In Beethoven’s wake, the ubiquity of play at the keyboard led to an unprecedented degree both of standardization and of specialization. Despite significant local variation in procedures relating to manufacture and pedagogy, the gradual homogenization of pianistic hardware and its installation across an ever-growing domestic user base allowed for the transmission and mobilization of skills, services, and software that permeated geographical and cultural boundaries. At the same time, the establishment of a relatively consistent playing field placed the onus on each individual pianist to carve out a distinctive niche in what was becoming an increasingly competitive professional environment. Augmenting the improviser-composer-pianist model adopted by Mozart, Beethoven, and their contemporaries, players such as Liszt forged their reputations on the virtuosic performance of technical feats that defied imitation and, reciprocally, on transcriptive feats of imaginative compression that proved both instrument and individual equal to the most daunting operatic and symphonic demands. For Liszt, réminiscences of operas involved reordering their sequential elements as well as the virtuosic variation, elaboration, and remixing of their most popular numbers into a highlight reel to be (re)played on demand. Adopting a contrasting approach, Clara Schumann was perceived to eschew novelty and spectacle in favor of putting virtuosity to work and dutifully recreating the masterpieces of the burgeoning canon, a ritual she performed by heart. Each distinctly implicated in the sensual and affective operations of memory, Liszt’s exuberant displays and Schumann’s faithful reproductions defined parameters of the piano recital’s recreative blend of the past and the present that persist to this day.
But at the keyboard, as we have heard and seen, matters are rarely as black and white as they appear. Despite their considerable differences, the historical figures of Liszt and Schumann are sufficiently complex and contradictory to resist such typecasting: Liszt could claim fidelity to the letter as well as to the spirit of Beethoven’s scores, while Schumann featured her own improvisations and compositions on her concert programs. More telling is the fact that a single instrumental medium could sustain such divergent practices and ideologies, proving itself adequate to the task of relaying all manner of musical utterances via digital actions and analogical gestures. Their aesthetic differences notwithstanding, Liszt, Schumann, and every other nineteenth-century pianist plied their art by way of a materiality that they were expected to transcend.

All media define the limits of the reproducible as well as the imaginable and the communicable. As touched on in Key 4–1, Adorno’s philosophy of musical reproduction was founded on the observation that music’s “true character as writing” was revealed via the mimetic tracing of its seismic peaks and troughs by the phonograph’s stylus. These oscillographic patterns, self-evidently uncoded and yet veiled from human comprehension, were akin to those formed both by Chladni’s experiments and by the “mysterious mosses and herbs” that somehow register the “beautiful song” that the father of Hoffmann’s Kapellmeister Kreisler “sang almost every day.” In notational terms, the sonorous illegibility of Beethoven’s sketches perhaps comes closest to matching the hermeneutic potential with which musical writing could be charged. For Adorno, such inscriptions formed a neumic substrate to be transduced by needles, performers, and other media; beyond composition, however, the process of interpretation was itself “the perfect imitation of musical writing.”

This suggests a reason why even relatively scrupulous nineteenth-century editors of “classical” works felt the need to supplement the melographic plotting of pitch and rhythm, not to mention the numerical shorthand that had served seventeenth- and eighteenth-century musicians so well, with analog sweeps connoting phrasing and digits that choreographed manual gestures via unambiguously denoted fingering. Beyond the mitigation of historical or stylistic unfamiliarity in the interest of appealing to a broad constituency of readers and players, such generic markers of idiosyncrasy were understood to bring the text asymptotically closer to the conditions of its performance. As Kinkel’s tribute to Chopin and Riemann’s editorializing of Beethoven’s op. 31, no. 3, makes opaquely clear (Figure 74), the meaning of notes had to be read between the lines constituting bar and stave; correspondingly, its tangible intangibility had to be digitally realized between the cracks that defined and defiled the continuum of the keyboard.

