoven:

Even more disconcerting is the relation of the late Introduction and Rondo in B minor for violin and piano to the first movement of Beethoven’s *Kreutzer* Sonata:

¹²⁵ Stephen Hefling and David Tartakoff, “Schubert’s Chamber Music,” in *Nineteenth-Century Chamber Music*, ed. Stephen Hefling (New York: Routledge, 2004), 100.

here what is borrowed is trivialized, and every dramatic detail becomes petty and even decorative.¹²⁶

“Decorative” and “trivial” certainly evoke gendered stereotypes, in which Rosen’s inability to understand the *Rondo* leads him to place it in the category of the feminine other.

Another critic, Edward Cone, funnels his discomfort by censuring Schubert’s compositional technique: “Schubert had always had trouble in controlling the rondo. It is to his finales, and especially to his rondo finales, that his reputation for rambling redundancy is due.”¹²⁷ Cone goes on to explain that the *Rondo in B minor* is an especially flagrant example of this “redundancy”: “[a]n even more swollen example, which the reader may examine for himself, is the Rondo for Violin and Piano, Opus 70 (1826); exclusive of the andante introduction, it contains over 650 measures!”¹²⁸ The *Rondo* does indeed contain the number of measures Cone’s formalist analysis views as incriminatory. Much of the work consists of contrapuntal or developmental swaths—transitional regions where the violin and piano reveal fully their instrumental natures.¹²⁹

¹²⁶ Charles Rosen, *The Classical Style: Haydn, Mozart, Beethoven* [1971] *Expanded Edition* (New York: Norton, 1998), 517.

¹²⁷ Edward T. Cone, “Schubert’s Beethoven,” *The Musical Quarterly* 56, no. 4 (1970): 787.

¹²⁸ *Ibid.*, 787.

¹²⁹ Su Yin Mak examines critics’ discomfort with Schubert’s sonata style, arguing that Schubert employs a lyrical strategy instead of more standard sonata rhetoric. “[E]xtended lyricism is at odds with the

More recently, Hefling and Tartakoff continue the tradition of critical unease surrounding the *Rondeau brillant* by stating that “the piece sounds weird, even today.”¹³⁰ Critical accord thus paints this late work of Schubert as “swollen,” “disconcerting,” and “weird.” The amount of transitional material is certainly uncommon in a rondo. Rondos traditionally achieve their power through direct juxtaposition of thematic areas and keys. In this rondo we are overcome by swaths of harmonic and rhythmic motion in the transitional areas and we lose sight of our harmonic and thematic destination. The unstable churning of these transitions suggests constant motion, as in a machine, at odds with the rhetoric of a classical rondo.

normative discursive strategies of sonata form. As a rhetorical argument, sonata discourse must constantly ‘drive forward’; yet the lyrical tendency toward self-expansiveness and stasis is anti-teleological in nature.” Su Yin Mak, “Schubert’s Sonata Forms and the Poetics of the Lyric,” *The Journal of Musicology* 23, no. 2 (2006): 267.

¹³⁰ Stephen Hefling and David Tartakoff, “Schubert’s Chamber Music,” in *Nineteenth-Century Chamber Music*, ed. Stephen Hefling (New York: Routledge, 2004), 102.

Schubert Rondo in B minor: Structural Diagram

Andante

A: "Operatic" material mm. 1-12 B minor

B: Cantabile style 12-32 B major (traveling through Ab major)

A: "Operatic" material 32-49 B major

Allegro

A: 49-94 Extroverted main theme B minor/major. Transitional material (trans.) 94-110

B: 110-124 Military music D major. Trans. 124-178

B material in Bb major 178-192

B material in D major 192-202. Trans. 202-281

A: 281-325 B minor/major. Trans. 325-345

C: 345-413 Dancing theme G major. Trans. 413-467

C material in Eb major, going back to G major 467-527. Trans. 527-586

A: 586-639 B minor/major. Trans. 639-667

Coda (B): B material now in the tonic key! B major 667-end (Hence in the coda Schubert fulfills, however quirkily, the requirements of the sonata-rondo made fashionable by Mozart, whose music he knew intimately.)

(Figure 1) Structural Diagram of Schubert's Rondo in B minor

In Schubert's *Rondo* the violin and piano grapple with the gears and levers of their own instrumentality, playing lines that one could never sing, based on highly repetitive and discrete musical building blocks that spotlight the virtuosity of the instrumentalist. While the violin is an inherently more vocal instrument than the piano, throughout the *Rondo* the violin oscillates between a vocal character and bursts of seemingly random flourishes of fast notes peppered with leaps.

An automaton's gears and levers are hidden by the same clothing that a human wears. In the *Rondo*, song is merely the exterior, social garb of the instrumentalist. While song weighs in at key points of the socially determined rondo form, as in extroverted main theme of the rondo, the interior of this work consists of self-consciously instrumental, mechanical material.



Example 3: the extroverted main theme of the Rondo in B minor for Violin and Piano measures 80-92.

Example 4: interior instrumental mechanism in the Rondo in B minor for Violin and Piano, measures 117-130.

The Structure: Virtuosity and Song

The immense emotional scope of the *Rondo* is clear from the opening bars, in which we are presented, briefly, with gestures worthy of an opera. The *Andante* introduction opens with explicitly instrumental material. The piano sets the stage for a soloist, borrowing the double-dotted rhythm of a French overture. The music at times mimics *recitativi accompagnati*, the classic place for anguished introspection in opera. Yet over this recitative accompaniment the violin executes a mix of vocal and virtuoso gestures in which our liminal operatic diva encompasses both human and instrumental voices.

The violin enters on a B in its low range, hurtling through two scalar octaves before declaiming what will become the *ur*-motive of the work: a rising whole step, the first gesture that can be construed as vocal. Only after being wound-up in automaton style does the violin land on a musical figure resembling speech.

The image shows a musical score for Violino and Pianoforte. The Violino part is in treble clef, and the Pianoforte part is in bass clef. The key signature is B minor (two sharps: F# and C#). The time signature is 3/4. The tempo is marked 'Andante.' The Violino part begins with a low B, followed by a rapid ascent of two octaves, marked with a '14' indicating a 14-measure phrase. The Pianoforte part begins with a forte 'f' dynamic, playing a series of chords in the left hand and single notes in the right hand, creating a recitative-like accompaniment.

Example 5: Rondo in B minor for Violin and Piano measures 1-4.

