A Brief History of Re-performance

by

Nicholas Patrick Seaver

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Signature of Author: _____
Program in Comparative Media Studies
11 May 2010

Certified by: _____
William Uricchio
Professor of Comparative Media Studies
Director, Comparative Media Studies
Thesis Supervisor

Accepted by: _____
William Uricchio
Professor of Comparative Media Studies
Director, Comparative Media Studies

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Abstract

Discussions of music reproduction technology have generally focused on what Jonathan Sterne calls “tympanic” reproduction: the recording and playback of sounds through microphones and speakers. While tympanic reproduction has been very successful, its success has limited the ways in which music reproduction is popularly imagined and discussed.

This thesis explores the history of “re-performance,” an alternative mode of reproduction epitomized by the early twentieth-century player piano. Re-performance centers around the recreation of a sound’s source rather than sound waves themselves.The thesis begins with a discussion of nineteenth-century piano recorders and the historical role of material representation in the production of music. It continues with the advent of player pianos in the early twentieth century that allowed users to “interpret” prerecorded material, blurring the line between performance and reproduction and inspiring popular reflection on the role of the mechanical in music. It concludes with the founding of the American Piano Company laboratory in 1924 and the establishment of a mechanically founded rhetoric of fidelity. Bookending this history is an account of a performance and recording session organized by Zenph Studios, a company that processes historical tympanic recordings to produce high-resolution data files for modern player pianos. Zenph’s project appears futuristic from the perspective of tympanic reproduction, but is more readily understood in terms of the past, through the history of re-performance, suggesting a need for renewing critical attention on re-performative technologies.

Contemporary developments in music reproduction such as music video games and sampling may make new sense considered in the context of re-performance. This alternative history aims to provide a ground on which such analyses could be built.

Thesis Supervisor: William Uricchio
Title: Professor of Comparative Media Studies

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Biographical Note

Nick Seaver graduated from Yale University with a BA in Literature in 2007. His undergraduate thesis explored social constructions of "noise" through the history of sound reproduction technology. In the masters program in Comparative Media Studies at MIT, he has studied artistic uses of indeterminacy, spatial experience in the video game *Half-Life 2,* the physical artifacts produced by noise artists, and the production of semi-autonomous musical systems. He has worked as a research assistant for Project New Media Literacies and HyperStudio, MIT's lab for the digital humanities.

In Fall 2010, he will start in the PhD program in Anthropology at UC Irvine.

He can be contacted at nick.seaver@gmail.com. Please contact before citing or quoting from this paper.

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Thanks to John Q. Walker, Anatoly Larkin, and the other members of the Zenph team for welcoming me into their studio, helpfully answering my incessant questions, and showing me their vision of the musical future.

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In memory of Stuart G. Berggren.

“The past is not surpassed”: Making Pianistic History

> “I was totally wowed,” a woman in the audience told CBC News. “The only thing missing was a hologram of Gould actually playing.”[1]

In 2006, on what would have been Glenn Gould’s 74th birthday, in the studio named after him at the Canadian Broadcasting Centre in Toronto, Zenph Studios produced a concert featuring his performance of the work that launched his career when he recorded it for Columbia Masterworks 50 years previous: Bach’s *Goldberg Variations.* The *Variations*, published in 1741, had been considered esoteric harpsichord music until Gould’s interpretation on the piano revived them for a modern audience—an aria and 30 short contrapuntal variations on its bass theme. Zenph’s concert was unusual in many respects, but two facts suggested that it should not have happened at all: Gould famously abandoned live performance at the age of 31, and he died at 51.

The bench in front of the 9-foot grand piano was empty, as was an adjustable wooden chair upstage—a replica of the chair Gould always sat on when he played. Atop another piano bench downstage was a small computer with a glowing green LCD screen—a cable ran from it to the underside of the piano. A copy of Gould’s 1955 *Goldberg Variations* record leaned against the front of the bench. With no one on stage, the piano began to play—in Gould’s unmistakable style—the opening Aria of the *Variations*.[2]

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[1] CBC Arts, “Software, robotic piano replicate Gould's Goldberg Variations.”

[2] This description derives from John Walker, interview with the author, February 18, 2010; and Mark Manring, “Glenn Gould in Re-performance.”

The concert was not a séance, but rather what Zenph Studios called a "re-performance":

> Zenph® Studios takes audio recordings and turns them back into live performances, precisely replicating what was originally recorded. Our software-based process extracts every musical nuance of a recorded performance, and stores the data in a high-resolution digital file. These re-performance files contain the details of how every note in the composition was played, including pedal actions, volume, and articulations – all with millisecond timings.[3]

The piano was not an ordinary piano, but a Yamaha Disklavier Pro Mark III—a robotic piano that could, with the aid of the computer at the foot of the stage, play itself. Zenph's team of human and technological listeners—algorithms, musicologists, analog-to-digital converters, pianists, microphones, and software engineers—had pored over Gould's 1955 recording and had carefully constructed digital files that now sat in the memory of the on-stage computer. Although Gould was not seated at the bench, he seemed to be everywhere else: in the grooves of the record, the name of the studio, the replica of his chair, and in the few megabytes of data that ran through the cable and triggered the array of precision solenoids attached to the piano's internal mechanism, or "action." That "the only thing missing" seemed to be a holographic projection of Gould himself was a testament to the success of Zenph's other projection: the motion of Gould's hands and feet, pulled through time and space in thousands of precise measurements and reconstituted by the technological apparatus on stage.

Zenph's project appeared unremittingly contemporary, the stuff of holograms, robots, listening algorithms, solenoid arrays, and digital files. However, as contemporary as it seemed, it was also intricately historical. From Gould's remediated

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[3] Zenph Studios, "What is a Re-performance?"

omnipresence to Bach's reinterpreted harpsichord music to the piano itself—an instrument invented at the start of the eighteenth century—the scene on stage was as much historical tableau as futuristic holodeck. In *We Have Never Been Modern,* Bruno Latour writes, "We do have a future and a past, but the future takes the form of a circle expanding in all directions, and the past is not surpassed, but revisited, repeated, surrounded, protected, recombined, reinterpreted, and reshuffled."[4] Reproducing technologies play a critical role in this relationship between the past and the future: it is not coincidental that the stage of Zenph's re-performance was occupied by a computer, a piano, and a vinyl record. However, it is all too easy to forget that reproducing technologies themselves have histories.

Lisa Gitelman writes, "media tend to be very slippery historical subjects," the victims of "tenacious, valorizing narratives of *dematerialization."*[5] The holographic imagination of the woman in Zenph's audience follows one such narrative out to its logical conclusion: a virtual performance by a dead man, visually and sonically identical to the original but completely dematerialized. Successful media erase themselves, and Gould's hologram is in a sense the goal—a spectral and immaterial figure that transcends the technology used to produce it. That the woman forgets the material contents of the stage is entirely the point: As Zenph's founder John Q. Walker says, "We're trying to abstract away the performance."[6]

If Zenph's goal is the dematerialization of performance—the lifting of performance from its historical, technological, and cultural context—then the goal of

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[4] Latour, *We Have Never Been Modern,* 75.

[5] Gitelman, "Media, Materiality, and the Measure of the Digital," 199.

[6] Walker, interview with the author.

this thesis might be considered re-materialization. The logic of reproduction and abstraction denies historical specificity in favor of repeatability. Zenph's version of Gould's performance was only "the same" as the original in specific and intentionally delimited ways. If one focuses attention elsewhere—on the robotic piano and glowing screen and listening algorithm, for example—then it quickly becomes clear just how different "the same" can be. This thesis attempts to explore this difference, reinstalling re-performance in its historical and cultural contexts. Futuristic visions of virtual pianists have precedents in machines as mundane as nineteenth-century piano transcription machines and as seemingly obsolete as early twentieth-century player pianos. And although these technologies are all invested in abstraction and repetition, they embody concrete and local ideas about music, performance, and the nature of reproduction. Re-performance has a history.

Tympanic reproduction

Zenph's project seems strange partially as a result of the way we usually experience reproduced sound. Jonathan Sterne writes in *The Audible Past* that, "Prior to the nineteenth century, philosophies of sound usually considered their object through a particular, idealized instance such as speech or music."[7] This changed in the nineteenth century: Sterne writes, "In acoustics, physiology, and otology, sound became a waveform whose source was essentially irrelevant [...] Where speech or music had been the general categories through which sound was understood, they

[7] Sterne, *Audible Past,* 23.

were now special cases of the general phenomenon of sound."[8] In this context, technologies that sought to reproduce sound—like Edison's phonograph or Bell's telephone—treated it as a form of motion, using transducers modeled on the human eardrum, or "tympanum," to capture and produce vibrations. Because of this early connection between the physiology of the ear and sound reproducing technology, Sterne refers to this mode of reproduction as "tympanic."[9]

Tympanic reproduction has been tremendously successful, and as a result has come effectively to define modern sound reproduction. All conventional speakers and microphones are based on this tympanic mechanism. The vast majority of music recorded today is listened to through speakers, recorded by microphones in the studio as a series of human and transducer duets, and edited through the manipulation and eventual fixing of a set of tympanic records into a "master" copy. Consequently, the language used to describe sound and its reproduction is organized according to this paradigm: terms such as "liveness," "fidelity," and even "record" denote and connote relations that are frequently derived from tympanic recording practices.[10]

Re-performance

As Sterne describes, part of the power of tympanic reproduction comes from the idea that it is a "universal" sound reproducer, able to treat sound as a general category, indifferent to its source, and to isolate hearing from the rest of the body. What

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[8] Ibid.

[9] Sterne's account is founded on a device called the "ear phonautograph" that literally used a human ear to transduce sound.

[10] For an appraisal of "liveness," see Auslander, *Liveness*, ch. 3; for "fidelity," see Sterne, *Audible Past,* ch. 5; for "record," see Gitelman, *Always Already New,* ch. 1.

Sterne makes clear in his book is the cultural labor that was required to attain this effect—the sense that sounds produced by a speaker actually had no local source, but had somehow become split from their "actual" source.[11] Sterne writes, "Attending to differences between 'sources' and 'copies' diverts our attention from processes to products; technology vanishes, leaving as its by-product a source and a sound that is separated from it."[12] Re-performance, on the other hand, is explicitly concerned with the reproduction of sources and *music,* as opposed to the more general "sound."[13] Instead of considering reproduction as a means by which original sources are technologically superseded, re-performance seeks to reproduce sources *per se.* Anatoly Larkin, music producer at Zenph, says, "What we try to create is, as much as possible, the accurate live performance that would match exactly the performance that happened on the day of the recording many years ago."[14] This logic is at the core of the re-performative project.

Precisely defining re-performance is difficult. The definition of tympanic recording is supported by scientific definitions that came of age with the technique itself; the scientific appraisal of sound as motion supported a relatively clearly defined set of technologies that sought to capture and reproduce vibrations in the air. It is harder to find settled agreement on what constitutes a performance or a musical work.

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[11] This idea has been further theorized in terms of acoustic ecology as "schizophonia" in R. Murray Schafer, *The Soundscape,* and it was proposed as the basis for *musique concrète* in Pierre Schaeffer, "Acousmatics."

[12] Sterne, *Audible Past,* 21.

[13] Developments in modern music that treat music as "organized sound" complicate this distinction in productive ways, and although not included here due to scope, a re-performative analysis of such experimental music would prove quite interesting. See Kahn, *Noise, Water Meat,* Part II for more on the incorporation of "sound" into "music."

[14] Anatoly Larkin, interview with the author.

Because performance is contested, re-performance is contested as well. John Walker, for example, rejects a close connection between the re-performative work of the early player piano and Zenph's work on the grounds that piano recording technology in the early twentieth century did not capture the "whole" performance.[15] That position raises a question: Just what is a "whole" performance? Where Sterne's history of tympanic reproduction begins in the past with a concrete yet universalizing mechanism, my history of re-performance begins in the present, with an abstract yet materially specific question: How does one make performance happen again?

Pianistic reproduction

Because re-performance operates in specific rather than universal ways, this thesis focuses on one type of re-performance: the mechanical recreation of individual keyboard performances—a practice that I call "pianistic reproduction." The piano had become one of the primary sources of music in American and western European homes over the course of the nineteenth century, and by the turn of the century had become a potent cultural symbol. Production of pianos increased dramatically at the start of the twentieth century, and it was with the piano that the most popular historical example of re-performance—the player piano—was developed.[16]

Pianistic reproduction draws on the idea of "pianism"—a term that originates in the mid-nineteenth century and describes both technical and artistic mastery of the

[15] Walker, interview.

[16] See Roell, *The Piano in America* for a thorough history of the piano in Victorian America.

piano.[17] As a historically appropriate term and one that embodies the hybrid nature of the pianist's role—machine operator and artist—"pianism" is a useful way to think about what is recorded and reproduced by devices like the player piano. If tympanic technologies were consciously modeled on an understanding of the physiology of the ear and the physics of vibration, pianistic technologies were modeled on an understanding of what it meant to play the piano. While many of the issues raised by pianistic reproduction find analogs in other forms of re-performance, the current argument is intentionally limited to preserve material specificity. Although other automatic instruments exist, there are often considerable differences in their performance traditions, histories of automation, and relationships to musical scores.[18] Re-performance privileges the specific over the universal, and this thesis follows that lead.

A brief history

Sterne describes his history of tympanic reproduction as "deliberately speculative," using "history as a kind of philosophical laboratory—to learn to ask new questions about sound, technology, and culture."[19] The history in this thesis is aimed toward similarly exploratory ends. If tympanic reproduction structures the language of reproduction and sound in particular ways, what alternatives appear when we attend to re-performance? What follows from considering reproduction and performance

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[17] *Oxford English Dictionary Online. "*pianism, n." March 2009. http://dictionary.oed.com/cgi/entry/00299371.

[18] See Bowers, *Encyclopedia of Automatic Musical Instruments* for many more examples, including automatic banjo trios, music boxes, and combination violin and piano-playing cabinets.

[19] Sterne, *Audible Past,* 27.

together, instead of as technologically distinguished opposites? How do historical ideas about pianism influence the development of technologies for pianistic reproduction?

I do not intend to produce a coherent and teleological alternative history of sound reproduction. Walker says, about tympanic reproduction, that "Edison took us down one path for 125 years."[20] I am not interested in retrospectively clearing another. Rather, I seek to use the devices in this history as epistemic objects—machines that reflect momentary historical arrangements and ideas about performance and music. These are machines to think with, and they offer materially and historically situated ways to explore the ramifications of re-performance.

Gitelman's concept of "material meaning" guides my approach to understanding these technologies: this type of meaning is "that nexus of cultural practices, economic structures, and perceptual and semiotic habits that make tangible things meaningful."[21] The technologies in this thesis acquire and produce meanings in ways that are deeply contextual. Thinking of them as "socially embedded sites for the ongoing negotiation of meaning" rather than "points of epistemic rupture" allows for the appreciation of this contextuality while avoiding, as much as possible, presentist revisions that seek to establish a canon of foundational moments.[22] This focus on context and situated material meaning is doubly important for a technology like the player piano, which has

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[20] Walker, interview.

[21] Gitelman, "Media, Materiality," 203.

[22] Gitelman, *Always Already New,* 6.

been enrolled into the prehistory of computing, ostensibly as a result of its "failure" in the history of music reproduction.[23]

When Gitelman and Sterne discuss the ways that media erase themselves, they are describing success stories. Re-performance is not currently a widely diffused success (although it may have been in the early twentieth century and may yet be).[24] As a result, its self-erasure is incomplete: Zenph's concert was a self-consciously technological spectacle, and we cannot imagine listening "through" a player piano in the way we listen "through" a tympanic record, as if the medium were transparent.[25] Histories of tympanic reproduction benefit from studying a surviving medium in a historical period of transition, when today's norms and common ideas were still contingent and in flux. Re-performance has never (with perhaps the momentary exception of the early 1920s) reached a point of cultural stability and widespread use against which to define a period of "transition"—it has been, effectively, always in transition.