For Kittler, media provided the psychic wherewithal by which modern subjectivity was made conceivable and representable: gramophone, film, and typewriter formed a mediological triad to be mapped onto the Lacanian registers of the real, the imaginary, and the symbolic. At times, the schematicism of this overlay
occludes the extent to which these strands were intertwined. In particular, as we
saw in Key 2–3, the piano combined digital and analog elements associated with
both Apollonian typewriter and Marsyan gramophone, with the symbolic process-
ing of musical information and its mimetic realization. Contiguous both with Scott
de Martinville’s oscillographic lexicon of nature’s “written general language of all
sounds” and with Hoffmann’s alphabetically discrete invocations of such phenom-
ena, the nineteenth-century piano was complicit in an ideological and techno-
logical quest to make the spirit audible through the very artificial and mechanical
means that Rousseau, Herder, and Hegel had decried. Rather than adapting and
conforming to the properties of the instrument, the musical subject at the keyboard
was heard to project herself through the production of an inimitable sound that
served as a sonic signature: ludic fungibility was trumped by the manifest destiny
of both the work and the individuals who brought it forth, preserved for posterity
on cylinders and disks. The deadly seriousness of such enterprises was captured
by the sober tone in which Edison projected the phonograph’s capacity to preserve
“*the last words* of the dying member of the family—as of great men.”

The impersonality with which personality could be technologically conveyed
promised—or threatened—to diminish the significance of composers, as Adorno
grimly acknowledged and recent developments in sound and media studies have
borne out: “If at some later point, instead of doing *Geistesgeschichte*, one were to
read the state of the cultural *Geist* off of the sundial of human technology, then
the prehistory of the gramophone could take on an importance that might eclipse
that of many a famous composer.” Yet insofar as the history of sound recording
has identified the phonograph as a paradigmatic technological breakthrough, it
has covertly endorsed values based on poetic configurations of fidelity, fatality,
and the preservation of selfhood that are more revealing of Hegelian historicism
and Edison’s auto-mythologizing than the immediate conceptual and technologi-
cal circumstances from which the device emerged. From before Hoffmann’s day
right up until our own, however, the reification of sound as an inscrutable and
inviolable form of indexical inscription to be reproduced analogically has been
supplemented by digital modes of recreation that make no attempt to conceal
the artifice of contrivance (and vice versa). Via the strategic deployment of pegs
and pins, the tripping of keys, or the flipping of bits, digital technologies from the
music box to Ableton *Live* open sonic events to playful manipulation and inter-
vention, allowing players not only to play them back but to *recreate* (with) them.
Vilified as crudely inexpressive on account of the simulative play they exhibit, such
mechanisms have often been deemed childish and jejune by comparison to the
serious business of artistic (re)production. Viewed from a different angle, how-
ever, their unsentimental playfulness speaks truth to aesthetic power: the *mimicry*
of the *mīmos* underpins the loftiest mimesis, exposing the contingency of even the
most earnest attempts to model and capture sonic reality.
If children themselves were only made aware of the keyboard’s capacity to recreate musical visions, Adorno fondly supposed, they would soon “tire of tootling and join forces to spell out Beethoven sonatas.” Conversely, Adolf Bernhard Marx recognized the value in granting children the freedom to play around on the piano in their own way, to seek out sounds, even to clatter over the keys (without damaging the instrument). Once lessons have begun, this kind of play is mostly suppressed: children are told that devoting themselves to finger exercises and written-out pieces is more productive. But if this singular and indispensable freedom be denied, how can the vulnerable musical imagination [Tonphantasie] of each child be sustained?

Rather than restricting them to the development of technique and the dutiful recitation of texts, Marx encouraged children to explore the keyboard’s sonic resources by running, jumping, and scrambling over its uneven terrain.

In recent years, György Kurtág’s Játékok (“Games”), an ongoing collection of “pedagogical performance pieces” begun in 1973, have perhaps best manifested the childlike paidia of this type of play at the keyboard, the recreative gestures of which both prompt and reflect a cornucopia of visions, associations, and recollections. Echoing Marx, Kurtág recounts that the composition of Játékok was suggested by children playing spontaneously, children for whom the piano still means a toy. They experiment with it, caress it, attack it and run their fingers over it. They pile up seemingly disconnected sounds, and if this happens to arouse their musical instinct they look consciously for some of the harmonies found by chance and keep repeating them. . . . Pleasure in playing, the joy of movement—daring and if need be fast movement over the entire keyboard right from the first lessons instead of the clumsy groping for keys and the counting of rhythms—all these rather vague ideas lay at the outset of the creation of this collection. Playing—is just playing.