The urgent virtuosity of the opening transforms into a liquid melodicism after the first appearance of the Neapolitan sixth in measure nine. The texture that follows clearly imitates the *Lieder* for which Schubert is so justly famed, with the violin and the keyboard alternating as the singer.



Example 6: Rondo in B minor for Violin and Piano measures 9-14.

Schubert places this flight into song between two pillars of clear instrumental virtuosity. Although song thus appears to be kept under the control of the instrumental, the *Andante* presents an arrangement that is more suited to the literary tropes of the period. Schubert offers vocal character as something private and intimate, placed as the interior of a more public style. Yet while we see a classic argument laid out in the *Andante*, the

rondo presents an even more daring antithesis, reversing the stereotyped roles of exterior virtuosity and interior song.

In the rondo that follows the *Andante*, the violin and keyboard imitate vocal style in places where the structure of the movement is defined by harmonic stability. Song thus defines the external features of the form, marking out for the ear what may be referred to as an A- or B-section of the rondo. The lengthy episodes of transitional material that follow between these points of stability—doubtless the very stretches that Cone finds “rambling”—expand such that a listener has no clear sense of their role within the overall structure. Indeed, in this rondo the virtuosity depends directly on the seething instability of these transitional areas.

Both the A and B sections of the *Rondo*, at precisely the points where the instruments mimic the rhetoric of language and leave behind swirling ambiguity, draw on an explicitly public style with tinges of military music. Indeed the first appearance of the B theme, in measure 110, enters *pp* and staccato, conjuring an image of toy soldiers.



Example 7: Rondo in B minor for Violin and Piano measures 110-116.

The piano presents a rollicking theme, while the violin rhythmic figure on A trumpets the newly achieved arrival of the relative major. The places where the instruments imitate human rhetoric are extroverted, referencing music easily understood within a social framework. The theme that defines the C-section (starting at measure 345) exudes delicacy and grace, yet imparts the lilt of a dance.

Example 8: Rondo in B minor for Violin and Piano measures 345-360.

Soon after Schubert presents each of these themes, the instruments swirl off into unstable fragments, at times returning to the theme in another key. Departing from the

social role of these thematic areas, Schubert exposes the interiority of composition, foregrounding scales, arpeggios, and tangled invertible counterpoint. These serve as virtuoso material for the keyboard and violin; the listener's attention is inevitably drawn to the production of sound through the instrument as machine.

The wide leaps and arpeggios propel the bow across the strings. The difficulty of these string crossings is visually dramatized as the audience watches a perfectly coordinated bow grasp precisely a string and in a split second jump back to another string. To execute this complex motion the bow arm initiates numerous circular motions. The back of the shoulder or the elbow may provide the initial impulse, while slight circles in the wrist and fingers provide the small scale motor action. While Schubert's unorthodox passage-work demands machine-like precision, it also provides visual display to the audience.

Transitional material surfaces even when not functioning as a pathway between the main melodic sections of the rondo. The C-Section provides a notable example of extensive development within a melodically unified section. As its dance-like Viennese ease glides to the end of its first statement in m. 402, the violin melts into an intimate vocalise. However, a soft harmonic trauma soon disturbs the lyricism. What appears to be a solid cadence to B major, seemingly at the moment of arriving on the tonic chord, instead alights on a D dominant-seventh chord. This harmonic motion is essentially a

deceptive cadence, resolving to bIII6/5 (alternately one could read the chord of resolution as a V6/5 of bVI that does not resolve but moves to a diminished seventh chord).

The musical score consists of three systems, each with a Violin staff and a Piano grand staff (treble and bass clefs). The key signature is B minor, indicated by two sharps (F# and C#). The score is densely written with many accidentals, particularly in the piano accompaniment. Dynamic markings include *f* (forte), *p* (piano), and *pp* (pianissimo). The notation includes various note values, rests, and phrasing slurs, suggesting a complex and expressive piece.

Example 9: Rondo in B minor for Violin and Piano measures 400-414.

This moment recalls the shock of the first appearance of the Neapolitan at m. 9 in the *Andante*. In the *Andante* the harmonic disturbance spurred an emotive onset of song.

After this disruption in the rondo, however, the lyricism continues for only a few bars before being abruptly interrupted by the virtuosic, developmental material so pervasive to this rondo. This development does not function as a link between the pillars of a rondo; instead it plays out as an internal development, replete with scalar runs and arpeggios that leap over the strings of the violin. The figuration presents such difficulties that the audience will sense the difficulties—indeed, the dangers—this passagework presents. The effort of instrumental production will be clearly apparent to the listener no matter the skill level of the violinist.

In performance a violinist may either attempt to smooth out the difficulties of this type of passagework or expose the struggle. While my argument may seem to emphasize the physical production of the music, the interpretive choices remain quite open. One example in the rondo is the large and difficult leaps that seem to call for Viennese ease yet are nearly impossible to execute without a slight gap in the sound. Should time be taken during this leap to emphasize the drama of the violinist's dangerous swoop from the highest E string to the lowest G string? Or should the connection be as smooth and as hidden as possible, seemingly defying physical laws?



Example 10: Rondo in B minor for Violin and Piano measures 436-440.

The violinist may choose to expose the limitations of the human body, not concealing the necessary time for a movement of the arm and creating a small breath that echoes the singer's need for air. However, if violinists choose (and manage) to perform the connection smoothly, they underscore an equally important element—the incessant ticking pulse of the movement. Hence without the breath, the clockwork pulse remains firmly in control of the violinist's body.

Schubert uses several strategies to underscore his self-conscious instrumental awareness. Virtuosity is one such strategy, but he also introduces an idea not defined through either pitch or rhythm but rather through articulation. Only the violin performs this motive; the articulation would prove very awkward on a keyboard. By developing an instrumentally specific gesture, Schubert brings instrumentality into the structure of the *Rondo*. Indeed, as the work progresses articulation provides a foundation for some of the violin's most virtuosic *obbligato*. After the first appearance in m. 110, the violin

harps on this figure (consisting of two slurred eighth-notes and two short eighths)

throughout the next modulatory area. With this motive the violin responds to the piano, even though the piano will never reply with the same gesture.

7

Example 11: Rondo in B minor for Violin and Piano measures 138-149.

The pitch patterns and shape vary widely throughout; only the articulation remains consistent. (Eighth-note rhythms—another consistent feature—are not defining since strings of consecutive eighths abound throughout the *Rondo*.) While this figure first springs up in the B-Section and then vanishes, it resurfaces unexpectedly in the middle of the C-Section (mm. 438 ff.).