The chapters of this thesis focus on three dominant issues that arise with regularity in attempts to reproduce performance, linking them to historical epistemic objects. Although these objects arrive in chronological order, this is not to imply that the issues raised are necessarily nested or sequential. Chronology anchors these

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[23] Historian David Suisman outlines (and to an extent, endorses) this reclamation of the player piano as "digital" in an article published shortly before the completion of this thesis. See Suisman, "Sound, Knowledge, and the Immanence of Human Failure." The allegorical use of the player piano as a symbol of obsolescence and mechanical alienation is also widespread. See Gaddis, *Agapē Agape* and Vonnegut, *Player Piano* for two of many examples.

[24] Turntablism, music video games such as Guitar Hero, and digital audio manipulation all resonate with the logic of re-performance; possible futures of re-performance are discussed in the conclusion.

[25] Jonathan Sterne describes this mode of listening in terms of "audile technique," owing much to the history of medical auscultation and sound telegraphy. See *Audible Past,* ch. 3.

objects in one order; in actuality, the practices described here frequently overlap and influence each other, as will become evident over the course of this thesis.

Chapter 1 discusses the material representation of music and performance. Through the history of nineteenth-century piano recorders—devices that automatically transcribed keyboard performances—I examine the relationship between performance, authorship, and writing technologies in the context of the musical work. This relationship, under continuous social, cultural, and technological negotiation, provides the backdrop for the developments that make up the rest of the thesis.

Chapter 2 considers the reconfiguration of musical labor effected by automatic piano players. These machines provided the "playback" to Chapter 1's "recording." By separating the work of pianism into parts, automatic players allowed users to "interpret" music that had already been recorded by an expert pianist. Mechanical notions of pianistic expertise allowed for the redistribution of pianism among a variety of human and machine components. The rising popularity of the Pianola and other similar devices at the start of the twentieth century inspired fervent defenses and critiques of the role of technology in music production. Cultural anxieties about the relationship between mechanical and musical expertise manifested in these responses to complicated machinery.

Chapter 3 explores the role of scientific discourse in the establishment of re-performative fidelity. The advent of high-end reproducing pianos—devices that automated dynamic control of the piano—allowed for the reproduction of performances that had been captured on special recording pianos. Through the example of the American Piano Company laboratory, founded in the mid 1920s, this

chapter outlines an ideal that I call “mechanical fidelity”—a rhetoric of sameness that is rooted in an understanding of pianos and pianism as fundamentally mechanical. Player companies competed with each other on the basis of fidelity, mutually constructing piano performance as mechanical and automatic pianos as artistic to achieve a reproductive ideal: perfectly and completely accurate, musical renditions of recorded performance.

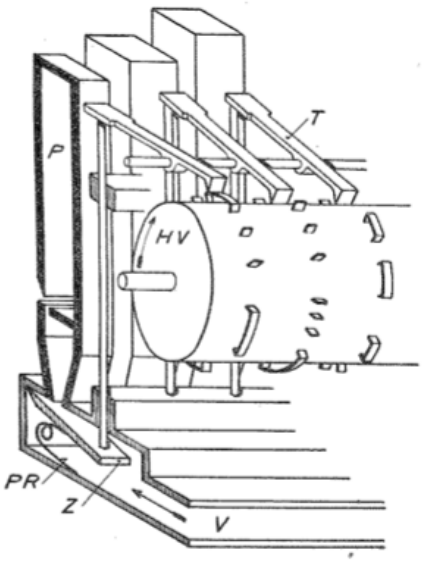
I conclude with an extended reflection on the modern context of Zenph’s re-performance project. Unlike the other technologies of this thesis, Zenph works intimately with tympanic reproduction, providing a case study for how re-performance might work in an environment thoroughly dominated by tympanic understandings of music reproduction. Through an information-theoretic approach, constructing performances as “data” and pianos and speakers as “rendering devices,” Zenph promises (or threatens) to collapse the distinction between tympanic and re-performative reproductions. Although the language of information theory implies a homogenizing and universalized newness that obviates the material specificity of performance, Zenph’s production of data is intermingled with material concerns. Through renovated ideas about musical representation, labor, and fidelity, Zenph offers one way to imagine the future of re-performance.

I hope that this alternative media history defamiliarizes the technology of music reproduction. The success of tympanic reproduction has lent it a sense of inevitability and universality; through demonstrating other ways it might have been (and ways it actually was), I aim to recover the viability of alternatives. Re-performance offers novel ways to think about reproduction, music, and technology. As the established norms

and truisms of tympanic reproduction struggle to account for the proliferation of digital file types, increases in interactivity, and complications of the relationship between originals and copies, authors and audiences, this history of re-performance suggests an alternative way to make sense of it all.

1. Representation: Reading, Writing, and Recording Performance

In 1775, the French monk Joseph Engramelle published *La Tonotechnie, ou L'art de noter les cylindres*, a treatise on the art of pinning cylinders for barrel organs. These organs were played by a rotating cylinder studded with pins (Fig. 1). The pins, in conjunction with a mechanism inside the organ, allowed air to flow through various pipes without the need for anyone to play the keyboard. The barrel organ itself is supposedly of pre-Christian origin, one of the earliest "automatophones"—instruments that play themselves—and their basic mechanism persists today in comb-tooth music boxes.[26] These cylinders "contained" music, but they did so in a way that would seem unusual to modern listeners. The barrel organ inarguably produced music, but what was the cylinder? Was it a performer, the producer of music? Or was it a kind of notation, music fixed in material form?



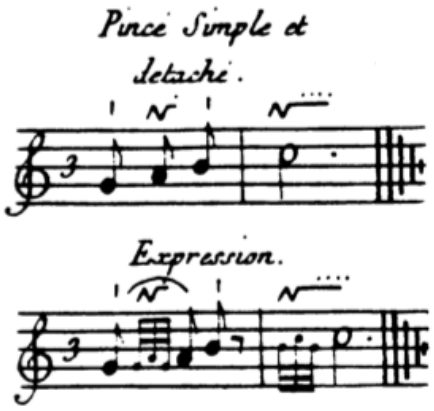
1. Pinned cylinders. This diagram shows the mechanism of the barrel organ: the cylinder *(HV)* rotates, opening the pipes *(P)* through a lever mechanism *(T).* (Buchner, *Mechanical*)

Questions like these, posed retroactively, do little to help us understand the material meaning of the barrel organ for Engramelle, in his historical context. They assume a stability of the relationship between performers, scores, and musical works

[26] Buchner, *Mechanical Musical Instruments*. Ord-Hume, *Barrel Organ.* Fuller, "An Introduction to Automatic Instruments."

that—as we will see in this chapter—is continually evasive. The production of music is a deeply technological enterprise, and these technologies produce meaning in cultural contexts. So, to understand the relationship the barrel organ had to notation, it is important to consider the relationship Engramelle would have had to notation technologies.

Engramelle's treatise is interesting because it explicitly addresses the role of the organ cylinder as a musical record. Engramelle's goal, outlined in his treatise, was that "the works of the great composers, played by the great masters, should be preserved with the help of mechanical musical instruments."[27] The gap between music as it was notated and music as it was played during Engramelle's time was significant: the performer's work included the production of non-notated "ornamentation"—nearly continuous small flourishes and expressive grace notes (Fig. 2). Organ cylinders, which had primarily been translations of musical notation, had typically omitted these distinctive components of human playing style. Engramelle, significantly, sought to reproduce the timing and ornamentation of human players, making the cylinder a record of not only the composition, but the way it was performed.



2. Ornamental expression. These two staves from one of Engramelle's students show the difference between music as it would be notated and played. The bottom line represents what would be pinned on an organ cylinder. The lines above the notes are the pinner's shorthand. (Ord-Hume, "Ornamentation")

[27] Buchner, *Mechanical Musical Instruments,* 16.

Historians and musicologists interested in mechanical music have enrolled Engramelle into their history as a founding figure in the connection between human playing and machine playing. His cylinders, they suggest, offer a way to access the ephemeral performance styles of his period. Musicologist David Fuller writes,

> The elaborate code of separation of notes down to the very smallest is claimed by Engramelle to be based on the playing of the finest artists of the day. [...] We have, in the matter of articulation at least, a direct link between the analysis of a playing style and its realization on cylinders.[28]

For Fuller and others, cylinders operate like a recording might today: a representation of a musical work in a particular instantiation. Fuller writes that these cylinders are "the only totally authentic medium" through which to hear organ music as it actually was.[29]

Engramelle's cylinders start this chapter as one example of the myriad ways that musical representation—the fixing of music into material form—can work. Material representations of music, critically, are the subjects and objects of particular kinds of writing and reading. Engramelle's cylinders could be "read" by barrel organs or musicologists, to different ends. As new representations of music emerge, they do so alongside new modes of writing and reading them.

Musical writing

In 1881, three years after Edison introduced his first phonograph, Thomas Lea Southgate collected together a short chronology of piano recording devices for the Royal Musical Association. He titled it "On Various Attempts That Have Been Made to Record Extemporaneous Playing." The occasion was the British introduction of

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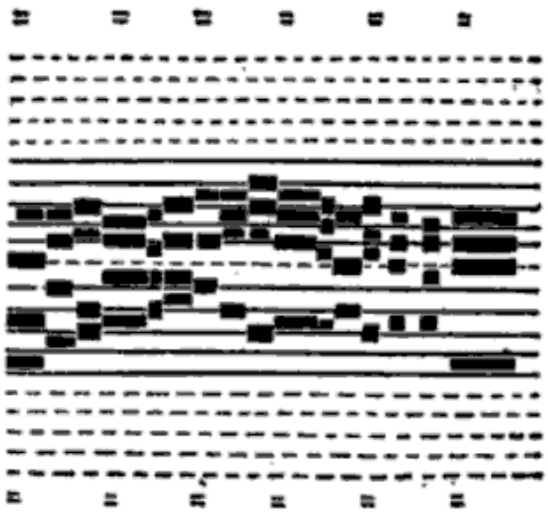
[28] Fuller, "Automatic Instruments," 166.

[29] Ibid.

German telegraph engineer J. Föhr's *Electro-chemischer Notenschreib-apparat*, or "Music Electrograph," a device that, installed into a standard piano, would electrochemically mark a moving roll of paper with lines corresponding to the notes that had been played. A set of platinum styli press on an unwinding paper roll; "the paper as it passes through the machine is saturated with a chemical solution of ferrocyanide of potassium, sulphuric acid and water"; and when a piano key is pressed, "a circuit is completed, and the current runs from a Leclanché battery, passing through the saturated paper" and "staining it a bluish color."[30] Lengths of lines indicated lengths of notes, and black and white keys were distinguished from each other in the transcription by the use of thick lines for the white keys and thin lines for the black (Fig. 3). An auxiliary foot pedal allowed the pianist to stamp out the time while he played, marking the roll with rhythmic divisions. These chemical traces, once set, were "ruled, by means of an inking roller, with the usual lines of the staves, and some dotted ledger lines above and below."[31] Once ruled, Southgate wrote,



3. Hybrid notation. The lines of the electrograph were made "musical" by the subsequent printing of staff and ledger lines. (Grove, "automatic appliances")

> There is no great difficulty in translating this species of musical shorthand; with a little patience and intelligence, it can readily be done, either by the composer or his amanuensis.[32]

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[30] Southgate, "Various Attempts," 195.

[31] Ibid.

[32] Ibid., 196.

This and the other piano recorders in Southgate's review, dating back as far as 1747, constitute a small menagerie of writing machines that rely on various banks of inscriptive points—blades, crayons, pencils, inked wheels, and electrochemical styli—to "write" music. Lisa Gitelman suggests in *Scripts, Grooves, and Writing Machines* that "inventing new ways to write or new kinds of writing presupposes a model of what writing and reading are and can be."[33] Music writing had generally been the domain of composers, situated at the headwaters of musical production. Piano recorders like Föhr's Electrograph performed a strange kind of automatic writing, suggesting that the connection between performance and authorship was not necessarily unidirectional. These machines called in to question accepted norms about the proper role of musical representation—its place in an already contested system of cultural production—and set the stage for a renovated approach to musical reading.

Werktreue

The translation of notation to sound via performance was as old as notation itself, but the terms of this translation—the relationships between authors, written symbols, performers, and ultimate sounds—were subject to continuous social and technological negotiation. This negotiation, from around 1800, revolved around the emerging ideal of *Werktreue*—faithfulness to a musical "work."[34] *Werktreue* proved to be a powerful regulative ideal, as philosopher of music Lydia Goehr writes,

> Following from the central conception of a musical work as a self-sufficiently formed unity, expressive in its synthesized form and content of a genius's idea, was the general submission of all associated concepts.

[33] Gitelman, *Scripts, Grooves, and Writing Machines,* 4.

[34] Goehr, *The Imaginary Museum of Musical Works.*

> Concepts and ideals having to do with notation, performance, and reception acquired their meaning as concepts subsidiary to that of a work.[35]

Understanding the material meaning of piano recorders requires an appreciation of this technocultural context; for Southgate, notation and extemporaneous playing would have acquired meaning with and against the dominant ideal of the work. Translating across the liminal spaces of the musical work, piano recorders might be considered as material arguments about its parts, technologically enacting particular arrangements of performance, notation, and writing.

Virtuosi

In the early nineteenth century, the public face of pianism was dominated by virtuoso players like Franz Liszt, whose astronomical popularity prefigured contemporary celebrity culture.[36] Jim Samson writes of early nineteenth-century pianism that it "was in a special sense a performance culture, in that it was centred on, and invested in, the act of performance rather than the object of performance, which was usually, but not always, the musical work."[37] However, over the course of the nineteenth century, this performance-centered culture gave way to an increased focus on *Werktreue*:

> [A]s the notated text congealed into a fixed form, supposedly representing its author's intentions, so the performer became increasingly an interpreter:

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[35] Ibid., 242.

[36] German poet Heinrich Heine coined the term "Lisztomania" to describe the ecstatic response of a predominantly female fan base at Liszt's performances, imagery that strongly recalls the "Beatlemania" of the 1960s, both in its fervor and gendered portrayal of fan behavior. For more on the virtuoso phenomenon, see Hamilton*, After the Golden Age.*

[37] Samson, "The Practice of Early-Nineteenth-Century Pianism," 112.

> subordinated to the work, but at the same time marked off as special by the uniqueness of his/her interpretation.[38]

The reception of piano recorders generally embodied this subordinating attitude toward performance: in Southgate's survey and related U.S. patents, recorders are considered tools for composers, not performers. Goehr writes of the virtuosi that they "reconciled themselves to subservience to the composer and the *Werktreue* ideal by introducing a parallel practice of virtuoso performance often based on extemporization."[39] Southgate characterizes piano recorders as devices for capturing "extemporaneous playing" rather than, say, interpretations of written works. The goal was not to capture a "performance" but rather an incipient "work," the mechanical translation from key to note reinforcing the idea that the former could be readily subsumed into the latter.

Although performers could of course be composers as well, the emerging cultural norms, embodied in piano recorders, signaled what Georgina Born calls

> the rise of the romantic principle that musical invention depended on the self-expression of the individual composer-genius, who must refuse to follow established rules or submit to external controls; and the arrival of a 'work-based practice' centred on the belief that musical works were perfectly formed, finished and 'untouchable,' and transcended any particular performance.[40]

In the context of these negotiations between authorial intent and interpretive flexibility, the ability to write music automatically offered a paradoxical third option: an equivalence between the two that legitimized extemporaneous play by rendering it a form of authorship. If the work transcended performance, as Born suggests, then the ability to transform performances into notation perturbed this hierarchy: the work could

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[38] Ibid., 126.

[39] Goehr, *Imaginary Museum,* 273.

[40] Born, "On Musical Mediation: Ontology, Technology, and Creativity," 8.

now derive from the performance, rather than vice versa. Although still valorizing the composer-genius and the work concept, piano recorders suggested that in the place of a unidirectional flow of compositional intent, inspiration might emerge from a flattened relationship between performance and score.