A set of twelve miniaturized depictions of toys and games for piano duet, Bizet’s Jeux d’enfants triangulates the playfulness advocated in Marx’s and Kurtág’s ludopedagogical statements while forming a chronological link between them that belies the notion of the nineteenth century as a no-play zone. Among them, perhaps the most thoroughly—even tautologically—playful gestures are choreographed in “Saute-mouton” (“Leapfrog”), subtitled “caprice.” Here, the eponymous pursuit accounts for the genre and mode of performance as well as the musical subject matter, at which the score or a recording can offer only the faintest hint. Each hand leapfrogs the other at the outset (Figure 78, Audio 21), while the hand-off between the two pianists in m. 2 turns proceedings into a two-player game. Starting and ending at opposite ends of the keyboard, the leapfrogging multiplies at mm. 21–24 as if reflected in a mirror (Figure 79, Audio 22): for the players, the chiasmic intersection in the middle plots collisions between the hands of self and other that must be negotiated with quick-witted agility.
Figure 78. Georges Bizet, “Saute-mouton” from Jeux d’enfants, mm. 1–4 (Paris: Durand, Schoenewerk & Companie, [1872]).


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Figure 79. Bizet, “Saute-mouton,” mm. 21–24 (Paris: Durand, Schoenewerk & Companie, [1872]).


To listen to this audio, scan the QR code above with your mobile device or visit DOI: http://doi.org/10.1525/luminos.16.30
Questions arise from the self-evident ludomusicality of Bizet’s digital analogy: Does the Aeolian modality stage the mimicry of children at the piano, for whom the white keys become a literal playground for running, skipping, and jumping, or does it self-consciously invoke paidia by way of a calculated indifference to diatonic protocol? Throughout the piece, the breathless ilinx of hands and bodies alternates with the artful coordination of quasi-Wagnerian chromatic chicanery, indicating the affective ambiguity with which childhood is represented as well as reenacted.

Like Kurtág’s games, Bizet’s diversions are to be coyly and nostalgically observed as well as enthusiastically played: for both players and listeners, they are at once ironic and naïve, recreative and recreational.

Despite the stylistic gulf that lies between them, Kurtág’s Játékok and Bizet’s Jeux d’enfants activate the same playful vectors when set in ludomusical motion. The same could be said of the qualities of kineticism, inertia, pleasure, and frustration exhibited and elicited by Beethoven’s Bagatelle in C, discussed in Key 4–5, and Lucas Abela’s Pinball Pianola (2012, Figure 80 and Video 9), an interactive sound
installation that fuses the mechanics of an upright piano and a pinball machine in a manner designed to appeal to “virtuosos and wizards alike.” The machine's keyboard triggers twenty flippers that propel the ball toward the piano's strings; the sonic results are amplified by contact microphones and processed by a range of adjustable effects and filters that are activated by way of six yellow targets studding the field of play. Uncoupling and rewiring the pianistic logic according to which digital input is directly and predictably mapped onto sonic output, the paidia of Pinball Pianola opens up a playful space between flipper, bumper, target, and string that, despite the staves adorning it, is as far removed from musical scores as it is from the scores typically accumulated in the course of playing pinball.

From Beethoven's bagatelles to Pinball Pianola, recreational devices and techniques form a genealogical and epistemological supplement to the dominant narrative that relates the technological mediation of sound primarily in terms of ever-increasing verisimilitude, a narrative belied over the course of recent decades by a decisive turn away from the analogical demonstration of naturalistic fidelity and toward the digital attributes of promiscuity, economy, and mobility. In its multiple hedonic, renovative, and restorative senses, recreation can be set alongside established modes and technologies of reproduction as a means of accounting for the generation, retrieval, transduction, simulation, playing, and replaying of sonic data. Recreation emerges from the reciprocity between visible, audible, and tangible representations of information in both space and time: it has to do with play put on display.