Schubert also draws our attention in self-conscious fashion to the process of invertible counterpoint—material that demands facility from the performers but remains far removed from song.



Example 12: Rondo in B minor for Violin and Piano measures 93-102.

The two lines commencing in m. 94 (and identically in later locations) come together to form octaves or unisons on the strong beats (one and three) of the bar. The counterpoint therefore only takes place within a microcosm, in the interior of the pitches presented on beats one and three. If we look at only these strong beat unisons, the pitches outline a ii7 in B major. Schubert probes the interior of each pitch of the arpeggio, however, and

exposes content and meaning within each. The content of this interiority is purely mechanical. Each pitch expresses the same short contrapuntal algorithm.

A master of counterpoint commands vast knowledge of the “mathematical” laws of tonal music. Yet the mathematical underpinnings of counterpoint lead to a strikingly spiritual place. Counterpoint shares this combination of magic and mathematics with natural magic. When Schlegel, referring to the contrapuntal style of J.S. Bach and Palestrina, writes that church music “functions as a screw, a lever,” he links older mechanical arts imbued with spirituality and magic with a new concept of greatness in music.¹³¹ By challenging the dominance of the eighteenth-century rhetorical style, composers were commenting musically on the sweeping changes rocking Europe, changes that exposed the screws and levers of their craft.

We are often tempted to read singing as a statement of inner, individual agency. E.T.A. Hoffmann’s character Nathanael believes that the automaton Olympia expresses her interior emotions through her vocal performance:

Olympia [*sic*] played the piano with great talent and also skillfully sang a *bravura* aria in a voice that was high pitched, bell-like, almost shrill . . . Then he [Nathanael] perceived the yearning glance with which she looked at him, and he

¹³¹ “Das grosse in der Musik ist mechanisch, grade der Geist der Kirchenmusik, die Fuge; sie geht wie Schraube, Hebel pp —” Friedrich Schlegel, *Literary Notebooks 1797-1801*, ed. Hans Eichner (London: The Athlone Press, 1957), 197.

saw how every note achieved absolute purity in the loving glance that scorched him to his very soul. Her skillful roulades appeared to him to be the heavenly exaltations of a soul transfigured by love; and, finally, when the cadenza was concluded, the long trill echoed shrilly through the hall and he felt as if he were suddenly embraced by burning arms. No longer able to contain himself, rapture and pain mingling within him, he cried: Olympia!¹³²

Ultimately, Nathanael will realize that the soul he felt so powerfully in Olympia's performance does not exist.¹³³ Song is intimately bound to language, language that we internalize through our social exterior. Song, therefore, may be a false expression of individual subjectivity. The mechanisms of the body as expressed and examined through virtuoso performance claim as much weight in the critical revelation of the interior as the act of song.¹³⁴ Indeed, Schubert's examination of the instrumental, the

¹³² E.T.A. Hoffmann, *Selected Writings of E.T.A. Hoffmann*, trans. and ed. Leonard Kent and Elizabeth Knight, *The Tales*, vol. 1 (Chicago: University of Chicago Press, 1969), 158. "Olimpia spielte den Flügel mit grosser Fertigkeit und trug ebenso eine Bravour-Arie mit heller, beinahe schneidender Glasglockenstimme vor . . . Da wurde er gewahr, wie sie voll Sehnsucht nach ihm herübersah, wie jeder Ton erst deutlich aufging in dem Liebesblick, der zündend sein Inneres durchdrang. Die künstlichen Rouladen schienen dem Nathanael das Himmelsjauchzen des in Liebe verklärten Gemüts, und als nun endlich nach der Kadenz der lange Triller recht schmetternd durch den Saal gellte, konnte er, wie von glühenden Armen plötzlich erfasst, sich nicht mehr halten, er musste vor Schmerz und Entzücken laut aufschreien: »Olimpia!«" E.T.A. Hoffmann, *Werke*, vol. 1, *Phantasiestücke in Callots Manier, Nachstücke*, ed. Gisela Spiekerkötter (Zurich: Stauffacher-Publishers Ltd., 1965), 315-316.

¹³³ Hadlock reads Olympia as a contained, manageable, diva. "Here a perfect singer obediently warbles her song unmarred by 'organic defects', bad temper or unmanageable ambition—until Hoffmann reveals the secret of Olympia's perfection: she is a musical robot, the final, fantastical solution to the problem of the prima-donna mother and her influence. Olympia has no mother; but she has two fathers . . ." Heather Hadlock, "Return of the Repressed: the prima donna from Hoffmann's 'Tales' to Offenbach's 'Contes,'" *Cambridge Opera Journal* 6, no. 3 (1994): 236.

¹³⁴ This argument differs from Carolyn Abbate's view of singing and automata. Abbate's use of Frankfurt school concepts functions well for the repertoire she addresses, including Ravel. Yet the substitution of

effervescent arpeggios and gnarly contrapuntal passage-work beyond the capacity of the voice, exposes the interior of the instrumental style in vast swaths of liminal, transitional material.¹³⁵ The rondo rejects the late eighteenth-century belief that internal coherence and sensibility is the key feature of humanity; instead singing becomes the instrumentalist's human clothing. The instrumentalist poised between human and machine, leads a discourse that examines the limits of socially imposed language.

Schubert was by no means the only composer to provide a compelling exposition of these issues. For another statement on counterpoint and virtuosity interwoven with existential anxiety, we turn finally to a late string quartet of Beethoven, in which the composer grapples clearly with questions of mortality and, in so doing, speaks through a half-human, half-mechanical voice.

the term "puppetry" for automata ignores the powerful aura of natural magic surrounding automata well into the nineteenth-century. Abbate writes that singing avoids mechanism: "[s]inging (like speaking) plays strongly against the implications of puppetry and mechanism that haunt instrumental performance." Carolyn Abbate, "Outside Ravel's Tomb," *Journal of the American Musicological Society* 52, no. 3 (1999): 482. Abbate states elegantly the dilemma of instrumentalists, exposing the mechanism of sound production with their external instrument: "For one thing singers, unlike instrumentalists, are not mutely clutching dead objects of wood or metal that 'make music' – things in the shape of boxes and pipes, festooned with wires, subconscious morphological reminders of music machines or marionettes." Ibid., 482-483 I contend, however, that this implication of the machine in instrumental performance is a source of power, not a hindrance.