Translations and natural language

In her account of nineteenth-century shorthand writing, Gitelman describes "the common but rather intricately held belief that written words were the graphic representations of speech."[41] For the inventors of shorthand systems, the gap between orality and literacy was bridged (or filled) by a style of writing that was simultaneously oral and literate. This "linguistic hermaphrodism," as Gitelman calls it, in which words are both "oral and not oral,"[42] finds an analog in what Southgate called the "musical shorthand" of the piano recorder. In an obligatory defense of traditional composition, Southgate wrote:

> [T]here is no need to dilate on the fact that the trained composer is just as able—so to speak—to hear with his eyes, as ordinary people are to understand the import of words from silently reading them.[43]

Hearing with the eyes was a kind of literacy, the existence of which validated the notion that musical notation and sound could be, in some way, commensurable. Just as stenography and other linguistic shorthands traded on an intricate model of commensurable oral and literate language, so the silent practice of the desk-bound composer "hear[ing] with his eyes" relied on a particular model of musical

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[41] Ibid., 26.

[42] Ibid.

[43] Southgate, "Various Attempts," 189.

representation in which notation could actually *be*, in an intricate sense, the music it signified.

The piano recorder, by translating back from performance to notation, appeared to resolve the tension between the two. Adorno wrote of the phonograph something that could equally apply to pianistic recording: it "reestablishes by the very means of reification an age-old, submerged and yet warranted relationship: that between music and *writing.* [...] music approaches decisively its true character as writing."[44] The notion that extemporaneous performance might somehow exceed the representational ability of notation was countered by converting the piano into a machine that simultaneously wrote and sounded, reinforcing the authority of written musical representations. That the process of translating from the recorder's "shorthand" to conventional notation required significant human interpretation went largely unmentioned—turning music into a thing was not the work of things alone.

Piano recorders could be said to write music, but what did that mean? The very idea that music can be written is situated among arguments about the location of musical works. When Adorno wrote that the grooves of the record "can be recognized as true language to the extent that it relinquishes its being as mere signs,"[45] he endorsed the idea that music in some sense *is* writing and language, and its existence as such is verified through technological reification. Writing, however, does not exist in the abstract, but rather is always instantiated in specific technologies and protocols—the "writing" of the phonograph is different from the "writing" of the piano recorder.

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[44] Adorno, "Form of the Phonograph Record," 279. Quoted in Hankins and Silverman, *Instruments,* 146.

[45] Ibid.

Jonathan Sterne writes about a tendency in the early history of phonographic recording to seek in the grooves a "natural sound-writing" that exchanged the semiotic indifference of language for the "verity and fullness" of sound made visual.[46] One experimenter, Edward Wheeler Scripture, "believed that automatic or indexical writing contained the possibility of a truer, hidden code—the very secret of existence. In this respect, he followed a much longer tradition of searching for a 'true' plane of writing."[47] Phonography, deeply tied to nineteenth-century biological understandings of the ear, offered for Scripture (and later Adorno) a "natural" sound-writing. If the phonograph could be said to write in a language, that language would be reified natural sound.[48]

Piano recorders, in many ways, operated in more complex semiotic terrain. "Music" had only recently come to reside in conventional notation, and recorders produced what could quite literally be called musical *incunabula:* inscriptions that probed the liminal space between music written by hand and music printed by machine. The automatic and indexical nature of this writing implied a "natural" status like the inscriptions of the phonograph. However, this naturalness was granted not to arcane grooves, but to a kind of writing that resembled already established notational conventions. Piano recorders were not just material arguments for the commensurability of music and writing, but also arguments for the naturalness of a

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[46] Sterne, *Audible Past,* 49.

[47] Ibid.

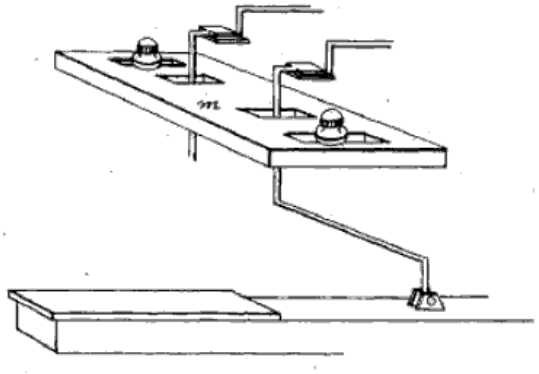
[48] Even Wittgenstein attempted to locate the musical work among its representations: "There is a general rule according to which the musician can extrapolate the symphony from the score, and according to which one can derive the symphony from the groove on the gramophone record and then, using the first rule, in turn derive the score once again. That is what constitutes the inner similarity between these seemingly so completely different constructs. And this rule is the law of projection, which projects the symphony into the language of musical notation. It is the rule for the translation of the language of musical notation into the language of the gramophone record." Wittgenstein, *Tractatus* 4.0141, quoted in Levin, "Tones," 43.

specific kind of music-writing: conventional Western notation. Föhr's thick and thin chemical lines, captured into staves by his inking roller, gestured towards future inventions that would allow "music"—conventional notation—to be written automatically. The translation of these lines into notes by hand completed his automatic goal: asserting the "inner similarity," as Wittgenstein wrote, between performance and writing.

In this tangle of sociocultural arguments and interests, it is too easy to forget the object at its center: the piano. Just as the relationship between performer, text, and author was unstable and contested, so was the physical body of the piano. From the piano's invention at the beginning of the eighteenth century, its makeup varied. From the number, size, and location of keys and pedals to the response of the internal mechanism, or action, the piano was not just one thing.[49] If piano recorders embodied a particular attitude toward performance and the musical work, they also functioned as material mappings of the piano itself. In order to record pianistic performance, piano recorders had to be physically connected to the piano. Whether rigidly fastened to the interior of the piano, or balanced on the keys, the mechanism of the piano recorder was an interface inverted and interpreted: mechanical connections negotiated between the surface of the piano and the surface of the recording roll, physically enacting a translation between the two (Fig. 4). The ways that keys connected to inscribing points enabled or precluded the collection of various types of information—key color, force, duration, or pedaling, for example—their diversity belying the idea that an indexical

[49] For an overview of this variety, see: Good, *Giraffes, Black Dragons, and Other Pianos.*

relationship between action and sign is also necessarily a simple one.[50] Automatically writing performance entailed translating it from one form to another, and the interface of the piano, as the mediating body between performer and sound, played a significant role in shaping these translations. Passing through the keyboard, the performer's actions were whittled down to a signifying minimum: horizontal motions of the hands were mapped to a series of discrete pitches and vertical motion into a binary on and off. Born suggests that technological mediation is both "the clue to transcending idealist ontologies of music" and "diplomacy, [...] the negotiation between apparently incommensurable worlds."[51] As mediators and translators, piano recorders were in one sense material arguments about the relationship between performance and notation.



4. Mechanical translation. This diagram shows the connection between a piano key and a recording apparatus. (Fernow, "Music-recording")

Geist

If live performance and written notation had been made commensurable, there was still a sense in which they were different. Common sense would indicate that even if the composer could "hear with his eyes," there was still a significant difference

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[50] This complicated indexicality offers what I think is a more viable alternative to the common tendency of historians and theorists to enroll player pianos into the prehistory of digital computing. Lisa Gitelman writes of later piano rolls that "their dubious legibility proved an experience of the incipient question rather than the accomplishment of digitized sound"; attempts to consider these pianistic technologies as "digital" forebears frequently gloss over the physicality, indexicality, and relationship to musical practice that was so central to their use and development. Gitelman, "Media, Materiality," 211.

[51] Born, "Musical Mediation," 11.

between this silent listening and the sound of a pianist at the keyboard. What was this difference, and what happened to it when performance was turned into writing?

In Southgate's view, these machines were compositional aids that made it possible to capture "the playing of true artists, whom nature has richly endowed with the faculty that we term inspiration."[52] Extemporaneous playing, as opposed to traditional compositional writing, offered the possibility for transcendent expression:

> [T]he performing musician is frequently more impassioned, and has what the Germans term more *Geist*, when engaged in the exposition of his art, than when seated slowly setting down his ideas at the desk.[53]

It is important to note that this distinction is not precisely the difference between "live" and "recorded" music: in 1881, with phonography in its infancy, there was not yet such a thing as "live" music, at least in the sense that music can be "live" today—defined against music that is tympanically recorded. Rather, there was a fundamental disparity between music that was written and music that was extemporized, and this disparity hinged on the relationship between music writing, music performance, and the *Werktreue* ideal.

Regarding the nature of the improvisor's inspiration, Southgate quotes H.F. Chorley's 1854 *Modern German Music*,

> It is hard to conceive that [...] the most masterly of modern improvisatori should have been a mere machine into which so much learning had been crammed.[54]

The strain between the desire to mechanically capture *Geist* and the tendency to define it as anti-mechanical is an aporia that will recur frequently in this history. Music

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[52] Southgate, "Various Attempts," 189.

[53] Ibid., 190.

[54] Ibid., 191.

technologies offer ways to conceive of music production, and defining the human in opposition to the mechanical is a common approach. Chapters 2 and 3 will see more anti-mechanical definitions of skill and artistry in action.

Situated legibilities and musical reading

The first device intended to record a live keyboard performance mechanically and then play it back appears to have been Jules Carpentier's *Mélographe Répétiteur*, displayed at the 1880 Paris Electrical Exhibition the year before Southgate's survey.[55] Southgate attests that the system "writes down ordinary music played on the keyboard *dans la langage de Jacquard*,"[56] punched as a series of holes in card. These cards would be passed through the machine as it was hand-cranked and read pneumatically, allowing air to pass through the reeds of the small harmonium to which it was attached. By 1887, Carpentier had divided this functionality into two devices: the Melograph, for recording key presses, and the Melotrope, for playing them back.[57] The Melotrope sat on the keyboard and, driven by a hand crank, could play 37 notes through a system that mechanically read the punched card and pressed down on the keys. The Melotrope, in conjunction with the punched cards produced by the Melograph, introduced the complement to automated music writing: automated music *reading.*

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[55] Other playback mechanisms dot the landscape of early automatic pianos, like Forneaux's 1863 Pianista and Merritt Gally's 1879 Autophone, but the Carpentier Melograph is the first attested system for both playing back and *recording* performance. The implications of automatic playback with regard to musical labor are addressed in Chapter 2.

[56] Southgate, "Various Attempts," 193.

[57] This history is broadly attested in a variety of secondary sources, but in the case of conflicting details, I have followed the generally authoritative Ord-Hume, *Pianola*.

The Melotrope would eventually be enrolled into the history of the player piano as an ancestor of the more popular device that read punched paper rolls in place of the Melotrope's more cumbersome folding cardboard sheets. The most successful automatic piano player of the early 1900s was Edwin Scott Votey's Pianola, produced by the Aeolian Company in New York.[58] Invented in 1897 and patented in 1900, the Pianola was a *vorsetzer* (after the German for "setting in front"), a freestanding machine that could be rolled up to the keys of a piano to then play it with a set of felt-tipped wooden fingers. The *vorsetzers* enacted such an apparently straightforward substitution that they came to be called simply "piano players," taking on the name of the people they seemed to replace. However, these people were not so much replaced as displaced—pianolas sat between them and their pianos, covering up the keyboard but still requiring human input. On the front of the pianola were a pair of pedals and a set of small levers. By pumping the pedals, a user could advance a punched paper roll (the material of choice for automatic music after the Melotrope's stacks of folded card) over a "tracker bar" lined with holes; when a hole in the paper lined up with a hole in the tracker, a vacuum (also produced by the pedals) would suck air into the machine, causing the corresponding finger to press a key. The force of the key presses depended on how hard the user pedaled. The levers gave the user—now referred to as a "pianolist"—control over the sustain pedal, tempo, and dynamic variation.

With the increased popularity of music rolls, Lisa Gitelman writes, the peculiarities of mechanical reading were thrown into sharp relief:

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[58] "Pianola," though initially an Aeolian Company trademark, was quickly genericized to refer to all player pianos, a meaning that persists in general use today. In the enthusiast community, "pianola" is used in distinction to "reproducing piano," the more thoroughly automated machine covered in Chapter 3.

> In May 1906, an American appeals court handed down a ruling having to do with perforated music rolls [...] On one side of the lawsuit was a successful manufacturer of piano rolls. On the other side was a music publishing company that argued that certain music rolls violated the copyright it possessed for sheet music.[59]

In the ensuing litigation and legislation the variously interested parties mobilized arguments about musical authorship, the goals of copyright, and the similarities between phonograph records and music rolls. However, a dominant theme across these arguments was *legibility.* As copyright focused on the rights of authors with regard to their writing, it had neglected the conditions in which those writings might be read. Since the rights of the author were possessed *in vacuo*—not tied to specific material expressions—the material specificities of mechanical reading evaded juridical order. Gitelman writes, "To admit that rolls contained notation, [the appellate judge] reasoned, would be to admit that phonograph records also contained notation, when anyone could plainly see that they did not."[60] On analogy with phonographic grooves—an inscriptive technology that we have seen differs in fundamental, semiotic ways from piano recording—the court decided that rolls were not a form of sheet music (although paper with markings on it), but rather were machine parts that enabled the player piano to reproduce music.[61]

Gitelman characterizes the strange result of this decision: automatic piano players "'read'—and read paper, it turned out—without reading anything by an actual author, at least as far as the federal judiciary could discern."[62] Legally recognized

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[59] Gitelman, "Media, Materiality," 201.

[60] Ibid.

[61] This ruling would be superseded by the U.S.Copyright Act of 1909, which established a system of mechanical licensing to integrate both phonographic and pianistic recordings into the juridical order.

[62] Gitelman, "Media, Materiality," 212.

authorship (at the time) required a human reader, in spite of the fact that musical reading machines "involved new subjectivities [...] as the activities of both playing and reading became with greater force something that machines as well as people could do."[63] In response to a question about whether *someone* might be able to read the inscriptions intended to be read by machines, a representative from the National Piano Manufacturers' Association said that "no one can take that music roll and tell you what particular note any particular slit or dash represents."[64]

These arguments reveal a fundamental point: Legibility is constituted by a relationship between a reader and an inscription. Claims about legibility impose and identify order among readers, writers, and authors—be they mechanical or human—and these claims about legibility have to be situated. "Human-readable" or "machine-readable" are not universal or objective categories, but rather local situations. While the piano industry may have denied human legibility for legal ends, the tacit knowledge of roll producers and pianola operators suggested a different status for the punched holes.

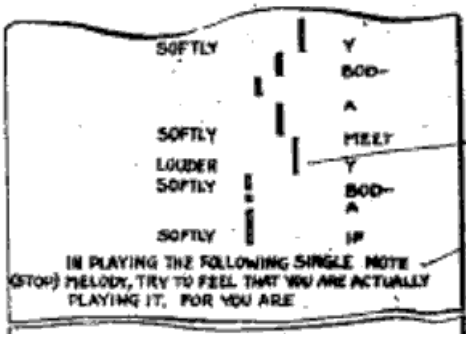
Hybrid legibility

Although the music roll industry argued in *White-Smith v. Apollo* that piano rolls were not intended to be human-readable, they stressed in many of their house publications the need for a kind of pianolist literacy (Fig. 5). A 1921 pamphlet from the Gulbransen Player-Piano Company instructed the consumer in the use of patented

[63] Ibid.

[64] Ibid., 210.

"Gulbransen Instruction Rolls," which contained "sketches from almost every kind of music, with expression marks all through them and printed explanations."[65] These instruction rolls and pamphlets, along with examples from the other player companies, emphasized the importance of interpreting the perforations in the piano roll. Without the ability to read from the holes the contours of musical phrasing, the pianolist would sound "unrealistic":



5. Pianolist literacy. "In playing the following single note melody, try to feel that you are actually playing it, for you are." This Gulbransen instruction roll taught the aspiring pianolist how to interpret perforations. (Martin, "Instruction Roll")

> It had been found that while the operation of a player piano is to a large degree automatic, the proper manipulation of the controls for the regulation of tempo and expression to obtain a realistic reproduction of original playing is only accomplished by those either familiar with music, or those who have been carefully instructed in the use of the [player] piano.[66]

This ability is what Gitelman refers to as a "paraliteracy,"[67] or a "nonmusical literacy"[68] —a literacy that is separate from the conventions of musical production. Given the situated nature of legibility and Gitelman's own notion of media protocols, however, there is little advantage in endorsing the marginalization of any particular literacy. Rather, one might think of all musical literacy as "paraliteracy," dependent on particular arrangements of materials, discourses, readers, and texts. The fact that piano rolls present material music as a series of punched holes and printed instructions sets them

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[65] Martin, "Gulbransen Instruction Rolls," 4.