To reframe the playfully recursive qualities of the phenomena addressed in its four predecessors, this final Key bears witness to the performance of its own chiastic reversal. Rather than apprehending digital games primarily as technological remediations of prior events and phenomena, this Key focuses on games developed and published by Nintendo in order to tease out elements that resonate with the musical past in unexpectedly revealing ways. Hitherto, digital games have been intermittently deployed to shed catachrestic or skeuomorphic light on ludomusical objects and practices drawn from the literate and manual traditions of Western art music. In what follows, conversely, Japanese digital games are presented in light of their capacities to process those objects and practices, which in turn assume the wherewithal to redefine the significance of digital games themselves. As a means of illustration and demonstration, digital games here replay the themes addressed in each previous Key, to which end each of the miniature Keys that follow recursively maps onto its large-scale predecessor and counterpart.

First, the concept of ludomusicality is revisited from a Nintendian perspective; second, the media-genealogical lineage of the digital analogy is retraced via recreational devices with and by which to play in Nintendo's game-worlds, both on- and off-screen. The third mini-Key addresses the emergence of digital ludomusicality and its intersection with improvisation as artistic practice, a nexus explored by the work and play of the game developer and media artist Toshio Iwai, while the fourth examines
Nodame Cantabile’s recreation of Mozart’s Sonata for Two Keyboards as a competitive and collaborative endeavor pursued by students at the fictional Momogaoka College of Music, who serve as avatars for players wielding Wii remotes and nunchuks. Absurd though it might sound, Nodame Cantabile demonstrates and affords modes of ludomusical performance that, via the labyrinthine media-archaeological channels that both connect them to and remove them from the phenomena they recreate, are at once historical and contemporary. As such, the game’s brazen eschewal of any pretense to authenticity and its wholehearted embrace of the playful elements that attend rituals of performance offer potential ways of (re)presenting the ludomusicality that lies latent in the high scores of the past. Finally, the Key pivots toward its resting place by recapitulating the combinatorial and recursive themes of the book writ large.

5–1 NINTENDO’S BRAND OF LUDOMUSICALITY

The tangled genealogy of the digital game resists the casual ascription of cause and effect, origin and derivation. Similar elements can be found in different ecosystems, and the perception of affinities and discrepancies is preliminary to the assembly of a method sufficiently flexible to account both for local idiosyncrasies and for the transnational logic of capitalism and control that has driven interactions within and among East Asian and Western nations since the end of the Second World War. This task is made more challenging by the rhetoric of exceptionalism that infiltrates national discourses in response to global dynamics. From Super Mario Bros. to The Legend of Zelda, the worldwide popularity of Nintendo’s evergreen franchises indicates that while the concepts behind digital games emerge under specific conditions and constraints, they can migrate freely across geographical, cultural, and technological borders. The systemic design and representational attributes of such games should not be essentialized as “Japanese”; at the same time, neither should the differences that distinguish them from their Western counterparts, which reflect historical circumstances and technological resources that have at times overlapped and been held in common.

According to the art historian Nobuo Tsuji, a playful shuttling between artistic whimsy and artisanal skill, decorative ornament and functional structure, and (in Caillois’s terms) between the childlike ebb and flow of paidia and the strict observance of rules that typifies ludus has distinguished Japanese culture for centuries. In pursuit of a “Japanese way of playing,” Rupert Cox arrives at the Kantian conclusion that those who play “accept the context which constrains their action and the ludic structure which frees it.” Along similar lines, the digital-game scholar and former Nintendo developer Akihiro Saitō notes that the perception of affordances where others see constraints is characteristic of a playful mindset that pervades Japanese visual and literary culture. In considering the autopoietic question of how relatively simple devices (such as Nintendo’s Game Boy [1989]) can give rise to complex phenomena (such as the gameplay of Pokémon Red [1996]), Saitō invokes
the refinement, precision, and ambiguity wrought via the relatively crude technology of Edo-era woodblock prints depicting the “floating world” (ukiyo-e) and the intricacies that emerge from the rigorous compression of the *haiku*. Saitō maintains that the carefully designed interfaces of Nintendo’s games draw on the spaces and rituals of *motenashi* (hospitality), such as the artful arrangement of flowers in the *chashitsu* (tea ceremony room): for him, it is no coincidence that Nintendo was founded in Kyoto, “the birthplace of Japan’s hospitality culture,” in 1889.