¹³⁵ Hefling and Tartakoff write that "restless rhythmic energy and unexpected harmonic turns overrun the bounds of a somewhat sprawling hybrid rondo structure." Stephen Hefling and David Tartakoff, "Schubert's Chamber Music," in *Nineteenth-Century Chamber Music*, ed. Stephen Hefling (New York: Routledge, 2004), 102.

Chapter 5

“The Levers of Dread, Fear, Horror, and Pain”

“Beethoven’s music sets in motion the levers of dread, fear, horror, pain, and kindles that infinite longing that is the essence of Romanticism.” (E.T.A. Hoffmann, 1810)¹³⁶

Too often twentieth-century musicians and scholars have routinely defined classical music as Arcadian bliss floating above the corruptions of a fallen industrial society. Lawrence Kramer summarizes the utopianism of high modernists that still persists in musical thinking today.

No story? No philosophy or politics? No way. The modulations, dissonances, and complexities that Schoenberg values constitute a familiar allegory: the loss of organic society under the pressure of urbanized modernity. They had supposedly told that story from within, as it unfolded, with the added twist that the more music came to embody the prophetic values of the organic society, the more remote any such society became under the obliterating force of modern scale, industrial economies, and an ‘uninitiated’ mass public. It’s worth noting in passing that this is the kind of fantasy that gets classical music in trouble, but there is no escaping fantasy in this setting; we just need a better one.¹³⁷

As Kramer notes, classical music, including works by justly worshiped composers of the first Viennese school, hardly represents an alternative “organic”

¹³⁶ “Beethovens Musik bewegt die Hebel des Schauers, der Furcht, des Entsetzens, des Schmerzes, und erweckt jene unendliche Sehnsucht, die das Wesen der Romantik ist.” E.T.A Hoffmann, “Recension” *Allgemeine Musikalische Zeitung* 40 (1810): 633.

¹³⁷ Lawrence Kramer, “Music, Historical Knowledge, and Critical Inquiry: Three Variations on *The Ruins of Athens*,” *Critical Inquiry* 32, no. 1 (2005): 64.

society. I contend that this repertoire addresses thorny issues of industrialism and materialism directly, thus assuming a prominent artistic and even spiritual role in post-industrial society. As Kramer states, just the fantasy that classical music is removed from our current realities undermines its position in cultural debates. Musicians need to understand and claim the technological and mechanical meanings they both produce and are capable of creating.

Musicologists often point to E. T. A. Hoffmann as the beginning of a critical tradition that insulates canonic music from social issues.¹³⁸ R. Murray Schafer sums up this position well when he states that in Hoffmann's thinking, "[t]o retain its purity, music must resist social contamination."¹³⁹ To blame Hoffmann for this Modernist position, or to pin failings of our current classical culture on early German Romanticism, obscures the truth. In his *Oxford History of Western Music*, Richard Taruskin writes that "[a]s musicians and music lovers, we still live under the iron rule of Romanticism."¹⁴⁰ Locating the genesis of our current musical dilemmas with early

¹³⁸ For an example of the dominant musicological thinking concerning Hoffmann and his review of the Fifth Symphony, see Taruskin, vol. 2, 641-651. Recent work by Werner Keil challenges this conventional thinking about Hoffmann. See Keil, "The Voice from the Hereafter: E.T.A. Hoffmann's Ideal of Sound and Its Realization in Early Twentieth-Century Electronic Music," trans. Siobhan Donovan and Andrew Johnstone, in *Music and Literature in German Romanticism*, ed. Siobhan Donovan and Robin Elliott (Rochester: Camden House, 2004), 143-61.

¹³⁹ R. Murray Schafer, *E.T.A. Hoffmann and Music* (Toronto: University of Toronto Press, 1975), 45.

German Romantics such as Hoffmann creates a “clean” yet misguided narrative, for the isolationist view of music did not germinate in the thinking of Hoffmann or other Romantics. The fetish of socially pure music and utterly passive audiences developed in the twentieth century amidst misguided attempts to validate elusive utopias.

However, the impact of thinkers like Hoffmann should not be underestimated, and nineteenth- and twentieth-century performance practices are not wholly unrelated. Hoffmann’s preoccupation with musical androids and Beethoven’s levers shows clearly how uneasily Hoffmann grappled with the role of music amidst the new technologies. The entrance of mechanization, in Hoffmann’s view, actually contributed to the elevation of instrumental music.

Indeed, in his seminal review of Beethoven’s Fifth Symphony, Hoffmann invokes a mechanical metaphor. Not only does Beethoven’s music operate by “setting levers in motion,” but the levers communicate “dread, fear, horror and pain” —ominous commentary on the new social reality of industrialism faced by both Hoffmann and Beethoven. Hoffmann does not propose a materialist discourse in opposition to the “infinite longing” of Romanticism; instead the symphony’s ability to function mechanically explains the modern “Romantic” nature of instrumental music.

¹⁴⁰ Richard Taruskin, *The Oxford History of Western Music* (Oxford: Oxford University Press, 2005), 2: 651.

If we place this quotation within the context of the review, Hoffmann first describes Haydn and Mozart before addressing Beethoven. Hoffmann famously labels all three Viennese school composers as “Romantics.” However, a closer reading shows a clear progression in Hoffmann’s assessment of them. Haydn, for example, invokes for Hoffmann the image of an edenic pre-industrial society.

The expression of a serene and childlike disposition prevails in Haydn’s compositions. His symphonies lead us into vast green woodlands, into a gaily coloured throng of happy men. Youths and maidens dance in a row, swaying back and forth; laughing children peer out from behind trees and rose bushes and tease one another by throwing flowers.¹⁴¹

Mozart, Hoffmann writes, leads us to the “spirit realm,” which for Hoffmann would be the realm of natural magic that includes automata.¹⁴² But for the music of Beethoven, Hoffmann’s poetic speech requires far more portentous expressions:

“Now Beethoven’s instrumental music opens to us the realm of the colossal and the immeasurable. Glowing beams of light shoot through the deep night of the realm and we perceive giant shadows surging back and forth, closer and closer around us, destroying everything in us except the pain of that endless longing . . .”¹⁴³

We have lost the innocence of Haydn and the magic of Mozart. With Beethoven the age of urbanized modernity is fully upon us.

¹⁴¹ R. Murray Schafer, *E.T.A. Hoffmann and Music* (University of Toronto, 1975), 84.

¹⁴² *Ibid.*, 84.