[66] Martin, "Instruction roll for player pianos," US Patent 1,524,269.

[67] Gitelman, "Media, Materiality," 208.

[68] Ibid., 210.

off from the period's "conventional" notation, but the argument that this makes them "nonmusical" is difficult to maintain. What is it that makes conventional notation more musical than any other historically contingent collocation of musical practices?

While roll instructions complicated the question of legibility by rendering the roll simultaneously and differently human and machine legible (Gitelman says, "emphatically empty of musical notation but just as emphatically marked with legible signs"[69]), a later development in roll technology invoked another possible mode of musical reading. Duo-Art "AudioGraphic" rolls, introduced in 1927, were intended for the owners of reproducing pianos (devices that automated the control of dynamic level and tempo that had previously been available to the pianolist). In addition to the recorded performance of a pianist, AudioGraphic rolls featured a significant amount of educational printed material:

> The new educational feature of these rolls is that they have *printed upon them* such varied material as pictures, phrase marks and words, so that the untrained listener receives the *double appeal* made to the eye and to the ear, much as does the trained musician when he watches the score while listening to an orchestra.[70]

The analogy between AudioGraphic rolls and conventional scores emphasized the fluidity of musical reading: for the musically untrained, the "themophrasing" marks—curved lines that traced out musical phrases on the roll—could fulfill a purpose similar to an orchestral score for the musically trained. This form of reading was divorced from the conventional goal of music-reading—performance—but the Aeolian company emphasized instead another mode of reading: a simultaneous aid to listening. According to material printed at the start of AudioGraphic rolls,

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[69] Ibid., 209.

[70] Farnsworth, "AudioGraphic Music."

> The notes which now follow have been planned as an aid to your listening. The Themophrasing helps in understanding the form of the composition while the running comment is offered as a suggestion for bringing you quickly into sympathy with the music.[71]

The metaphor of sonic resonance—bringing the listener "into sympathy"—reiterated the "double appeal" of the advertisement quoted above: engaging music with both the ears and eyes offered the untrained person the ability to approach the practice of a musically trained person. Southgate's "hearing with the eyes" is virtualized here: instead of mentally producing music from notation, the listener or reader can observe its automatic production, the themophrasing lines collecting perforations into visible phrases, and the running commentary providing an authoritative guide for music appreciation. The user seated at the bench no longer needed to hear with her eyes—she could hear the music with her ears—but connecting the production of music to an act of readership remained a significant goal of music roll producers.

These collections of technologies and cultural practices constituted what Georgina Born calls "assemblages"—"particular combination[s] of mediations [...] characteristic of a certain musical culture."[72] These mediations might be "sonic, discursive, visual, artefactual, technological, social, [or] temporal"[73]—their heterogeneity evidence for the fact that the "musical" was not plainly the "sonic," but instead a multifarious construction. Born's assemblages are similar to Lisa Gitelman's definition of media:

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[71] Duo-Art American AudioGraphic Series, A-61.

[72] Born, "Musical Mediation," 8.

[73] Ibid.

> socially realized structures of communication, where structures include both technological forms and their associated protocols, and where communication is a cultural practice, a ritualized collocation of different people on the same mental map, sharing or engaging with popular ontologies of representation.[74]

Recovering the specificity of these media technologies is not just a matter of identifying their material existence—although this is significant and frequently left undone—it is also important to understand the context in which they operated as meaningful machines. From the regulative *Werktreue* ideal to the expressive extemporizing of the virtuosi, anti-mechanical *Geist* to hybrid pianolist, the variously automatic machinery of re-performance found its meaning in specific contexts. What Goehr writes of *Werktreue* is true of these machines as well: they find their function and meaning "within a specific crystallization of ideas about the nature, purpose, and relationship between composers, scores, and performances."[75] Music technologies provide exceptional opportunities to examine how, in the face of semiotic, technological, and discursive instability, momentary and local stability could be found in and produced by machines. For piano recorders and the other technologies that make up the rest of this thesis, it is this tension—between the local fixity of material objects and the general fluidity of cultural practice—that provides motivic force. Bridging this gap is not only a retrospective and historiographic problem, but also an explicit concern of historical users and inventors. If questions of representation tended toward abstract philosophical reflection, the question of labor would be much more fiercely contested in the social world of music production.

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[74] Gitelman, *Always Already New,* 7.

[75] Goehr, *Imaginary Museum,* 253.

2. Reconfiguration: Machines to Play for Them

In September 1906, John Philip Sousa wrote for *Appleton's Magazine:*

> Sweeping across the country with the speed of a transient fashion in slang or Panama hats, political war cries or popular novels, comes now the mechanical device to sing for us a song or play for us a piano, in substitute for human skill, intelligence, and soul.[76]

Sousa's article, "The Menace of Mechanical Music," captures a sentiment towards musical machines that has been remarkably persistent before and since: the idea that machines—"megaphones, wheels, cogs, disks, cylinders, and all manner of revolving things"—are musically insidious and "reduce the expression of music to a mathematical system" devoid of music's natural vitality.[77] Sousa, as a composer and bandleader, certainly had his own business interests in mind while opposing the machinery that threatened to take away his livelihood; however, his appeal to the musical "soul"—not to mention "the national throat" and "chest"[78]—speaks to a concern generally held about the relationship between humans and machines. Sousa outlines a dystopia where babies learn to sing from phonograph records, children marvel at a man playing the piano with his fingers, and the marching brass band is replaced by "a huge phonograph, mounted on a 100 H.P. automobile, grinding out 'The Girl I Left Behind Me.'"[79]

In this chapter, I am interested in exploring some of the ramifications of automation for musical labor—what it means to "substitute" a mechanical performer for a human one, how these substitutions function in their cultural contexts, and how

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[76] Sousa, "The Menace of Mechanical Music," 14.

[77] Ibid.

[78] Ibid., 15.

[79] Ibid., 16.

performance is reconfigured by and for mechanical reproduction. If Chapter 1 traced out an alternative history of recording, this chapter follows with an alternative history of playback. In the context of machines that, in various and often partial ways, were able to "play," the nature of performance was reconsidered and reconfigured. For inventors, reproducing a performance through technological means required changing it—dividing it into parts that could be assigned to performing machines or humans. From Chapter 1's questions of legibility, this chapter moves to questions of labor: how is the work of performance rearranged so that it might be reproduced? For cultural critics, these mechanical reconfigurations of musical labor inspired frequently vehement responses about the changing role of skill in the production of music. Inventors and proponents of so-called "mechanical music" suggested that the devices represented a logical progression in the history of musical instruments, while their detractors argued that they were a "menace" to musical performance. Whether or not they presented a threat to music or musical labor, the mechanical musical hybrids of the early twentieth century present a case study with which to examine the complicated coexistence of mechanical and human performance.

Locating pianism

As described in the previous chapter, the relationship between performer, instrument, and score had been subject to continuous negotiation over the course of the nineteenth century. Where performers had formerly taken significant liberties in interpreting scores, by the introduction of the pianola they were generally limited to an idealized and limited form of interpretation. Pianistic expertise was an uneasy hybrid:

performers were instrumentalized and subservient to the score, yet their role as interpreters was highly valued in the production of "musicality." Virtuoso pianists continued to exist, but their expertise had been reconsidered—shifted from performance to interpretation. Those interested in producing machines that could play had to answer a central question: What exactly did the pianist do in order to turn the score into music?

Ignacy Jan Paderewski, one of the last major piano virtuosi of the period, wrote in 1909,

> [A] musical composition, printed or written, is, after all, a form, a mould: the performer infuses life into it, and, whatever the strength of that life may be, he must be given a reasonable amount of liberty, he must [be] endowed with some discretional power. In modern meaning discretional power is *Tempo Rubato*.[80]

Tempo rubato, which translates literally as "stolen time," was the digression from rigidly metronomic tempo. By speeding up and slowing down, pianists "infuse[d] life into" the score. "Life" here meant essentially tempo variation. Paderewski characterized metronomic time as mechanical and unsuitably strict:

> To be emotional in musical interpretation, yet obedient to the initial tempo and true to the metronome, means about as much as being sentimental in engineering. Mechanical execution and emotion are incompatible. [...] a composer's imagination and an interpreter's emotion are not found to be humble slaves of either metronome or tempo.[81]

For the producers of musical machines, Paderewski's assertion that "mechanical execution and emotion are incompatible" was an inadvertent challenge: How could a machine play music that was not mechanically executed? The answer for Paderewski (and the player companies) seemed to be in freeing interpretation from the rigidity of

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[80] Paderewski, "Tempo Rubato."

[81] Ibid.

metronomic time. The score could not contain the nuance of human time, "[b]ecause there are in musical expression certain things which are vague and consequently cannot be defined; because they are according to individuals, voices or instruments."[82]

In addition to tempo variation, changes in dynamic level were called out as distinctively human parts of piano-playing. The early pianola, designed such that all notes were played at the same volume, was derided in H.G. Wells' *Tono-Bungay* as "a mechanical gorilla with fingers all of one length."[83] Perhaps unsurprisingly, pianistic expertise came to be metaphorically located in the fingers. The fact that the early pianola could maintain only one global dynamic level resulted from its internal pneumatic system, not from the equal length of its wooden fingers; however, in the language of both proponents and detractors of mechanical music, the human hand and "touch"—its elusive relationship to the keys it pressed—were the definitive locations of musical expression.[84]

Redistributing pianism

The majority of piano rolls were punched metronomically from scores. Apart from some basic editing to accommodate the affordances of the pianola—removing notes from complex sections or adding them to simple sections—these rolls could be relatively simple translations of written notation. As such, they presented some of the difficulties Paderewski alludes to: the pianola played with even dynamic level in

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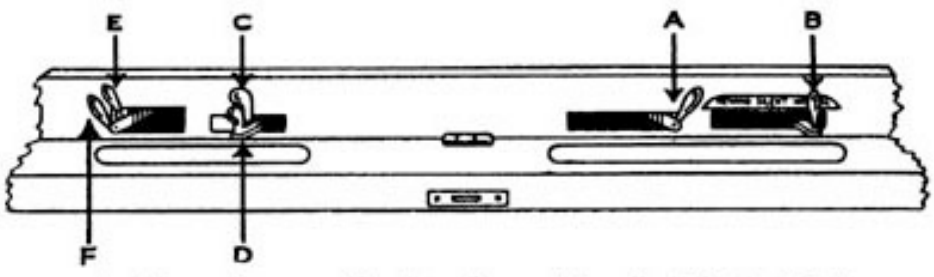
[82] Ibid.

[83] Wells, *Tono-Bungay,* 438.

[84] The question of touch will return in greater detail in Chapter 3

metronomic time, unless the puncher or pedaler intervened with some kind of variation. The interface of the pianola was designed for just this kind of intervention.

The separation of roles in pianistic performance at the end of the nineteenth century was mirrored in the mechanical body of the pianola. On the piano roll was a version of the score (despite what the companies might argue in court)—lacking the nuance and emotion of a human performer—and below it, in the shape of a few hand-operated levers, was an interface for reinserting human interpretation into mechanical playback (Fig. 6).



6. Interface reconfiguration. The pianola substituted a set of hand-operated levers for the traditional keyboard interface of the piano. On pianos with built-in player mechanisms, a panel like the one shown here would be installed below the keys. (Aeolian, *The Piano*)

By operating levers and pumping pedals, the person sitting at the bench could—in a mechanically specified way—interpret the music on the roll. Since interpretation meant intentional tempo and dynamic variation, then the pianola's levers seemed to offer the untrained user a "pure" form of interpretation—direct control over tempo and dynamic level, dislodged from the rest of traditional pianism.

Regarding this new state of pianistic affairs, the prominent British music critic Ernest Newman wrote,

> Only when you can forget your fingers can your brain be perfectly free. [...] It surely stands to reason, then, that the ready-made technique of the

> player-piano sets the musician's brain free to attend to the purely artistic side of the performance.[85]

The piano roll promised to separate out one of the more arduous and less expressive aspects of pianism: memorizing the notes. According to Newman, the best pianists were able to reach their interpretive peaks only once they had memorized the notes, leaving their minds free for expressive playing. A pamphlet published by the Aeolian Company in 1901 made a similar claim:

> In pianoforte playing by hand the performer must first acquire a certain amount of 'technic,' after which he is in a position to devote thought and energy to the acquisition and development of 'expression.'[86]

The pianola, by splitting playing from remembering and technic from expression, allowed the user to be "purely artistic"—if memorization was just "technic," then it could be left to machines. A note's "artistic" side was not to be found in its pitch or sequence—those could already be reliably stored on paper—but rather in its speed and volume. The already narrowing conception of the pianist's role was split in two: rudimentary mechanical skill, or "technic," and artistic interpretation, or "expression." The pianola reified the form of interpretation that had developed over the nineteenth century, reinforcing for Newman and others the idea that musical expression could be mechanically extricated from its former technocultural context.

Pianolism

Although the pianola took care of the more arduously acquired technic of the piano, the Aeolian Company emphasized that the pianola was not without its own

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[85] Quoted in Ord-Hume, *Pianola,* 3.

[86] Aeolian, "How to Play the Piano with the Pianola"

requirements for playing: “To play the pianoforte through the aid of the pianola, it is also necessary to acquire a certain amount of technic, but it is not technic of the ordinary kind.”[87] Advertisements and pamphlets from companies, critics, enthusiasts, and entrepreneurs treated the pianola as an instrument in itself, taking care to straighten out the contradictions that seemed inherent in a device that was at once mechanical and expressive.

The American music critic Gustav Kobbé wrote in his 1907 book, *The Pianolist*,

> Were [the pianola] purely a mechanical device to wind up and set going, the artistic results of which it is capable never would have been obtained [...] The fact that artistic expression instead of machine-like precision has been its aim is what has caused its possibilities as a musical instrument to appeal to me.[88]

What pianism was to the piano—a practice that was anxiously both technical and artistic—pianolism was to the pianola. Critics like Kobbé and Newman repeatedly emphasized the similarities between pianism and pianolism—both, they argued, offered the opportunity for musical expression supported by a mechanical technic, and the only salient difference was that the technic required by the pianola was far less difficult to acquire, making musical expression available to the novice with only a modicum of instruction. Their desire to seamlessly substitute one practice for another, isolating and altering only its difficulty, reflected the substitutive logic embodied in the mechanical pianola itself. This was the logic of standardized parts: pianism could be divided into components, and once so divided, these parts could be freely exchanged among humans and machines.

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[87] Ibid.

[88] Kobbé, *The Pianolist,* 14.

"Pianolism" reaffirmed the artistic agency of the person seated at the bench. Kobbé wrote, "this personal affiliation of pianola and pianolist, of instrument and player, has been worked out, so that the player is not a mere human treadmill pumping air into a cabinet on castors, but [...] a musical artist with an unlimited repertory."[89] This attitude was of great importance to the producers of automatic players who wanted to benefit from the cultural capital of musical expression just as eagerly as they sought advancement through mechanization (Fig. 7).

7. Player players. This undated advertisement for the Baldwin Player-Piano targeted the anxiety surrounding musical machinery. By emphasizing that the player piano was itself "played," companies tried to distance themselves from the negative connotations of "mechanical" music and associate instead with the accepted artistry of musical instruments. ("Baldwin," *Arts and Decoration*)

[89] Ibid., 17.