Miniaturization is an associated facet of play that is global in scope and yet is invested with distinct significance in Japan. From rock gardens and *bonsai* to cars and transistor radios, operations of shrinkage, compression, and folding, related both to mobility and to microcosmic consolidation, have been central to Japanese aesthetics and cultural practice. Akin to Huizinga’s notion of the magic circle, tightly circumscribed spaces such as the *chashitsu* are understood to be separate from the everyday world; the strict protocol that governs behavior there nonetheless gives rise to extraordinary and unrepeatable events. In such contexts, miniaturization concentrates the magical qualities of objects. By making them “manageable [and] accessible to handling,” as Rolf A. Stein writes of East Asian miniature gardens, “magical instruments share the nature of the work of art; the work of art shares that of a toy.”

Stein’s formulation encapsulates a nexus of qualities that can also be attributed to Nintendo’s systems. From the Game & Watch (see Key 1–4) to the Wii U (2012), portability, scale, instrumentality, and illusions of magic wrought by the manipulation of technology have been integral to Nintendo’s playful enterprises. The company’s attentiveness to the spatial dimensions of gameplay has repeatedly redefined the role of the screen: rather than exclusively taking place onscreen, Nintendian gameplay unfolds through, between, and beyond screens. This idea, articulated by successive generations of Nintendo’s celebrated game designers, indicates how the screen need not operate as a cinematic or televisual fixture, but can serve simultaneously as an interface, a reflective plane, and a barrier. In different configurations, the screens of the handheld DS and home-based Wii U systems are multiple, portable, foldable (in the case of the DS), touchable, and usable as a surface for writing, drawing, and painting. In all these regards, they invoke *byōbu* (Japanese folding screens), such as those painted by (or under the influence of) Edo-period artist Jakuchū Itō (Figure 81): as loci of both revelation and concealment, they help define a space analogous to the *chashitsu* in which formally defined yet delightfully unexpected encounters may take place.

In audible terms, the paradigm of high-fidelity musical reproduction associated with the home theater or the compressed formats and mobile listening practices circulating around Sony’s Walkman and Apple’s iPod are less relevant to contemporary ludomusical praxis than the notion that the Nintendian gaming device is itself akin to an instrument such as the harmonica or melodica, both of which were widely disseminated via postwar Japanese music education programs. Like the
harmonica, the Game Boy offers a distinctive timbre, located mainly in the upper portion of the audible frequency spectrum, that has been modified, extended, and repurposed by dedicated users to perform musical feats that far exceed its capacities as defined in its original design specification; like the melodica, the 3DS system (2011) affords digital, gestural, and pneumatic input and can be played in different orientations.

Nintendo’s controllers and handheld machines are not merely representational systems, computers, prosthetic extensions of the body, modes of communication, or vehicles of fantasy (although they are all those things). As technological nodes in historico-cultural networks, they are loci of instrumental performance: through them, music informs the playing of games just as games enable the playing of music.