¹⁴³ *Ibid.*, 84.

Ulrich Schmitt also reads responses to Beethoven as infused with the tumult of industrialism. Schmitt especially emphasizes the advent of steam power, and new senses of speed due to trains. He states: “and still these important and momentous findings from the early period of industrialism rightly name Beethoven as the symbol of a secret connection between technical and musical progress.”¹⁴⁴ I agree that Beethoven’s music address these issues, though I view Beethoven’s work as part of a continuous tradition of musical engagement in mechanical and technological discourses.

Schmitt makes a persuasive case for elements of Beethoven’s idiom that engage with early industrial audiences.

Expressed in terms of social history one could therefore describe Beethoven’s panoramic music as ‘music of the Industrial Revolution.’ This means that the structure of this music lays down an experience —key words: swiftness, quickness, *heightening of the nerves* (Georg Simmel), but also dynamics, euphoric mood, belief in progress — an experience, that for people in the first phase of the Industrial Revolution acquired existential meaning.¹⁴⁵

¹⁴⁴ “Und dennoch tragen diese wichtige und folgenreichen Erfindungen aus der Frühzeit der Industrialisierung den Namen Beethoven zu Recht: als Symbol einer geheimen Verbindung von technischem und musikalischem Fortschritt.” Ulrich Schmitt, *Revolution im Konzertsaal: Zur Beethoven-Rezeption im 19. Jahrhundert* (Mainz: Schott, 1990), 130.

¹⁴⁵ “Sozialgeschichtlich ausgedrückt könnte man deshalb Beethovens panoramatische Musik als ‘Musik der Industriellen Revolution’ bezeichnen. Das hiesse, das sich in der Struktur dieser Musik eine Erfahrung niedergeschlagen hat — Stichwort: Schnellebigkeit, Flüchtigkeit, *Steigerung des Nervenlebens* (Georg Simmel), aber auch Dynamik, Aufbruchstimmung, Fortschrittsglaube —, eine Erfahrung, die für die Menschen in der Anfangsphase der Industrielle Revolution existentielle Bedeutung erlangt hatte.” Ibid., 135.

In his String Quartet in A Minor, Op. 132, one of the fabled late quartets, Beethoven grapples with mortality, most famously in the movement that he labeled *Heiliger Dankgesang eines Genesenen an die Gottheit, in der lydischen Tonart* (Sacred song of thanksgiving of a convalescent to God, in the Lydian mode). In the first movement, however, virtuosity periodically lacerates the texture, preparing us for the tragic coda that culminates in the fiery immolation of the first violin.

In performance the quartet negotiates a critical choice. The slow introduction features imitative entrances in the style of Renaissance counterpoint. The first outburst of virtuosity at m. 9 follows directly this contrapuntal opening. In the measure before the outburst, the second violin plays moving quarter notes the entire bar, while the others join the quarters for the last two beats. If the second violin initiates a subtle *accelerando* during these quarters, the virtuosity will seemingly grow out of the counterpoint, linking the two historically mechanistic concepts. Imitative counterpoint was once a symbol of divine mechanicity. In this interpretation the church atmosphere of the opening feeds directly into the searching despair of the first violin's virtuosity. Spirituality and mechanical *Angst* form an alliance.

The flurry of virtuoso sixteenths at m. 9 elaborates on the concise 4-note motive of the imitative passage. The speed and regularity of these sixteenths alone does not create the virtuoso effect; the violin swoops swiftly across a wide swath of the

instrument, a dive and return of register more suggestive of a bird of prey than a human. The small, twisted, building blocks of the motive join to create the violin's gesture. The violin pauses rather abruptly after this action, and the cello immediately lures the violin to a world of melting lyrical sentiment.

Beethoven
Op. 132.
VIOLINO 1º
VIOLINO 2º
VIOLA.
VIOLONCELLO.

QUARTETTO.
Assai sostenuto.

Allegro.
Cres.
Dimin.

Example 1: Beethoven: String Quartet, Op. 132, mm. 1-16. (First edition, Berlin: Schlesinger, ca. 1827)

Virtuosity and counterpoint provide an antidote to the sentimental dotted motive that weaves throughout the movement. At several points the violin's solitary virtuosity returns (mm. 22 and 119). The violin's jolting runs serve as an existential cry. The mechanistic nature of the pattern draws our attention not just to the mechanical nature of instrumental performance, but to the body itself.

The breakdown of the body at the end of life brings heightened awareness of the limits, and hence material qualities of the physical self. Beethoven develops this tension fully in the coda (Example 2). After a disintegrating *morendo* (starting in m. 250) produces an uncanny hush, the motion starts up once again. Viola and cello commence a mechanical humming, a sixteenth-note oscillation between two pitches. The music distills down to nervous trills.

Picking up this oscillation from the lower strings, the first violin then expands the mechanical kernel into full-fledged virtuosity. What begins with the alternation of two left-hand fingers in a trill, a physical motion barely perceptible to the audience, spreads with widening intervals in the fingering left hand and the bow in the first violin. By m. 261 the trill oscillation becomes an oscillation of the bow much more visible and much more visibly "mechanical" than two fingers, between the open E-string and a stopped E on the A-string—a purely instrumental effect.



Example 2: Beethoven: String Quartet, Op. 132, mm. 251-263.

The material failings of the body subsume consciousness—a consciousness assigned in this coda to the second violin. While the second violin passionately declaims a dotted figure full of human sentiment in the last eight bars the movement nonetheless

ends in an anguished projection of death. The language of rationality subsides, and the lower three voices, after their wild oscillation, become cold pillars of support in the last three bars for the final unraveling of the first violin. Beethoven's use of virtuosity builds an explicit narrative that poses dark and pressing questions. Virtuosity may engage mechanical elements, yet this hardly makes it trivial, unimportant, or unworthy of scholarly attention.¹⁴⁶

For this reason, I claim that performing these works in a concert hall is hardly an outdated exercise in "high art." Compositions written during the first great turmoil in the relations between humans and machines still raise crucial issues of social meaning within the ever-shifting sands of the internet and electronically mediated interaction.

We must not ignore the raw social capital instrumental performance creates by its engagement with automata and industrialism. We rightly continue the ritual of live performances of works written hundreds of years ago, even in an age when recordings are readily available. Instrumental performance distills down to a crystalline essence both the immense dangers and the immense potential of human interaction with

¹⁴⁶ Elisabeth Le Guin writes in her book on Boccherini "[w]hy is virtuosity so often and so roundly dismissed by critics both of Boccherini's age and of ours?" Elisabeth Le Guin, *Boccherini's Body: An Essay in Carnal Musicology* (Berkeley and Los Angeles: University of California Press, 2006), 5.

technology. The virtuoso is indeed the machine come to life, and nothing is either as terrifying or enchanting as a machine with free will.