Ernest Newman argued that the pianola was a musical instrument by turning a critical eye to the piano itself. Responding to criticism of devices like the pianola as "mechanical," Newman wrote in 1920,

> The anti-[pianola] pianist is, in fact, a million removes from mere nature; he would be helpless without the huge box of mechanical tricks in front of him.[90]

With this comment, Newman cut to the heart of the anxiety surrounding mechanical music: What was it exactly that made the pianola mechanical while the piano was not? The piano itself, the physical center of Western domestic music for over a century, was undeniably a complicated machine. It was also a machine, as Newman pointed out, that built on previous instruments:

> The history of the best of the single instruments—the pianoforte—is the record of an incessant piling up of mechanism. After all, what is a pianoforte, in essence, but a dulcimer? Why all this elaborate mechanism for the mere striking of a piece of wire?[91]

For Newman, the history of musical instruments was the history of successive automations and mechanical improvements—bare wires plucked by fingers that gave way to guitar picks, violin bows, and dulcimer hammers—and the pianola "simply adds, for a special purpose, another five per cent or so to the enormous amount of mechanism already in the modern pianoforte."[92] Elaborating from this argument, Newman suggested that the piano

> gives its fine results *precisely because the machinery is so complicated* [...] In many respects once could wish the machinery to be still more efficient.

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[90] Newman, *The Piano-Player,* 19.

[91] Ibid., 18.

[92] Ibid., 29.

> Where the pianoforte falls short of our ideal at present is not in being a machine, but in *not being a good enough machine.*[93]

Newman's reappraisal of the piano is also a reappraisal of the distinction between the "mechanical" and the "musical." He points out, rightly, that musical instruments *are* machines; his conclusion that the pianola is simply another instrument requiring a human player derives from this argument. The figure of the pianolist as player rather than operator completed the image: levers and pneumatic pedals could constitute a viable—and, importantly, *musical*—interface. And, not only was this machine musical—it was potentially *more* musical than the piano, having located and extracted "musicality" so that it was available to anyone who desired it in a distilled form, unimpeded by the now inessential task of acquiring piano technic.

Interpretive expertise

Broader access to musical expression did not dismantle the structures of expertise and authority that had characterized the musical culture of the late nineteenth century. Rather soon after the popular introduction of the Pianola and competing devices, a variety of "expression lines" would be printed on piano rolls. These markings directed the pianolist in operating the tempo and dynamic levers and foot pedals according to the interpretation of "an authoritative pianist and musician, [...] the result of competent and careful musical readings."[94] The most prominent sources of these readings were famous pianists and composers, whose unquestioned authority in terms of performance and intent, respectively, could be translated into a novel kind of

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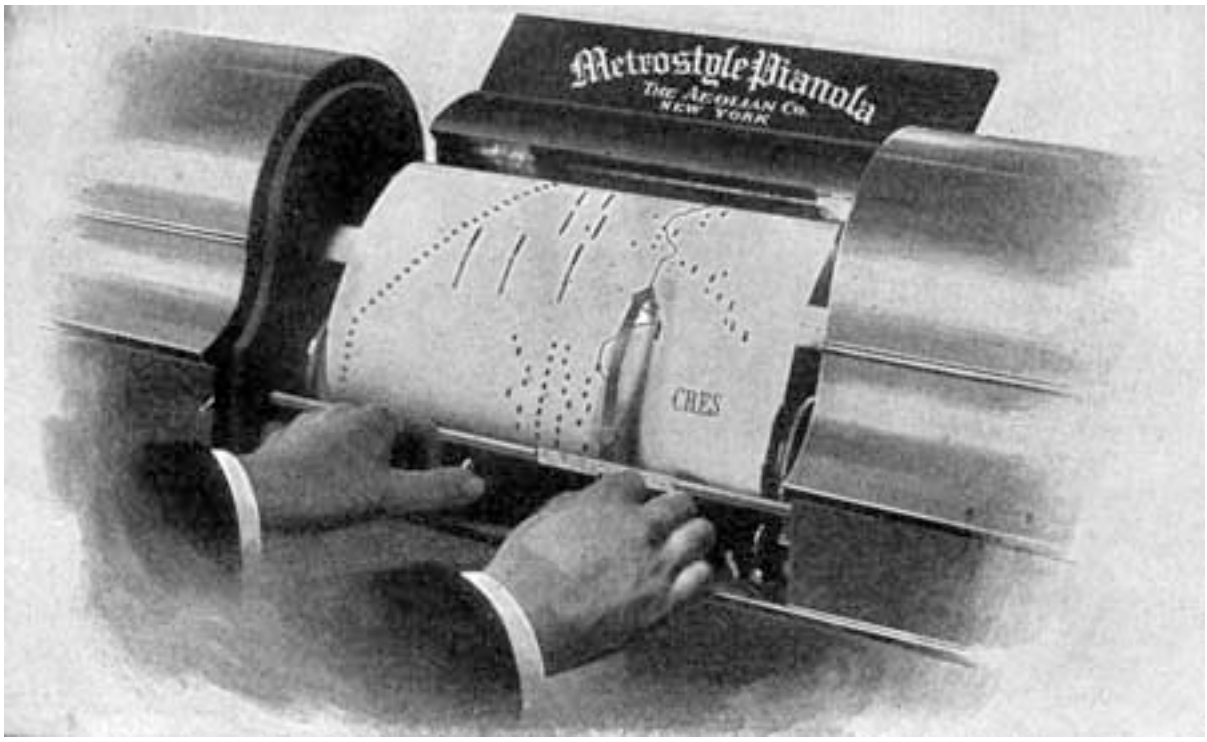
[93] Ibid., 38. Emphasis added.

[94] Aeolian, "The Metrostyle."

notation. If traditional scores were incomplete records of the nuance available to the pianist or the intent attributed to the composer, then these lines afforded the ability to read nuance and intent in a way that was previously impossible.

The tempo lever was equipped with a tall stylus that pointed to the moving roll; an undulating line that ran the length of the roll could be traced with the stylus, allowing the pianolist to vary the tempo in accordance with the wishes of a particular pianist or composer (Fig. 8).



8. Expressive traces. This advertising image from 1903 shows the Metrostyle stylus and line (at right), and the dynamic indication (dotted line at left). (Pianola Institute, “History”)

Now, instead of an improvised *tempo rubato,* the pianolist could reproduce an authoritative timing. A dotted line also printed on the roll provided the broad contours of dynamic level to indicate how hard one should pedal in order to recreate the proper dynamics. While the tracker bar “read” the holes in the paper the pianolist read the

curving lines. The Aeolian Company described its own Metrostyle system in a panegyric worth quoting at length:

> Nothing can compare with the Pianola with its now perfected arrangement, and there is no opportunity for dispute, there is no opportunity for discussion. Here is the stamped roll, indicating exactly how the composer or conductor or the player would play or interpret or conduct the composition. Its analysis is therefore complete. [...] *This is such a stupendous innovation on everything that has taken place in music so far that it stuns the intelligence. It is so far-reaching that it overwhelms ideals. We are completely at the mercy of an entirely new thought in musical development.* We now see piano-playing taken out of the realm of automatism and placed at one step into the very highest rung of the ladder of individualism. We have authoritative law from which there is no appeal.[95]

The lofty hyperbole of advertising copy argues for a very clear and privileged role of expertise in these rolls: the printed interpretation of an expert made the formerly "automatic" roll "complete." The expert's interpretation was "authoritative law from which there is no appeal."

Kobbé suggests that, as one might expect, the roll's authority was less fearsome in practice than prose:

> [The pianolist] may incline to regard the metrostyle as indicating the general spirit in which the piece should be interpreted, but vary it in detail as his mood or fancy dictates. The metrostyle may, in fact, be called the pianolist's "coach," giving him the kind of hints and directions which even the greatest players and singers value. Something, however, of the pianolist himself, something of his own thought and feeling goes into every interpretation.[96]

Both Kobbé and the Aeolian copywriters focus on individualism, but in two dramatically different contexts: for Kobbé, the significant individual is the amateur pianolist, engaged in the act of interpretation; for Aeolian, the "individualism" that opposes

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[95] Ibid. Emphasis in original.

[96] Kobbé, *Pianolist*, 13.

"automatism" is that of the musical expert.[97] Individualism distinguishes one performance from another, while automatism signifies a mechanical sameness.[98]

It is interesting to note *how* the Metrostyle line was recorded:

> This Metrostyle is a finger or guide, connected with the tempo-lever of the Pianola, to which is attached a pen, and as the performer [...] plays any classical or any modern composition, he guides his pen on the unwinding roll in accordance with his interpretation of the piece he is rendering.[99]

The Metrostyle system might be more precisely described as recording pianolism than pianism—the interpretation of experts rendered through a tempo stylus rather than a keyboard. If any part of pianistic skill might be said to exceed the capabilities of the Metrostyle, it was already gone by the moment of recording: the keyboard work required of the pianist had already been reconfigured into rolls, pedals, and levers.

Skill

Many supporters of mechanical music had an ambivalent relationship with traditional musical skill. Ernest Newman suggested that "First-rate playing is not so much a matter of technique as of feeling; and no amount of teaching or of practising can give the plain person that." A Gulbransen instructional pamphlet described musical expression as "really nothing but variety."[100] Whatever democratizing effect the pianola might have had on the ability to play piano music in the home, developments like expression rolls continued to rely on the perceived skillfulness of experts.

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[97] See Katz, "Amateurism" for an extended inquiry into the role of amateurs in the context of musical automation, from the player piano to the present.

[98] The type of individualism enabled by recording and measurement is explored further in Chapter 3.

[99] Aeolian, "Metrostyle."

[100] Martin, *Gulbransen Instruction Rolls,* 16.

The industry appeared to be of two minds about the ease of playing the pianola. This ease was obviously a selling point; however, in their attempt to make the pianola more culturally acceptable by analogizing it with the piano itself, the player companies also emphasized the skill required by the pianolist. A pamphlet from the Aeolian Company suggested that the pianola was not "automatic" at all:

> But let no one suppose that the Pianola is an automatic instrument, or that it produces "mechanical music." It *does not* play the piano. *You* are the one who plays, putting into music all the soul and expression you possess.[101]

Trading on the multivalence of "automatic," "mechanical," and "play," companies could deny the automatism and machinery of their automatic machines by insisting that skill, "soul," and "expression" remained. As described above, this skill was presented as directly connected to the details of musical expression—the skills taken care of by the Pianola were inessential. Historian David Suisman describes this in his book:

> [T]hese machines did require human labor and manipulation, and another approach suggested their continuity with the past—by stressing, in effect, their *difficulty.* According to this view, the player-piano was just a simpler, less taxing way of cultivating the older values, not a degraded form of music making.[102]

The complexity with which this view could be held should not be underestimated. In spite of persistent American cultural values, "skill" is not a readily quantifiable or definable attribute. Like legibility or performance, it is a relationship among discursive, material, and human players.

Skill has also been a favorite topic for contemporary discussions of the history of automatic music. Brian Dolan, in his history of the player piano industry and

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[101] Aeolian, *The Piano,* 3. Emphasis in original.

[102] Suisman, *Selling Sounds,* 99.

enthusiast community, *Inventing Entertainment*, refers to the pianola as "de-skilling" piano playing—reducing the amount of skill required to produce music.[103] Suisman, in a recent article, draws on the writing of the mid-century Socialist writer Harry Braverman to describe the machinery of the pianola in terms of a graded alienation of labor:

> The player-piano and phonograph appeared further along the spectrum of mechanization [than the piano], with growing amounts of control and skill now shifting from the operator to the machine. Increasingly, the knowledge and skill of production were relocated inside the mechanism, and human participation was reconfigured as the operator of a machine. It is worth noting, however, that these devices did not represent the endpoint of mechanization.[104]

Suisman continues to note that machines like the Pianola reserved some work for the human player; the reproducing piano (treated in Chapter 3 of this thesis) automated those controls and presumably occupies a position nearer to the "endpoint of mechanization." Suisman's model of musical mechanization shares much in common with Ernest Newman's:

> Does not more than half the progress of the human race consist in substituting machines for human limbs? [...] For probably thousands of years man has been steadily increasing the quantity of mechanism he uses in order to make music. [...] If a man wants a really "natural" musical instrument, free from any suspicion of the mechanical he will just have to whistle with his fingers.[105]

This model presumes a "progression" or "spectrum" of mechanization. On one end lies whistling with the fingers, and on the other, Suisman suggests, clock radios which "no longer depend on human labor to start (and often stop) making music."[106] Such a

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[103] Dolan, *Inventing Entertainment.*

[104] Suisman, "Sound, Knowledge, and the 'Immanence of Human Failure,'" 22.

[105] Newman, *Piano-Player,* 16-17.

[106] Suisman, "Sound," 22.

spectrum has some commonsense resonance, but it fails to account for the momentary, local, and historical experience of music technologies. “De-skilling” assumes a difficulty exchange: pianism consists of a number of tasks, and de-skilling is the delegation of those tasks away from the user and to the machine. This is problematic because it assumes a stable pianism—a practice with an identity that can be distributed among humans and machines. When Newman suggests that the pianola adds some set percentage to the mechanism of the piano or Suisman suggests that skill moves progressively inside the machine, the question is raised: What are the endpoints of this spectrum? Rhetorically setting them as whistling and clock radios may be persuasive, but what of the piano itself?

“De-skilling” focuses attention on a short historical comparison: previously the user had to remember the notes, and now they do not. In focusing on the progression of mechanization, it takes the stability of pianism and pianos for granted. The practice of pianism was always already technological, and linear or teleological accounts of mechanization miss the fact that just “how technological” a technology seems is primarily the result of social and cultural forces. Narratives of de-skilling rely on the idea that skill is finite and that a more skillful machine entails a less skillful person. Challenging this order reopens the question of users’ agency: rather than foreclosing on the pianolist or listener as mechanically alienated, we might instead look to see how users assert themselves in new ways with and through machines. British music educator Percy Scholes wrote in 1926,

> To make a piece of music, three men are necessary. The Composer: he produces black marks on white paper, but it is not yet music. The Performer: he turns it into tone. But unless there is someone to listen to it, it

> is—save so far as the performer's own ears are concerned—not yet music. *The Listener is necessary also.*[107]

Scholes, writing in support of music appreciation, elevated the role of the listener from its former place at the bottom of the creative hierarchy. "Remember that listening has a technique too," he wrote, "and it is worth while to get a technique of listening."[108] Agency was reclaimed, for Scholes, through the means of music appreciation and the active role enabled by re-performative technologies.[109] Suisman approaches this end through the figure of Conlon Nancarrow, a twentieth-century composer of avant-garde music for the player piano, but the reclamation of agency from narratives of alienation need not be limited to heroes of the avant-garde left. As technologically hybrid music-making continues its permutations through the present day, an appreciation of the complexity that was the "use" of the pianola provides a needed historical context with which to make sense of musical technologies that inspire fears of alienation or "de-skilling."

Towards re-performance

The confluence of score and interpretation in pianola rolls led the player companies to treat the pianola more explicitly as a device for reproduction. With the Metrostyle Pianola, the user could, if they desired, actively recreate the interpretation of another pianist. Promotional materials adamantly claimed this as an authentic and precise mode of reproduction, bringing the interpretation of an expert into the home

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[107] Scholes, *The Appreciation of Music by Means of the Duo-Art,* 4. Emphasis in original.

[108] Ibid., 48.