Examples of this duplex configuration are liberally strewn over Nintendo’s output. Across a broad array of genres and titles, the playfulness of the company’s games is often to be found where toys, instruments, music, and motion intersect. Within the mythos of The Legend of Zelda series, instruments such as the eponymous Ocarina of Time from the Nintendo 64 game (the playing of which is illustrated in Figure 82) perform supernatural functions such as warping through time and space, communing with the natural world, unlocking sealed gateways, and healing physical and psychic trauma. The Ocarina of Time can be placed in an organological context provided by the eponymous instrument from Mozart and Schikaneder’s Die Zauberflöte, which similarly acts as charm and summons as well as an agent of metamorphosis and protection. While the magical capacities of ocarina and flute might be traced back to Athena’s enchantment of the pipes picked up by the ill-fated Marsyas, in both cases pneumatic force is tempered by Apollonian discipline. In Nintendo’s game, the ocarina’s music is instrumental insofar as it is composed of discretely pitched elements that enable the player to accomplish gameplay.
objectives on behalf of the protagonist Link via digital permutations remembered and recreated via the manipulation of a five-bit serial interface.\textsuperscript{49}

The performance of memorized sequences that trigger sonic responses via the pressing of the Nintendo 64 controller’s brightly colored buttons (Figure 83) invokes earlier electronic games such as Milton Bradley’s iconic \textit{Simon} (1978). Beyond such associations, the ocarina can be played as an instrument in its own right by exploiting the range of chorded possibilities charted by Baudot when devising his

\begin{figure}[ht]
\centering
\includegraphics[width=\textwidth]{figure82.png}
\caption{Link learning “Epona’s Song” in \textit{The Legend of Zelda: Ocarina of Time} (Nintendo, 1998).}
\end{figure}

\begin{figure}[ht]
\centering
\includegraphics[width=\textwidth]{figure83.png}
\caption{Nintendo 64 controller (Nintendo, 1996). The Ocarina of Time’s five principal pitches are played using the yellow and blue buttons and modulated using the central analog stick. Photograph by Evan Amos.}
\end{figure}
own five-bit interface: beyond the five notes required for gameplay purposes, the player can produce a chromatic scale by means of chorded button combinations, and can even modulate pitch and timbre via the controller’s analog stick. In the process, the controller is transformed into an instrument and a ludomusical toy, indexed by the correspondence not only between its colored buttons and those of Simon, but by Milton Bradley’s personal commitment to the nineteenth-century ludic and pedagogical theories of Friedrich Fröbel, the pioneer of Kindergarten as educational method and environment.

The most overtly ludomusical software title in Nintendo’s catalog is Wii Music (2008, Figure 84), which features sixty-six instruments activated by mimetic motions and techniques that players perform via the Wii remote and nunchuk controllers. Miyamoto, who coproduced the software, encouraged people to think of it “as a new kind of instrument . . . that allows you to become a creator . . . and a performer of music.” After the fashion of Marx and Kurtág, Miyamoto complained that “music education for young children today begins with enjoying rhythm, but then suddenly jumps into music theory. [With Wii Music], I seriously want to . . . be able to change that.” When questioned as to whether Wii Music’s main mode qualified as a game given its lack of an overarching goal, quantifiable progress, and unambiguous fail states, Miyamoto freely acknowledged that it did not: it was, however, “more interesting” in that it was closer to a musical toy-box. Its combinatorial improvisatory mechanics evoke dice games, and even the innumerable variations generated by Winkel’s componium and C.P.U. Bach: as Nintendo’s then-president Satoru Iwata put it, “instead of accurately performing actions in time with a score, [Wii Music’s] gameplay is about enjoying limitless possibilities—all of which are correct.” For
his part, Miyamoto distinguished between the formal *ludus* of games and the *paidia* evoked by toys and musical instruments, both of which are implicated in synchronic and diachronic recreation à la Bizet: Nintendo is “like a toy company where we’re making these things for people to play with. As a consumer, you want to be able to . . . have those things from your youth that you can go back to and experience again.”

Established as a *hanafuda* playing-card manufacturer, Nintendo made products ranging from board games to dolls’ houses for almost a century prior to the Japanese release of the Famicom in 1983. The company’s approach to technology thus emerged from its lengthy history as a toy company: concomitantly, Nintendo’s digital technologies have both displayed and been subjected to a significant degree of retrogression and miniaturization. For Agamben, the toy either “[dismembers] and [distorts] the past or [miniaturizes] the present”: toys shrink the most significant artifacts of the present day to the Lilliputian scale that they will assume in the future. While Agamben was addressing traditional toys such as the dolls, spinning tops, and hobby horses rendered musical by Bizet’s *Jeux d’enfants*, the historical narratives that toys simultaneously evoke and conceal also have a bearing on the automation and mechanization integral to what Brian Sutton-Smith dubbed the “machine toy concept” and its instrumental implications.