Bibliography

Primary Sources

Anonymous. "Concert mécanique [sic] de l'invention & execution du Sr Richard, rue de Richelieu, dans une sale de la bibliothèque du Roi, en entrant à gauche, au rez de chaussée." *Le Mercure de France* (1771): 152-154.

Brewster, David. *Letters on Natural Magic, addressed to Sir Walter Scott*. New York: Harper and Brothers, 1843.

Burney, Frances. *Evelina*. 1778. Edited by Edward Bloom and Vivien Jones. Oxford: Oxford University Press, 2002.

Caus, Salomon de. *Les Raisons des forces mouvantes, avec diverses machines tant utiles que plaisantes*. Paris: Hierosme Drouart, 1624.

Descartes, René. *The Passions of the Soul*. 1649. Translated by Stephen H. Voss. Indianapolis: Hackett, 1989.

Diderot, Denis. *Encyclopédie; ou Dictionnaire raisonné des sciences des arts et des métiers*. Paris: Braisson, 1751.

Doppelmayr, Johann Gabriel. *Historische nachricht von den nürnbergishcen mathematicis und künstlern*. 1730. Mainz: Schott's Söhne, 1971.

Engel, Johann Jacob. *Ideen zu einer Mimik*. 1785. Darmstadt: Wissenschaftliche Buchgesellschaft, 1968.

Espinasse, Francis. *Lancashire Worthies*. London: Simpkin, Marshall & Co., 1874.

Heine, Heinrich. "Florentinische Nächte" Vol. 5, *Historich-kritische Gesamtausgabe der Werke*. Edited by Manfred Windfuhr. Hamburg: Hoffmann und Campe, 1994.

Hoffmann, E.T.A. *Phantasiestücke in Callots Manier, Nachstücke*. Vol. 1, *Werke*. Edited by Gisela Spiekerkötter. Zurich: Stauffacher-Publishers Ltd., 1965.

Hoffmann, E.T.A. "Recension." *Allgemeine Musikalische Zeitung* 40 (1810): 630-642.

- Hoffmann, E.T.A. *The Tales*. Vol. 1, *Selected Writings of E.T.A. Hoffmann*. Edited and Translated by Leonard Kent and Elizabeth Knight. Chicago: University of Chicago Press, 1969.
- Goethe, Johann Wolfgang von. *Faust*. Edited by Erich Trunz. Munich: C.H. Beck, 2007.
- La Mettrie, Julien Offray. *Man a Machine and Man a Plant*. 1748. Translated by Richard A. Watson and Maya Rybalka. Introduction by Justin Leiber. Indianapolis: Hackett, 1994.
- Neudörffer, Johann, Andreas Gulden, and Georg Wolfgang Karl Lochner. *Des Johann Neudörffer Schreib-und Rechenmeisters zu Nürnberg Nachrichten von Künstlern und Werkleuten daselbst aus dem Jahre 1547: nebst der Fortsetzung des Andreas Gulden*. Wien: W. Braumüller, 1875.
- Rousseau, Jean-Jacques. "Essai sur l'origine des langues." In *Oeuvres complètes*. Edited by Michel Launay. Paris: Éditions due Seuil, 1967-1971.
- Schott, Gaspar. *Magia Universalis Naturae Et Artis*. Bamberg: Schönwetter, 1677.
- Staël, Germaine de. *The Mannequin: A Dramatic Proverb in Two Acts*. Translated by Vivian Folkenflik. New York: Columbia University Press, 1987.
- Swift, Jonathan. *Gulliver's Travels*. 1726. Boston: Houghton Mifflin, 1960.
- Vaucanson, Jacques de. *Le Mécanisme du Fluteur Automate: An Account of the Mechanism of an Automaton or Image Playing on the German-Flute*. Translated by J.T. Desaguiliers. 1742. Edited by David Lasocki. Reprint, Buren: Frits Knuf, 1979.
- Voltaire, "Discours en vers sur l'homme." 1738. In *Oeuvres complètes*. 10 vols. Paris: Garnier Frères, 1877.
- Weber, Carl Maria von. "Der Trompeter." *Allgemeine Musikalische Zeitung* 41 (1812): 663-666.
- Wilkins, John. *The mathematical and philosophical works of the Right Reverend John Wilkins late Lord Bishop of Chester*. London: J. Nicholson at the King's-Arms, 1707.

Secondary Literature

Mori, Masahiro. "The Uncanny Valley." Translated by Karl F. MacDorman and Norri Kageki. *IEEE Robotics and Automation Magazine* (2012): 98-100.

Robbins, Bruce. "Enchantment? No, Thank You." In *The Joy of Secularism*, edited by George Levine, 74-94. Princeton: Princeton University Press, 2011.

Kang, Minsoo. *Sublime dreams of living machines: the automaton in the European imagination*. Cambridge: Harvard University Press, 2011.

Wolf, Rebecca. *Friedrich Kaufmanns Trompeterautomat: Ein musikalisches Experiment um 1810*. Stuttgart: Franz Steiner Verlag, 2011.

Riskin, Jessica. "Machines in the Garden." *Republics of Letters: A Journal for the Study of Knowledge, Politics, and the Arts* 1, no. 2 (2010): <http://rofl.stanford.edu/node/59>.

Hirt, Katherine. *When Machines Play Chopin: Musical Spirit and Automation in Nineteenth-Century German Literature*. Göttingen: De Gruyter, 2010.

Cassedy, Steven. "Beethoven the Romantic: How E.T.A. Hoffmann Got It Right." *Journal of the History of Ideas* 71, no. 1 (2010): 1-37.

Sarasúa, Carmen. "Technical innovations at the service of cheaper labour in pre-industrial Europe. The Enlightened agenda to transform the gender division of labour in silk manufacturing." *History and Technology* 24, no. 1 (2008): 23-39.

Dolan, Emily. "E.T.A. Hoffmann and the Ethereal Technologies of 'Nature Music'" *Eighteenth Century Music* 5 (2008): 7-26.