[109] Tim Taylor provides another interesting perspective on technology and musical labor vis-à-vis commodification in his article "The Commodification of Music at the Dawn of the Era of 'Mechanical Music.'" The turn-of-the-century rise of "music appreciation" figures in Taylor's account as one way in which "mechanical" technologies were culturally accommodated.

and onto the piano. Just what was being reproduced, however, was up for debate. The pianola was already a reproducing device,[110] capable of playing a piece of music in the same fashion over and over; with the Metrostyle and other expression systems, it gained the ability to reproduce not only a specific piece of music but also a specific expert's interpretation of it. That interpretation was not a performance *per se*, but a kind of record: Paderewski's pianola-drawn line was not the same thing as his piano performance, but his expertise was mediated through it nonetheless. One might characterize this as a progression in fidelity and mechanization: at first, only a crude and metronomic version of the score could be reproduced; then, an imprecise and human-produced version of an interpretation; in the next chapter, we will see the development of automatic expression recording, which might be characterized as the next logical step in establishing re-performance as it would eventually be picked up by Zenph Studios. However, as Jonathan Sterne writes in *The Audible Past,* fidelity is a complexly cultural production, not just in the development of reproducing technologies, but also in the conception of their objects. Although this history ultimately arrives at a technology intended to reproduce a specific performance by a specific performer, these historical examples have hopefully shown that just what constitutes "re-performance" is highly negotiable; performances, works, and interpretations are historical constellations of materials, practices, and people, and linearities, progressions, and teleologies do not adequately capture the vitality of their sociocultural contexts.

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[110] The piano could be conceived as a reproducing device as well. In line with arguments about *Werktreue* covered in Chapter 1, Suisman quotes nineteenth-century music educator Adolph Kullak: "Pianoforte playing is primarily a reproductive art only" ("Knowledge," 21).

3. Mechanical Fidelity: Materiality, Piano Science, and the Perfect Copy

In 1924, the American Piano Company, or "Ampico," one of the largest and most successful manufacturers of both player pianos and "straight" pianos, announced that it was forming a new department dedicated to scientific research. The journal *The Music Trades* quoted the goals of the new department, as outlined by its head, Charles Stoddard:

> "Among other things," said Mr. Stoddard in discussing the plans of the new department, "we shall make a careful research into tone analysis. [...] We doubt if there has been enough absolutely accurate knowledge in this whole subject of tone production. We cannot, of course, predict what we will find out, but we propose to go into the matter as thoroughly as is humanly possible. The manner in which we are approaching this subject is revolutionary."[111]

The American Piano Company laboratory, wrote *The Music Trades*, would be dedicated to the "thorough scientific investigation" of the piano.[112] Historian Larry Givens effusively describes the duration of the laboratory as "the only period in the history of the player piano industry in which real *scientific methodology* was applied to the development of the player piano."[113]

The goal of Stoddard's department was to improve what Ampico called its "re-enacting piano"—a player piano that could reproduce the performance of a live pianist. These pianos—generally referred to as "reproducing pianos"—sought to automate the controls that had previously been afforded to the user in the pianola. Where pianolas reconfigured and redistributed pianistic labor, reproducing pianos repeated it. Ampico

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[111] "Entire Piano Industry to Profit," *The Music Trades*, 21.

[112] Ibid.

[113] Givens, 25. Emphasis in original.

called their offering a "re-enacting piano" because it could "re-enact *every* element of great piano-playing."[114] Reproducing pianos from other companies—going by names such as "re-performing piano," "artistic piano," or "expression piano"—were described in similar language, suggesting that they could, with perfect fidelity, reproduce the playing of expert pianists.[115]

Jonathan Sterne writes of tympanic fidelity that it "is much more about faith in the social function and organization of machines that it is about the relation of a sound to its 'source.'"[116] Fidelity for the reproducing piano was no different: it had to be produced through a careful arrangement of humans and machines. Laboratories like the one founded by Ampico, by producing scientific knowledge about the piano, provided the ground on which fidelity could be built. The techniques and attitudes of these scientists privileged the piano's material status as a machine, building out from it a mechanical model of performance and an automatic system of measurement that supported advertised claims of fidelity. This chapter examines what I call "mechanical fidelity": a rhetoric of faithful repetition that was built in laboratories, relying on the materiality of the piano's mechanism as a symbol and guarantor of objective reproduction.

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[114] Ampico, *Course in Ampico Salesmanship*, 16. Emphasis in original.

[115] The historical distinction between pianolas, reproducing pianos, and player pianos is imprecise. Enthusiasts generally distinguish between "push-up" models that attached to a piano (which I call "pianolas"), built-in models (which I treat in the context of the pianola), and reproducing pianos that featured automatic dynamic control. Especially between built-in players and reproducing pianos, there is an extensive gray area populated by a variety of differently configured machines which, for the sake of space and simplicity, have been elided.

[116] Sterne, *Audible Past,* 219.

Finding touch

For companies interested in reproducing a pianist's performance, it was first necessary to locate and define the object to be reproduced. This object was what pianists had long referred to as "touch." Touch had been ambiguously defined in its specifics, but it generally referred to the way in which the pianist operated the keys of the piano. Earlier technologies took care of recording the "what" and "when" of played notes, but the "how" remained elusive—this "how" was touch. Although variously described as a kind of expertise, a mechanical fact, or a transcendent artistic moment, touch was, if anything, a location. The point of physical contact between performer and instrument was understandably a site of anxiety—it was here where the pianist's organic body ceased and the mechanical configuration of the piano action began. Touch was potently symbolic territory; arguments about the nature of pianism fought for it, claiming it in the name of mechanical expertise or organic artistry.

Historian of technology Myles Jackson outlines these two competing views of piano performance as they manifested in nineteenth-century German piano pedagogy. In one view, "the technique of proper piano playing was purely mechanical" and thus possible to teach through mechanical means.[117] Jackson describes a number of "mechanical" methods of instruction that endorsed the idea that pianistic expertise was a type of mechanical proficiency: "virtuosity was being increasingly defined as [playing] rapid and difficult passages (or what was referred to as the mechanical aspects of performance) [...] physicists seemed to be able to offer quantifiable answers

[117] Jackson, "Physics, Machines, and Musical Pedagogy," 375.

to a seemingly non-quantifiable aesthetic phenomenon."[118] The competing view maintained that "[t]he emphasis on 'mechanical skill' was [...] anathema to the true idea of art," and "the true purpose of music" was transcendent, greater than the sum of mechanical techniques.[119] These two schools of thought, which Jackson generally characterizes as "mechanical" and "organic," were not limited to nineteenth-century Germany but can be found repeated throughout literature on the art of pianism.

Arguments in support of both sides were made and contested through mathematical and experimental methodology. Helmholtz's famous 1863 acoustics textbook, *On the Sensations of Tone as a Physiological Basis for the Theory of Music,* treated the vibrations of piano strings mathematically, as if they were caused by an instantaneous percussive impact, their subsequent tone the result of the material they were made of and where they were struck. This idealized view, generally disregarding variations in force, the nature of the hammer, and the duration of contact between the hammer and string, had little use for the details of the key and thus touch.[120] Jackson recounts an experimental study performed in Paris: "In 1896 [Marie] Jaëll took fingerprints of various students' left and right hands while they played a Beethoven sonata" in an attempt to measure touch in terms of physiology.[121] The fundamentally hybrid nature of touch seemed to invite a wide variety of investigative strategies: piano teachers concerned themselves with the posture and finger position of their students,

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[118] Ibid., 384.

[119] Ibid., 387.

[120] Although "an exact analysis of the motion of a string excited by the hammer of a pianoforte would be rather complicated," Helmholtz offers in an appendix some preliminary equations that might be used to further investigate piano hammers as they were: covered in elastic felt that would result in longer contact with the string and thus more complex vibrations. Helmholtz, *Sensations,* 380.

[121] Jackson, "Musical Pedagogy," 407.

physicists modeled the levers and strings that the fingers impelled, and physiologists observed the minute motions of the body. Residing at the interface of physiology and physics, human and machine, artist and instrument, touch was a potently hybrid concept: a hiding place for ineffable aesthetic nuance or simply the momentary transfer of force.

Piano science

The central object of the Ampico lab's research was the piano action—the mechanism that translated a finger pressing a key into a hammer hitting a string. By focusing their attention on the action (rather than, say, the physiology of performers or the acoustics of performance spaces), the scientists of the Ampico lab endorsed a particular argument about what "mattered" in pianistic reproduction, and by extension, pianism. The scientific gaze refigured the piano as a "machine" in a very literal sense: a fundamentally material collection of levers and pivots that operated in predictable and fixed ways. Musicologist Kent Holliday writes,

> Commencing an era of unprecedented achievement in numerous technological fields, it was logical to assume that even the subtlest nuances of a pianist's mysterious art could somehow be captured and explained in scientific terms, much like an immobile butterfly fixed on a pin. If Helmholtz could discover the laws of acoustics by an inductive method, so could the whole musical process be replicated by machine, given another decade or so.[122]

In the scientific method of the piano lab, the fundamentality of materiality was granted a priori. From this perspective, touch was simply a mystification of mechanical facts that could be readily explained and measured.

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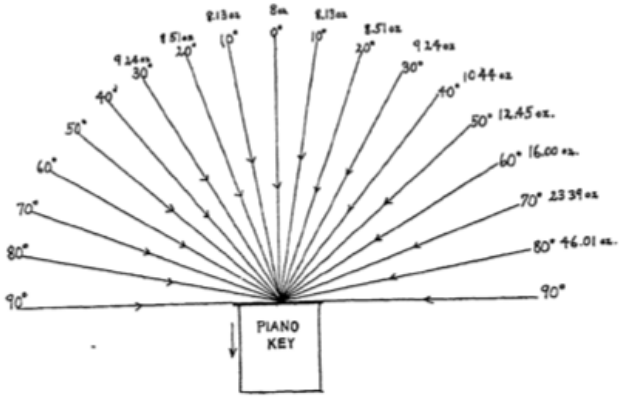
[122] Holliday, *Reproducing Pianos,* 53.

This view was well summarized by Otto Ortmann, a pianist and researcher at the Peabody Conservatory of Music, in 1925:

> No matter how we hold our hands, how gently or harshly we stroke or strike the key, no matter how relaxed or rigid our arms are, how curved or flat our fingers, we can do nothing else to the key than move it three-eighths of an inch or less vertically downwards. [...] Any variation in touch which does not influence or in some way change key-speed is useless when evaluated in terms of the result on the action.[123]

Constructing the piano action as a material assemblage of simple machines meant that it could be treated as a reliable mechanical translator, conveying force from the key to the string in an objective way. As mechanism, the piano resisted interpretive interventions, producing sound in necessarily delimited and regular ways. Gentleness, harshness, relaxation, and rigidity meant nothing to the machine that could only take an impulse on one end and convert it into a hammer strike on the other (Fig. 9). For researchers invested in objective knowledge about the piano's mechanical traits, the piano came to represent and *be* a collection of mechanical traits. All the pianist could do was input a series of impulses: Ortmann concluded, "What we actually do, then, when playing the piano, is to produce sounds of various pitch, intensity, and duration. Nothing more."[124] For the researchers, the



9. Vertical displacement. Ortmann diagrams the variety of angles from which one might strike the key and the single direction in which the key can respond. (Ortmann, *Touch*)

[123] Ortmann, *The Physical Basis of Piano Touch and Tone,* 15-16.

[124] Ibid., 171.

mechanical nature of the piano action acted as a kind of filter: nothing extra-mechanical that the pianist did had any effect on the ultimate sound because it *could not* have any effect on the ultimate sound. The status of the piano action as the physical last thing before the striking of the string ensured it.

Mechanical objectivity

The materiality of the piano action enforced a version of what Lorraine Daston and Peter Galison call "mechanical objectivity." Mechanical objectivity refers to a particular scientific tendency—a tendency away from "the interpretive, intervening author-artist of the eighteenth century" and towards a mode of inquiry that privileges machines and the mechanical, deriving scientific representations "through a strict protocol, if not automatically."[125] Daston and Galison refer specifically to the production of scientific images, but this relationship to technology is easily recognizable in the scientific construction of the piano. In the logic of mechanical objectivity, machines represent a kind of reliability—a guarantee of impartiality. Daston and Galison point out that, in this role, "the machine's constitutive and symbolic functions blur, for the machine seemed at once a means to and a symbol of mechanical objectivity."[126] For the piano scientists, the piano action was both the means through which performance was translated into mechanical action and a symbol of the underlying mechanical nature of the entire act of performance. The piano researchers, invested in mechanical

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[125] Daston and Galison, *Objectivity,* 121.

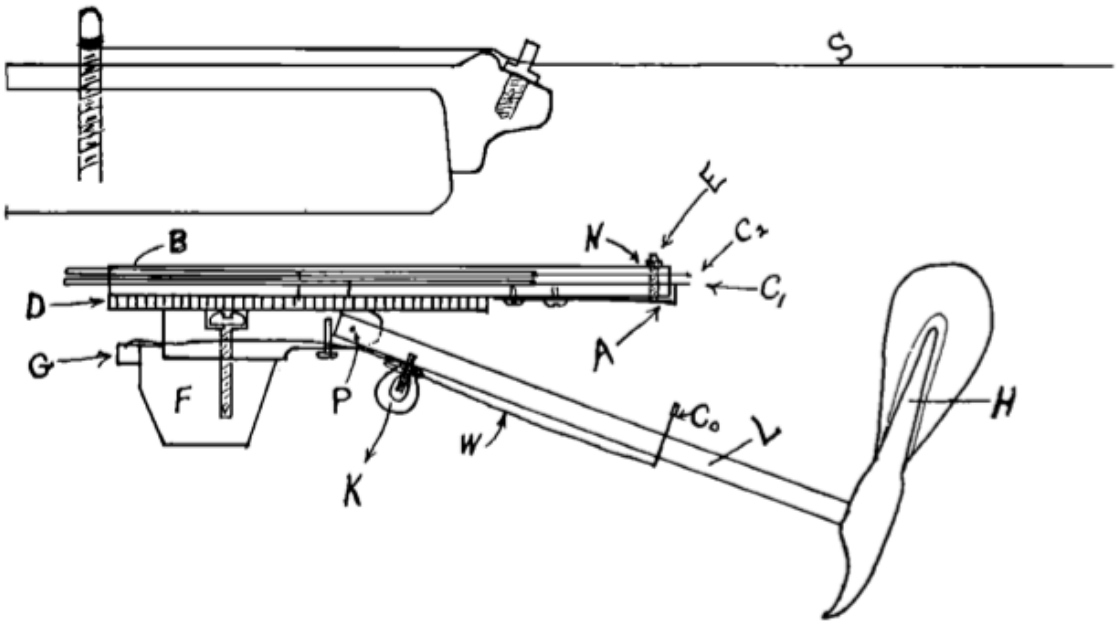
[126] Ibid., 139.

objectivity as a methodological obligation, found it, perhaps unsurprisingly, in the object they studied.

Quantification

While the mechanical objectivity of the piano action was taken to prove and guarantee the mechanical nature of piano performance itself, it also permeated the piano laboratory's attempts to quantify performance. A device for measuring hammer speed, developed in the Ampico lab by Clarence Hickman, provides one example.