Mayer, Paola. "Variations on a Romantic Theme: The Education of the Artist in E.T.A. Hoffmann's *Der Kampf Der Sänger und Der Feind*." *Seminar: A Journal of Germanic Studies* 43, no. 3 (2007): 280-300.

Nocks, Lisa. *The Robot: The Life Story of a Technology*. Westport: Greenwood, 2007.

- Voskuhl, Adelheid "Motions and Passions: Music-playing Women Automata and Cultural Commentary in Late 18th-Century Germany." In *Genesis Redux: Essays on the History and Philosophy of Artificial Life*, edited by Jessica Riskin, 293-320. Chicago: Chicago University Press, 2007.
- Voskuhl, Adelheid "Producing Objects, Producing Texts: Accounts of Android Automata in Late 18th-century Europe." *Studies in History and Philosophy of Science* 38 (2007): 422-444.
- Voskuhl, Adelheid. "The Mechanics of Sentiment: Music-Playing Women Automata and the Culture of Affect in Late Eighteenth-Century Europe." PhD diss., Cornell University, 2007.
- Chantler, Abigail. *E.T.A. Hoffmann's Musical Aesthetics*. Burlington: Ashgate, 2006.
- Cheung, Tobias. "From the Organism of a Body to the Body of an Organism: Occurrence and Meaning of the Word 'Organism' from the Seventeenth to the Nineteenth Centuries." *The British Journal for the History of Science* 39, no. 3 (2006): 319-339.
- Chapin, Keith. "The Nuances behind E.T.A. Hoffmann's Programmatic Statements." *19th-Century Music* 30, no. 1 (2006): 44-64.
- Mak, Su Yin. "Schubert's Sonata Forms and the Poetics of the Lyric." *The Journal of Musicology* 23, no. 2 (2006): 263-306.
- Buchmann, Bertrand Michael. "Protoindustrialisierung." In *Wien, Geschichte einer Stadt 3 Von 1790 bis zur Gegenwart*, edited by Peter Csendes and Ferdinand Oppl. Wien: Böhlau, 2006.
- Le Guin, Elisabeth. *Boccherini's Body: An Essay in Carnal Musicology*. Berkeley and Los Angeles: University of California Press, 2006.
- Kramer, Lawrence. "Music, Historical Knowledge, and Critical Inquiry: Three Variations on *The Ruins of Athens*." *Critical Inquiry* 32, no. 1 (2005): 61-76.
- Taruskin, Richard. *The Oxford History of Western Music*. Oxford: Oxford University Press, 2005.

- Gooley, Dana. "'La Commedia del Violino': Paganini's Comic Strains," *The Musical Quarterly* 88, no. 3 (2005): 370-427.
- Hübener, Andrea. "Stages of Imagination in Music and Literature: E.T.A. Hoffmann and Hector Berlioz." Translated by Siobhan Donovan and Andrew Johnstone. In *Music and Literature in German Romanticism*, edited by Siobhan Donovan and Robin Elliott, 123-41. Rochester: Camden House, 2004.
- Keil, Werner. "The Voice from the Hereafter: E.T.A. Hoffmann's Ideal of Sound and Its Realization in Early Twentieth-Century Electronic Music." Translated by Siobhan Donovan and Andrew Johnstone. In *Music and Literature in German Romanticism*, edited by Siobhan Donovan and Robin Elliott, 143-61. Rochester: Camden House, 2004.
- Bial, Henry, ed. *The Performance Studies Reader*. New York: Routledge, 2004.
- Hefling, Stephen and David Tartakoff. "Schubert's Chamber Music." In *Nineteenth-Century Chamber Music*, edited by Stephen Hefling, 39-139. New York: Routledge, 2004.
- Kawabata, Maiko. "Virtuoso Codes of Violin Performance: Power, Military Heroism, and Gender (1789-1830)." *19th-Century Music* 28, no. 2 (2004): 89-107.
- Riou, Jeanne. "Music and Non-Verbal Reason in E.T.A. Hoffmann." In *Music and Literature in German Romanticism*, edited by Siobhan Donovan and Robin Elliott, 43-55. Rochester: Camden House, 2004.
- Riskin, Jessica. "The Defecating Duck, or, the Ambiguous Origins of Artificial Life." *Critical Inquiry* 29, no. 4 (2003): 599-633.
- Mattli, Christian. *Der Tod der Primadonna: Der Mensch als Instrument im literarischen Werk E.T.A. Hoffmanns*. Bern: Lang, 2003.
- Dolan, Emily Iuliano. "The Origins of the Orchestra Machine." *Current Musicology* 76 (2003): 7-23.
- Yearsley, David. "Bach the Machine." In *Bach and the Meanings of Counterpoint*, 173-209.

Cambridge, 2002.

Chantler, Abigail. "Revisiting E.T.A. Hoffmann's Musical Hermeneutics." *International Review of the Aesthetics and Sociology of Music* 33, no. 1 (2002): 3-30.

Schechner, Richard. *Performance Studies: An Introduction*. New York: Routledge, 2002.

King, Elizabeth. "Clockwork Prayer: A Sixteenth-Century Mechanical Monk." *Blackbird* 1, no. 1(2002):
http://www.blackbird.vcu.edu/v1n1/nonfiction/king_e/prayer_print.htm.

Kowar, Helmut. *Die Wiener Flötenuhr*. Vienna: Technisches Museum Wien, 2001.

Abbate, Carolyn. *In Search of Opera*. Princeton: Princeton University Press, 2001.

Richards, Annette. "Automatic Genius: Mozart and the Mechanical Sublime." *Music and Letters* 80, no. 3 (1999): 366-389.

Moevs, Christian. "Miraculous Syllogisms: Clocks, Faith and Reason in Paradiso 10 and 24." *Dante Studies* 117 (1999): 59-84.

Abbate, Carolyn. "Outside Ravel's Tomb." *Journal of the American Musicological Society* 52, no. 3 (1999): 465-530.

Rosen, Charles. *The Classical Style: Haydn, Mozart, Beethoven*. 1971. *Expanded Edition*. New York: Norton, 1998.

Metzner, Paul. *Crescendo of the Virtuoso: Spectacle, Skill, and Self-Promotion in Paris during the Age of Revolution*. Berkeley and Los Angeles: University of California Press, 1998.

Kinderman, William. "Wandering Archetypes in Schubert's Instrumental Music," *19th-Century Music* 21, no. 2, (1997): 208-222.

Rumph, Stephen. "A Kingdom Not of This World: The Political Context of E.T.A. Hoffmann's Beethoven Criticism." *19th-Century Music* 19, no. 1 (1995): 50-67.