Dr. Hickman was one of the founding members of the new American Piano Company laboratory. He had received his degree in physics and acoustics under a student of Helmholtz. Hickman was responsible for developing the spark chronograph, a precise timing device that would eventually be incorporated into the recording piano in the Ampico studio. The spark chronograph worked by attaching a lightweight electrical contact to the hammer; as the hammer swung upward, this contact would touch two fixed contacts that were a known distance apart (Fig. 10). These completed circuits would cause sparks in another device outfitted with a fast-moving paper roll. By measuring the distance between the marks those sparks left on the paper, Hickman could calculate the speed at which the hammer had traveled. Hickman's method had the advantage of being lightweight (therefore precise) and simple (therefore more reliable), but it also endorsed a kind of directness: if the hammer hitting the string was the essence of playing the piano—the moment in which the relevant sound was



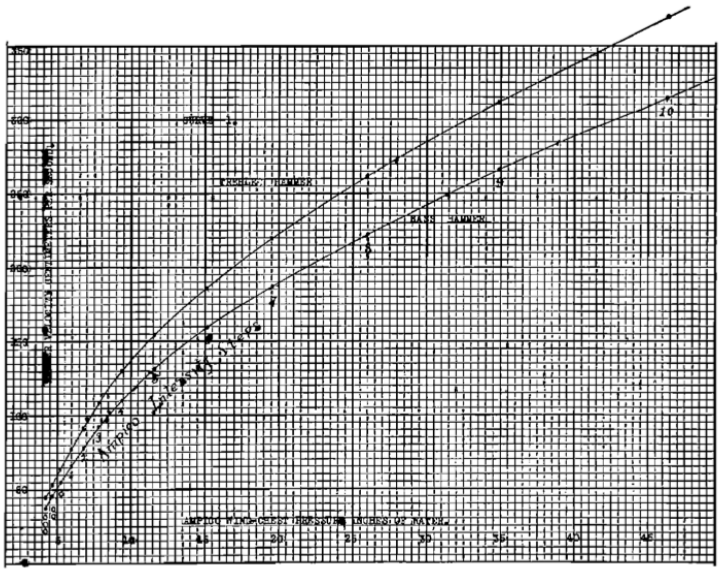
10. Spark chronography. This diagram shows part of a piano action with Hickman's spark chronograph installed. When the hammer *(H)* was flung upward by the action towards the string *(S)*, the electrical contact *(C_0)* would rapidly touch *(C_1)* and then *(C_2).* The time elapsed between these contacts, recorded on a paper roll, could be used to derive the hammer's speed. (Hickman, "Spark Chronograph," 143.)

produced—then measuring the hammer speed was the most direct way to quantify the dynamic level of a note.[127]

This substitution—hammer speed for volume—spoke to a problem that was solved by mechanical objectivity: "volume" was not a variable that could be measured directly from the material parts of the piano. For Hickman and Ampico, hammer speed came to "mean" volume. This equivalency was mechanically and experimentally produced: the piano action mechanically guaranteed that hammer speed was an objective representation of the pianist's playing; by correlating these speeds with

[127] Lest one think the hammer is as far as the quest for direct measurement can be taken, a 1929 patent by Henry Price Ball suggested that linking volume directly to hammer speed was "fallacious, as the amplitude of movement of the string and the intensity of tone produced thereby [...] is not a straight line function of the velocity of the hammer." Ball's invention purported to quantify dynamics by measuring the vibration of the string itself. See Ball, "Music-recording instrument," US Patent 1,716,811.

pressure levels in the re-enacting piano's bellows (Fig. 11), Hickman outlined a procedure by which hammer speed and dynamic level could be made functionally equivalent. The piano action channeled mechanical objectivity out of both ends, rendering the pianist's work thoroughly (though still expertly) mechanical and guaranteeing that hammer speed would constitute a reliable representation of that mechanical work. Hickman's pressure-speed diagram provides a vital example of the type of equivalence-making that would come to characterize mechanical fidelity.



11. Mechanical equivalency. This diagram shows the relationship between hammer speed (on the y-axis) and pneumatic pressure (on the x-axis) in an Ampico reproducing piano. The two lines show the differing responses of treble and bass hammers, which were different weights. In this diagram, hammer speed "means" dynamic level. (Hickman, "Spark," 144)

Mechanical fidelity

At the root of fidelity was a difficult question: What did it mean to make something happen again? Mechanical objectivity, grounded in the re-creation of nature through mechanical means, offered a possible answer. Ortmann wrote this explanation:

> If A plays 'poetically' and B does not, then, as far as the single tone is concerned, A plays sounds of different intensity than those of B; and if B could play sounds of the same intensity as A, B would play just as poetically as A.[128]

[128] Ortmann, *Piano Touch and Tone,* 171.

This reproductive syllogism was enabled by mechanical objectivity: the piano keys, if operated with identical intensity, could not do anything but respond identically. So, making a performance happen again was (it seemed) as simple as providing the piano action with the proper series of notes at the proper duration and intensity, as measured by the spark chronograph. With pianism mechanically reduced to these variables, their accurate reproduction appeared to guarantee a perfect mechanical equivalency. The mechanical objectivity of the piano, which allowed to players to play alike, could also be used to repeat a performance.

In 1927, in the window of the American Piano Company showroom in New York City, one could see a reproducing piano playing Rachmaninoff's famous Prelude in C sharp minor. Printed across the roll in large type that could be read from outside was this:

> I am the AMPICO. I re-enact the playing of the world's greatest pianists and bring their musical magic into your home. This [...] is the actual playing of Rachmaninoff just as if he were personally at the keyboard. When the Ampico plays, it is just as if the hands of the artist were actually touching the keys. The same strings are vibrating identically as they vibrated when Rachmaninoff himself controlled them. This is not a copy or an imitation or a reproduction, but the actual playing of Rachmaninoff himself.[129]

This bold language gives an idea of the differences between tympanic and mechanical fidelity as they were socially and technologically constructed: advertisements for the phonograph featured explicit comparisons between singers and record players, but would never argue that the record player *was* the singer herself. This ad for the Ampico was quite explicit, going so far as to deny the fact that the recording was a "copy or an imitation or a reproduction" at all: this was "the actual playing of Rachmaninoff himself."

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[129] Ampico, "The Story of the Ampico." Quoted in Givens, *Re-enacting the Artist*, 77.

Although tempting to attribute this to advertising language gone to the extreme, it is instructive to examine just how this ad meant "sameness."

The advertisement is thoroughly concerned with materiality, emphasizing Rachmaninoff's hands touching the keys and the vibration of the strings. This is the stuff of mechanical fidelity: making one machine behave like another, their status as machines providing a guarantee that sameness is possible. If the strings of one piano vibrate identically to the strings of another, then the performance those vibrating strings represent has been reproduced. Another Ampico publication suggests,

> The vibrations of each piano string can vary in only two respects: (1) intensity and (2) duration. Perfect re-enactment, therefore, consists in making the strings of the piano vibrate with *exactly the same intensity and for precisely the same duration* as they did when the artist played.[130]

But, returning to Sterne's definition of fidelity, this was more about arrangements of machines than it was about a comparison of results. When Rachmaninoff played his piano, the piano action objectively conveyed his "control" to the strings. When he played your piano (through the Ampico reproducing action), another chain of mechanical transferences connected his actions to your strings. The "fact" that the vibrations were exactly the same was a result of the mechanical objectivity of the piano action, extended geographically and temporally by the recording and reproducing apparatus. Listening "through," as with the phonograph or gramophone, was not necessary; the mechanically produced identity meant that one could listen *to* the piano instead.

Simply relying on machinery to guarantee fidelity was not enough, however. In the pursuit of differentiating themselves from competitors, the various reproducing piano companies made great efforts to distinguish their recording and reproducing protocols.

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[130] Ampico, *Salesmanship,* 28. Emphasis in original.

One example of this effort was a strange dispute between the Duo-Art and Ampico recording systems.

These two recording systems, which generally functioned similarly to the recording systems outlined in Chapter 1, had one fundamental difference: the Duo-Art recorder cut the roll "at the touch of the artist," marking a master roll with blades during the recording session; the Ampico recorder, on the other hand, marked the master roll with ink, to be cut later by a roll editor. The Duo-Art system, it was claimed, produced "a truer photograph of the artist's playing than recordings which are made by a marking mechanism and then cut afterwards."[131] The Ampico system emphasized that marking was more precise than cutting, and "as precision in beginning notes is an essential factor in the artist's phrasing," this system allowed for more perfect reproduction.[132] These arguments reveal mechanical objectivity in action. So far I have discussed mechanical objectivity as a guiding principle or guarantee that could be appealed to, but in the daily life of the reproducing piano, mechanical objectivity was quarreled over and constituted differently by a number of players. For Duo-Art, the "mechanical" nature of their recording was the ultimate guarantee of its accuracy; by excluding any human intervention, they bought fully into a kind of mechanical objectivity that relied on physical machines. Ampico, on the other hand, repeatedly emphasized precision. More important than excluding humans from the mechanics of roll production was ensuring that precision was achieved. Precision was stereotypically attributed to machines, but this

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[131] Ampico, *Salesmanship,* 35.

[132] Ibid.

argument from Ampico reveals the fluidity with which "mechanical" traits could be found in human or machine labor.

Ampico was also surprisingly forthcoming about the editing that took place after their rolls were marked. Rather than reproducing the performance as it existed, Ampico wanted to reproduce an ideal:

> In making Ampico recordings the artist has an opportunity to listen as often as he likes to his own performance and to correct all such imperfections as his sensitive ear can discover, thus restoring, as it were, the flawless beauty which was in his mind as he played.[133]

Again, it is clear that the reproductions of the reproducing piano were not about recreating ultimate sounds, but rather something causal. For Ampico, this cause was not just the actions of the performer, but extended back even further—to the "flawless beauty" of the performer's mental conception of the piece. Authenticity preceded the performance itself in this editorially-aided manifestation of *Werktreue*.

Calibration

The mechanical reliability and sameness that facilitated mechanical fidelity had to be manually created between the playback and recording pianos. Reproducing actions were installed in a wide variety of pianos in a variety of settings, introducing instability into the system of mechanical transferences that constituted pianistic reproduction. Givens writes of the Ampico lab that,

> a touch analyzing device was developed [...] it was discovered that frictions in the piano action varied from note to note [...] A special Note Compensation Test Roll was issued by Ampico to calibrate the pneumatics, and by tailoring the opening of each pneumatic to the frictional value of the

[133] Ibid., 27.

> piano action assembly which it operated, an extremely light and even pianissimo was obtained.[134]

The reliability of machines was itself a sociotechnical construction—a useful principle on which to found a rhetoric of fidelity, but by no means guaranteed in practice. Ampico's Note Compensation Test Roll was a device for disciplining machines into the reproducing apparatus. The equivalence that Hickman had produced between hammer speed and pneumatic pressure was imperfect. As the two lines in his diagram indicated, different hammers responded differently to the same amount of pressure. Worse still, minor differences spread across the whole keyboard meant that individual key actions responded in individual ways to force. By running the Note Compensation Test Roll, the user could calibrate their piano, relying on their own auditory perception of equal loudness and adjusting the valves of the machine to fit. Here, as in the lab, the sameness of machines had to be produced.

Mechanical identities

The ways in which the player companies figured human and machine playing provide an interesting perspective on what it meant to play "like" a human or a machine. For their reproducing piano, Ampico emphasized the need to be able to "strike any note at any time with any degree of force used in the original playing";[135] as a result of this mechanical achievement (a kind of objectivity: the ability to play anything that could be played), the Ampico could reproduce faithfully the distinctive styles of famous pianists. The "Course in Ampico Salesmanship" provided some descriptions for salesmen to use

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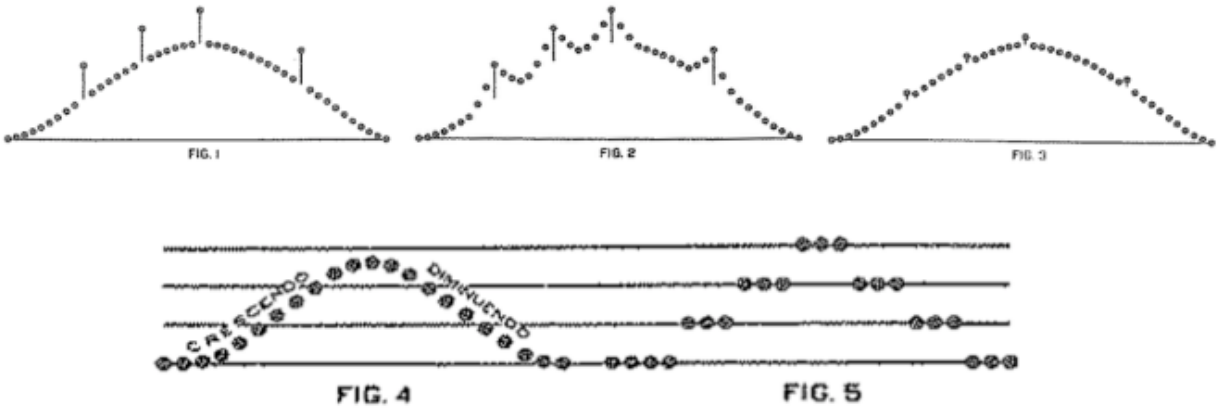
[134] Givens, *Re-enacting,* 58-59.

[135] Ampico, *Salesmanship,* 15.

with customers: “The colorful pedalling of Copeland [...] The feathery lightness of Godowsky’s flying fingers [...] The satisfying straight-forwardness of Mirovitch [...] The spectacular brilliancy of Nyiregyazhi [...] The incredible clarity of Rosenthal.”[136] Daston and Galison write, “the orientation away from the interpretive, intervening author-artist of the eighteenth century tended (though not invariably) to shift attention to the reproduction of individual items—rather than types or ideals.”[137] The Ampico guide’s collection of pianistic styles reflected this attitude: the mechanical blankness of a piano action that played all that could be played provided a backdrop against which to appreciate the individuality of performers rendered mechanically.

The Course in Ampico Salesmanship also included a set of diagrams (Fig. 12) that purported to illustrate the difference between human playing (and, implicitly, the



12. Rhetorical dynamics. These diagrams from Ampico compare the dynamic control of a human player (Figs. 1 and 4) to reproduction attempts by Ampico’s competitors. The pneumatic expression system of the Welte company (Figs. 2 and 3) either bleed accents out around the intended note or only allow for small accents. The Duo-Art system (Fig. 5) breaks the continuous control of a human player into discrete steps. Note that these are not based on measurements, but are rather rhetorical diagrams produced to advertise the Ampico system. (Ampico, “Salesmanship,” 118-119)

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[136] Ibid.

[137] Daston and Galison, *Objectivity,* 121.

playing of the Ampico system) and the playing of competitors' reproducing pianos. The defining characteristic of expert human playing, in this representation, was control. Accented notes could be pulled out of a slow crescendo with no effect on the surrounding notes, and perfectly gradual increases and decreases in volume were attainable. The pneumatic system of the Welte, according to Ampico, was unable to play instantaneous, sharp accents; instead, it either increased the volume of notes around the accent or accented individual notes, but quietly. The expression of the Duo-Art, which used a so-called "accordion pneumatic" system—a set of small bellows that controlled volume in a series of discrete steps—was characterized by Ampico as "much like that which would be produced by a beginner vainly trying to control his unruly muscles and unable to attain smoothness of expression."[138] In Ampico's language, the poor reproducing machine was in fact like an inexpert human performer, lacking control; the expert performer was in fact like an idealized machine, with the ability to play "any note at any time with any degree of force." The language of mechanical objectivity, which had underpinned the production of fidelity, had spread from pianos to the pianists themselves.

Built on the history of pianistic recording and facilitated by a scientific approach to fidelity, the measurements of the Ampico lab expanded the possibilities of representation. Where the piano recorders of Chapter 1 made records that were explicitly partial, the Ampico recorder, supported by a rhetoric of mechanical fidelity, claimed completeness. Thanks to a mechanical understanding of pianism and these new developments in the production of mechanical records, Ampico claimed for itself

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[138] Ampico, *Salesmanship,* 118.

the ability extend pianism across time and space, through an elaborate series of mechanical transferences. The keys, levers, pens, bellows, and rolls of piano re-enactment constituted a potentially global piano apparatus, conveying unchanged the actions of famous pianists from one set of keys to thousands of sets of strings. The reproducing piano industry had founded an ostensibly complete form of re-performance, but their successes were short-lived: the player piano industry, struggling financially towards the end of the 1920s, never recovered from the stock market crash. By the time of Zenph Studios' Gould recording in 2006, this earlier practice of re-performance would be largely forgotten.

“We make data”: Futures of Re-performance

> We must be prepared to accept the fact that, for better or worse, recording will forever alter our notions about what is appropriate to the performance of music.
>
> —Glenn Gould[139]

After the audience left the Glenn Gould Studio, the engineers moved in. Zenph’s concert was intended to commemorate Gould’s birthday, but it was also a test run for the recording that Sony BMG Masterworks would produce over the rest of the night.[140] Three microphones towered over the piano, and two stood in the front row of the audience, recording from five points for the eventual surround-sound release. In the recording booth sat a group of technological experts: engineers, pianists, programmers, piano tuners, a piano voicer, and software designers. As the piano automatically played, the recording engineers climbed ladders, moving their heads in small orbits to find acoustic “sweet spots” in which to place the microphones. As the temperature in the studio fluctuated and the piano acclimatized to the room, the tuners made minute adjustments, maintaining the tension of the strings over the course of the evening. The producer, listening to the recording through headphones, would remark on the piano’s tone—too “airy” or too “heavy”—and the piano voicer would run out on stage and put his hands inside the piano, pricking the felt of the hammers with a needle and adjusting the response of the action. As the piano played, the pianists-

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[139] Gould, “The Prospects of Recording,” 337.

[140] This description derives from my interview with John Walker and his with Mark Manring.

cum-programmers listened—notes that sounded wrong could be reprogrammed and loaded onto a floppy disk to be swapped in to the computer on stage. Occasionally the programmers would produce several alternatives for a note that sounded off; the recording team would listen to them all and vote to decide which was best—which sounded the most "Gould-like" or acoustically desirable. A dummy head in front of the keyboard had microphones in its ears, capturing a binaural recording that would acoustically transport future headphones-wearing listeners to that very spot.

I have explicitly treated the technologies in this history as alternatives to tympanic reproduction. Re-performance, in its historical contexts, was often figured explicitly against tympanic technology—the player piano, for example, offered a more realistic reproduction of piano performance than the phonograph in the 1910s. The moves toward representation, reconfiguration, and fidelity that these devices made might borrow from or oppose parallel moves in tympanic reproduction, but the two modes were generally distinct.[141] For the purposes of this thesis, maintaining this conceptual distinction was useful for tracing out the salient features of re-performance, as free as possible from the dominant language of tympanic reproduction. However, the distinction is nonetheless conceptual and historically accidental: a reproduction concerned with sources need not oppose a reproduction concerned with sounds. Zenph's re-performative work is in one way different from the others in this thesis,

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[141] With a few exceptions: anecdotal evidence supports the idea that tympanic records were occasionally used to confirm decisions about dynamic level in reproducing piano rolls, theAeolian company reportedly worked on a combination phonograph/player piano with little success in the early 1900s, and several patents exist for such proposed combinations. See Holliday, *Reproducing Pianos* and La Joie, "Combination player-piano, radio, and phonograph," US Patent 1,739,680.

starting from tympanic records and usually ending with them. Framing their work as historically unique, the engineers at Zenph balance re-performative and tympanic reproduction, offering one answer to an important question: What happens to re-performance in a thoroughly tympanic age?

Representations, data, and excess

Where Föhr's Electrograph attempted to translate between notation and performance, Zenph attempts to translate between performance and record. From the tympanic recording, Zenph extracts a performance that is "anacoustic"—"free of the acoustics of the setting in which the musician played the musical instrument to generate the audio recording."[142] Identifying the notes and how they were played might also be characterized as stripping out all of the information that is "not performance." Walker says that, regarding the performance it reproduces, "A sound wave is just lots of redundant data." "All I care about is the first two seconds to identify the entire acoustic environment."[143] The work done by Zenph's technological and human listeners, identifying notes and playing styles, centers on the removal of this excess information, leaving behind what Walker calls "the one thing I think is interesting—the playing of the notes."

The anacoustic record is at the core of Zenph's project precisely because it represents a performance as it never exists in practice. All music production, tympanic, re-performative, or otherwise, is eventually acoustically situated. The anacoustic record

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[142] Walker et al., "Methods, systems, and computer program products," US Patent 7,598,447.

[143] Walker, interview.

is “data” in an ascetic sense, information that has been procedurally isolated from the world. Just as the scientific laboratory produces facts about the world through its separation from it,[144] so Zenph purifies “performance” into “data” by separating it from its acoustic context. “We’re doing science here,” Walker says. “We make data.”[145]

Gould was a known tormentor of recording engineers, humming and swaying along as he played—habits he claimed that he could not control. Engineers would try to filter out his peculiar vocalizing and reposition microphones to avoid his head with varying degrees of success. Zenph’s Gould re-performance was a recordist’s triumph: Gould could now be offered “purely” as a pianist—without the uncertainties of the stage and without the undesired aspects of his performance. Re-performance works for Zenph as a means of purification, clearing out (and identifying) the redundant or the extra-musical. This treatment of the original Gould record raises an interesting question: Is Gould’s vocalizing extramusical?

For John Walker, the answer is a qualified “yes”: “What is it that [Gould] did as a performer? Ultimately, he did lots of things that are, in a way, extramusical. [...] Anything you might write in the score, I hope we’ve preserved.”[146] Of course, much of what makes Gould’s performance recognizable is *not* in the score. Walker’s appeal to notation is equally an appeal to tradition. As seen in Chapter 1, the relationship between interpretation and notation is delimited by ever-shifting cultural boundaries. Vocalizing is not part of the traditional interpretive work of the pianist, therefore it is not

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[144] Latour, *We Have Never Been Modern.*

[145] Walker, interview.

[146] Ibid.

included.[147] Gould the performer is produced by and for the data, a clarified and reduced version of Gould the man or Gould the physical body. Inasmuch as Zenph's data are anacoustic, they are decontextualized, and this provides their power as well as their weakness—the ability to isolate and identify a pure "performance" that is nevertheless an incomplete record of an actual event.[148]

In the future, Zenph aims to automate the translation between tympanic and re-performative data, making it possible to take, say, an mp3 of a piano performance, and have the performance play on an actual piano. The kinds of mechanical equivalence produced by piano recorders in the late nineteenth century find a modern analog in the universalizing language of "data." Performance comes to occupy the role of the "work," as the disembodied yet central figure to which specific forms of representation are subservient.

Reconfigurations, binding, and rendering devices

The figuration of performance as data lies behind another of Zenph's rhetorical moves: constructing the piano as a "rendering device." Rather than understanding his work as an extension of the reproducing projects of the 1920s, John Walker compares Zenph's work to computer graphics technology.[149] Producing a re-performance is like

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[147] Another issue of practical concern: the technological support for re-performing sounds other than piano sounds (e.g. the voice via speech synthesis or mechanical generation) is underdeveloped.

[148] The contextual force of tympanic recording should not be overstated, however. Tympanic recording effects its own decontextualization and purification. Gould was a strong proponent of splicing together multiple studio takes, and Walker happily demonstrates the moment where a noticeable splice from the original record remains audible in the re-performance as a sudden change in tempo. This remediation of splicing into an actual piano is complex and warrants a more thorough investigation.

[149] The Zenph patent discusses the computer-generated imagery of the *Jurassic Park* movie and optical character recognition as visual analogs for the processes it describes. Walker et al. "Methods," US Patent 7,598,447.

using motion capture to create a 3D animation: at the last stage, data are "bound" into the fixed form in which they will ultimately be distributed and consumed. "Binding" is the process through which variables become fixed to specific values. Walker says of this stage: "The album is the validation that the data is accurate at the moment of rendering. I need to demonstrate to you that the data is correct, and at one moment on one day, I've locked down enough variables to make a recording."[150] For Walker, the data exist independently of the physical variables that differ between performances. They exist, to use the legal language of *White-Smith v. Apollo*, "in vacuo," independent of any specific realization.

Conceiving of the piano schematically, as just a rendering device for data, allows for an interesting statement from Walker: the difference between speakers and pianos "is completely immaterial; those are both rendering devices for data."[151] From this information-theoretic perspective, the difference between re-performative and tympanic reproduction is collapsed (or elided), and a new logic of data and rendering takes its place. Where Zenph's Gould re-performance treads the line between the physical and the virtual (as the woman in the audience's holographic comment indicated), this rhetoric of data supports a much more expansive goal, as outlined in their patent:

> In other embodiments, the musical instrument is a virtual musical instrument, the sound detection device is a virtual sound detection device, the acoustic location is a virtual acoustic location, the actions of the musician are algorithmic simulations to define virtual sound waves and the sound waves are virtual sound waves.[152]

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[150] Walker, interview.

[151] Ibid.

[152] Walker et al., "Methods," US Patent 7,598,447.

The intent of this passage is to cover a variety of possible arrangements of the components of live performance, substituting the virtual for the physical at will. However, in the most extreme case, the patent covers a curious kind of non-performance: a virtual instrument, played by a simulated performer, producing virtual sound waves, recorded by a virtual microphone, in a virtual room. That is, a performance that exists nowhere at no time. This performance, while perhaps not useful for a listener, is very useful for outlining the structural assumptions that inform Zenph's re-performance. This completely virtual non-event has all the traits deemed relevant in a live performance recording and nothing else. There are no coughing audience members, humming pianists, playbills on the floor, or spatialized social hierarchies modeled in this performance. Rather, the instrument, microphone, room, and performer technique (limited by the parameters allowed in data production) are the complete definition of a performance.

Once the sound waves are de-virtualized, however, these features collapse (or are "bound," in Walker's terminology) into a single data stream. Binding might be conceived of, metaphorically, as the negotiable line between a recording and performance: the "liveness" of a piano concert consists in some degree of the fact that the details of how it will sound are not fixed in advance. A recording, on the other hand, sounds reliably similar whenever it is played.[153] Zenph's "live" Gould re-performance tangled that line, introducing a fixed data set into the open context of a robotic piano and an acoustic environment that would affect the ultimate sound. In the future, Walker wants Zenph to push this binding moment closer to the ultimate listener: "Rather than

[153] Simplifying for the moment the fact that recordings themselves are played in particular acoustic contexts, through a variety of equipment, and for a variety of listeners.

the mp3 residing in your player, you get the data and the model for the instrument, and the style you want it to be played in, and the room you want it to be played in, and your player binds it all together on the spot. It absolutely will happen."[154] Through novel 360° speakers that project sound into a space more "naturally" than conventional, unidirectional speakers, Zenph promises a hybrid form of mediatized re-performative/ tympanic listenership, the consequences of which are difficult to predict. As with the reconfiguration of domestic pianistic labor promised by the Pianola, Zenph's collapse of performance and recording promises to be a contentious and generative technocultural intervention.

Mechanical fidelity, voicing, and mapping

While Zenph's future may be in sampling engines, synthesis, and virtual instruments, their current method is built around the piano. Making the piano into a rendering device is not just a rhetorical move, but it also requires physical labor. A piano voicer is responsible for adapting the physically specific piano—with innumerable traits that define its sound—to the role of transparent rendering device. By pricking the felt of the hammers with a needle and adjusting the action of the piano, the voicer changes the tone quality of the instrument without retuning it. Walker describes the job of the voicer as making "the pianos sound like good examples of themselves." The ironic sign of the voicer's success is to configure the piano so that it is simultaneously accurate and empty: Walker says, "I want to make data that map to a

[154] Walker, interview.

blank slate."[155] In order to reliably perform the data, the piano has to be disciplined and numerically characterized.

Zenph's piano voicer is a man named Marc Wienert. He describes the body of the piano like this: "How beautiful a piano is is absolutely a chemistry between every element in the piano. The bridge, the ribs, the soundboard, the plate, the strings themselves, the action, all of it comes together, and if it doesn't come together the piano can't be good."[156] Wienert's task for the Gould re-performance was to bring these elements together so that they sounded "like Gould" when operated with Zenph's data. The complexity of producing an appropriately "blank" piano is evident in Wienert's discussion of Gould's preferred piano makes:

> We have a Yamaha here and [Gould's] 1955 recording of the Goldberg Variations is made on a Steinway, and Gould was a Yamaha Artist at the end of his life and this is a Yamaha that we've endeavored to bring a Steinway flavor to its personality, all the while letting it be the fantastic Yamaha piano that it is.[157]

The complicated identity of this piano derives from commercial, logistical, artistic, and historical pressures. Making the piano "sound like a good example of itself," as Walker desired, was not as simple as it might have seemed, and a "Gould-like" sound resided in the instrument as well as the data.

Disciplining the piano allows a connection to be made: for the data to be "mapped" to the body of the instrument. Walker says, "So we have to build into the felt of every hammer where pianissimo is (that's a 187), where piano is (that's a 214), where mezzo piano is (that's a 246). So we have to numerically, in a way, map to all the

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[155] Ibid.

[156] Marc Wienert, interviewed by Constance Barrett.

[157] Ibid.

dynamic levels and map smoothly between them."[158] Working with the programmers, the piano voicer has to produce numerical equivalency, across data, felt, and musical terminology, in an instrument that is a physically complex and interdependent system—as Walker says, "the darn instruments are all wood and steel pitted against each other."[159] The process of mapping allows Zenph to conceptually slide between physical and virtual instruments, performers, and rooms, using a quantitative language that makes the physicality of traditional live performance commensurable with its virtualization.

Methodically guaranteeing a uniform response from the piano allows Zenph to produce faithful re-performances. Thanks to a mechanical conception of pianism, augmented by a modern increase in precision and appreciation for instrumental and acoustic context, Zenph reduces the question of fidelity to a simple numerical comparison: Are the numbers right? The acoustic details of recording are, by Walker's characterization, in the service of the data. The same data could be recorded again and again, in different rooms, with different microphones, or on different pianos, and remain in a specific way faithful to an "original."

Futures of re-performance

Although Zenph's work appears futuristic, stretching the boundaries of musical reproduction, it makes more sense in the context of the history of re-performance. The ultimate reliance on materiality, complicated relationship between records and

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[158] Walker, interview.

[159] Ibid.

performances, and parametrization of performance that characterize a Zenph re-performance all resonate strongly with the historical examples covered in this thesis. Describing the Zenph record in terms of tympanic recording alone is plainly inadequate, and taking the flattening language of "data" as the ultimate description leaves little room for material specificity. Re-performance, with its intertwined and obscured history, offers an alternative way to make sense of this peculiar-seeming form of music reproduction.

Zenph's re-performances are not the only contemporary phenomena that could benefit from such an alternative perspective. For example, recently popular music video games such as *Guitar Hero* and *Rock Band* evade conventional tympanic understandings: players "play" the prerecorded music by correctly pressing a series of buttons, and certain versions allow small amounts of interpretation—drum fills, pitch bending, or audio effects.[160] In tympanic reproduction, conventionally understood, performance precedes recording. What, then, are these players doing? Re-performance opens up the ambiguous spaces between production and reproduction, allowing a priori for the proliferation of hybrid recording-performances. Other contemporary practices such as sampling and turntablism make new sense in a context where the fact that recordings are performed is a given. Glenn Gould wrote in 1966 of the "dial twiddling" audio enthusiast:

> At the center of the technological debate, then, is a new kind of listener—a listener more participant in the musical experience. [...] For this listener is no longer passively analytical; he is an associate whose tastes, preferences, and inclinations even now alter peripherally the experiences

[160] See Miller, "Schizophonic Performance" for an interesting take on this phenomenon.

> to which he gives his attention, and upon whose fuller participation the future of the art of music waits.[161]

Gould's vision of the musical future included listener interventions that deferred the moment of "binding," to return to Walker's terminology. This deferral, playing on and around the line between the fixity of material representation and the indeterminacy of live performance, characterizes not only obvious examples like *Guitar Hero*, but also simple interventions like the frequency equalizing Gould would have been familiar with. Re-performance offers a way not only to understand newly performative technologies, but also to recover the performativity of the old. Reviving the role of the listener or the user as a potentially *active* role, re-performance potentially casts the conventionally tympanic in a new light.

Georgina Born writes of music that it

> destabilizes some of our most cherished dualisms concerning the separation not only of subject from object, but present from past, individual from collectivity, the authentic from the artificial, and production from reception.[162]

Re-performance participates fully in these destabilizations, resisting easy categorizations in favor of hybridity and complexity that are rooted in the history of instruments, composition, and performance. As tympanic reproduction appears poised to crash together with re-performance in a number of technological and ostensibly "new" venues, it is becoming more important to find historical precedents through which to make sense of it all. The familiar language of tympanic reproduction and data flattens and universalizes, erasing the moments of translation and negotiation that

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[161] Gould, "The Prospects of Recording," 347. See Downes, "From Enthusiasm to Practice," for an extended study of system-building among high-end audio enthusiasts.

[162] Born, "Musical Mediation," 8.

make media work. The history of re-performance, on the other hand, offers epistemic objects that are both unfamiliar and materially specific. With this history that continually evades our “cherished dualisms,” we might make new sense of the present.

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