Keil, Werner. "Mechanismus und Organismus: Zu E.T.A. Hoffmanns Rezension der

- Beethovenschen Klavierstrios Op. 70." *Neues musikwissenschaftliches Jahrbuch* 4 (1995): 77-92.
- Grave, Floyd. "Metrical Dissonance in Haydn." *Journal of Musicology* 13 (1995): 168-202.
- Hadlock, Heather. "Return of the Repressed: the prima donna from Hoffmann's 'Tales' to Offenbach's 'Contes.'" *Cambridge Opera Journal* 6, no. 3 (1994): 221-243.
- Keil, Werner. "Dissonanz und Verstimmung: E.T.A. Hoffmanns Beitrag zur Entstehung der musikalischen Romantik." *E.T.A. Hoffmann Jahrbuch* I (1992-3): 119-32.
- Schmitt, Ulrich. *Revolution im Konzertsaal: Zur Beethoven-Rezeption im 19. Jahrhundert*. Mainz: Schott, 1990.
- Abbate, Carolyn and Roger Parker. "Dismembering Mozart." *Cambridge Opera Journal* 2, no. 2 (1990): 187-195.
- Beaune, Jean-Claude. "The Classical Age of Automata." In *Fragments for a History of the Human Body*. Part 1, edited by Michel Feher, Ramona Naddaff, and Nadia Tazi, 160-219. New York: Urzone Bukes, 1989.
- Charlton, David. *E. T. A. Hoffmann's Musical Writings: Kreisleriana, The Poet and the Composer, Music Criticism*. Cambridge: Cambridge University Press, 1989.
- Hoff, Dagmar von and Helga Meise. "Tableaux vivants – Die Kunst – und Kultform der Atitüden und lebenden Bilder." In *Weiblichkeit und Tod*, edited by Renate Berger and Inge Stephan, 69-86. Köln: Böhlau, 1987.
- Turner, Victor. *The Anthropology of Performance*. New York: PAJ Publications, 1987.
- Keil, Werner. *Hoffmann als Komponist: Studien zur Kompositionstechnik an ausgewählten Werken*. Wiesbaden: Breitkopf und Hartel, 1986.
- Hammerstein, Reinhold. *Macht und Klang: tönende Automaten als Realität und Fiktion in der alten und mittelalterlichen Welt*. Bern: Francke, 1986.
- Wehmeyer, Grete. *Carl Czerny und die Einzelhaft am Klavier oder Die Kunst der Fingerfertigkeit und die industrielle Arbeitsideologie*. Basel: Bärenreiter, 1983.

Ord-Hume, Arthur W.J.G. "Cogs and Crotchets: A View of Mechanical Music." *Early Music* 11, no. 2 (1983): 167-171.

Schnapp, Friedrich, ed. *Der Musiker E.T.A. Hoffmann: Ein Dokumentenband*. Gerstenberg: Hildesheim, 1981.

Dahlhaus, Carl. "E.T.A. Hoffmann's Beethoven-Kritik und die Ästhetik des Erhabenen." *Archiv für Musikwissenschaft* 38, no. 2 (1981): 79-92.

Ehmer, Josef. *Familienstruktur und Arbeitsorganisation im fruhindustriellen Wien*. Wien: Verlag für Geschichte und Politik, 1980.

Dahlhaus, Carl. *Die Idee der absoluten Musik*. Kassel: Bärenreiter, 1978.

Jones, Michael T. "Hoffmann and the Problem of Social Reality: A Study of 'Kater Murr.'" *Monatshefte* 69, no. 1 (1977) 45-57.

Hoover, Cynthia A. *The history of music machines*. New York: Drake Publishers, 1975.

Schafer, R. Murray. *E.T.A. Hoffmann and Music*. University of Toronto, 1975.

Weiss-Stauffacher, Heinrich. *Mechanische Musikinstrumente und Musikautomaten: beschreibender Katalog der Seewener Privatsammlung*. Zurich: Orell Füssli Verlag, 1975.

Peters, Diana Stone. "E.T.A. Hoffmann: The Conciliatory Satirist." *Monatshefte* 66, no. 1 (1974): 55-73.

Cone, Edward T., "Schubert's Beethoven," *The Musical Quarterly* 56, no. 4 (1970): 779-793.

Turner, Victor. *The Ritual Process: Structure and Anti-Structure*. Chicago: Aldine, 1969.

Benjamin, Walter. "The Work of Art in the Age of Mechanical Reproduction." In *Illuminations: Essays and Reflections*, edited by Hannah Arendt, 217-251. Translated by Harry Zohn. New York: Schocken Books, 1969.

Needham, Joseph. *Science and Civilization in China*. Vol. 4, *Physics and Physical*

- Technology. Part 2, Mechanical Engineering.* Cambridge: Cambridge University Press, 1965.
- Bedini, Silvio A. "The Role of Automata in the History of Technology," *Technology and Culture* 5, no. 1 (1964): 24-42.
- Chapuis, Alfred and Edmond Droz. *Automata: A Historical and Technological Study.* Translated by Alec Reid. Neuchâtel: Editions du Griffon, 1958.
- Chapuis, Alfred. *History of the musical box and of mechanical music.* 1955. Translated by Joseph E. Roesch. Summit, N.J.: Musical Box Society International, 1980.
- Merriam Sherwood, "Magic and Mechanics in Medieval Fiction." *Studies in Philology* 44, no. 4 (1947): 567-592.
- Zeydel, Edwin H. "Were Hrotsvitha's Dramas Performed during her Lifetime?" *Speculum* 20, no. 4 (1945): 453-454.
- Protz, Albert. *Mechanische Musikinstrumente.* Kassel: Bärenreiter-Verlag, 1939.
- Leichtentritt, Hugo. "Mechanical Music in Olden Times." *The Musical Quarterly* 20, no. 1 (1934): 15-26.
- Chapuis, Alfred, and Edmond Droz. *Le monde des automates; étude historique et technique,* 2 vols. Paris: E. Géli, 1928.
- Sonneck, O.G., and Frederick H. Marens. "Heinrich Heine's Musical Feuilletons [Concluded]." *The Musical Quarterly* 8, no. 3 (1922): 435-68.
- Gennep, Arnold van. *The Rites of Passage.* 1908. Translated by Monika B. Vizedom and Gabrielle L. Caffee. Chicago: University of Chicago Press, 1960.