Many of Nintendo’s most successful toys were created under the supervision of Gunpei Yokoi, who joined the company in 1965 and quickly established himself as a designer of uncommon ingenuity. Yokoi claimed that his ideal of play harked back to children’s games such as tag and hide-and-seek: he sought to “make old things possible with current technology.” The Game & Watch systems by which Yokoi’s international reputation was forged drew on a peculiar mixture of cutting-edge and antiquated technologies, evincing a mindset that he termed *kareta gijutsu no suihei shikō* (“lateral thinking with seasoned technology”). According to this way of thinking, ludic success was more easily attainable via the radical repurposing of mature, inexpensive technology than by the adoption of the latest technical innovation for its own sake. For Yokoi, “making old things possible with current technology” thus entered into a chiastic relation with the principle of “lateral thinking with seasoned technology.”

Yokoi’s technological approach to ludic design was framed by Japan’s volatile cultural and economic status in the aftermath of the Second World War. At first, individuals and corporations conspicuously relied on North American resources: while the *manga* artist and animator Osamu Tezuka pared down Walt Disney’s filmic animation techniques for television to save time and money, Nintendo adopted Disney characters to bring playing cards out of the gambling den and into the family home. In both cases, imitative measures taken for expedient reasons had unintended and far-reaching consequences. Tezuka developed a repertoire of limited animation techniques that defined the nascent medium of *anime*, while Nintendo gained new
access to a broad demographic that would prove responsive to Yokoi’s experiments in the world of toys. As Nishikado’s Space Invaders triumphantly demonstrated, the technological constraints and affordances of the digital-game medium in the late 1970s and early 1980s were well suited to two-dimensional sprites drawing on the iconography of manga and anime as well as the venerable calligraphic and painterly traditions that lay behind them. At the same time, the proliferation of inexpensive digital instruments such as Casio keyboards reflected and sustained an approach to composition and arrangement that conjured musical virtues from technological necessity. Iwai locates the most significant archaeological evidence of the digital game not in nineteenth-century analog media, but in the manually activated technologies of the music box and the flipbook. To the extent that they remediated and combined the properties of such antique and infantilized devices, digital systems such as the Game Boy became “an electronic flipbook” and a “musical instrument” via which “the touch of one’s fingers” activated and registered the play of “moving images and music.” As mandated by the von Neumann architecture, the sound and images of Game Boy games are structured by a digital lattice: the sprites are constituted by the mosaic-like configuration of pixels on the screen, while the music is produced via the execution of pitches and rhythms encoded in an analogous manner to the pegs that stud the surface of Caus’s organ barrel (Figure 3). From the flipbook to anime, from music boxes to MIDI, and from the Game Boy to works of art, the audiovisual elements that play into contemporary manifestations of ludomusicality can be traced along paths that wind across geographical and chronological planes, departing from and converging at the digital arrays by which pixels and notes become commutable.

Reflecting on the ways in which ludomusical relationships can be structured to become simultaneously audible, visible, and playable, Kōji Kondō, the celebrated composer of multiple soundtracks for games in The Legend of Zelda and Super Mario Bros. series, evoked the Game & Watch in observing that both the movements of characters and the sequencing of their music are synchronized to the CPU’s clock, enabling the rhythm of soundtrack and gameplay to be precisely coordinated. Kondō’s music for Super Mario Bros. was composed after he had played the game intensively to gauge how Mario ran and jumped, entraining the character’s rhythmic motions in order to create a satisfying counterpoint between music and gameplay. Working on New Super Mario Bros. for the Nintendo DS more than two decades later, Kondō went a step further by choreographing the behavior of nonplayer characters (NPCs). As they dance and jump in time to the music, they directly affect gameplay mechanics, transforming rhythm into a strategic resource for players. While Mario’s musical accompaniment was initially “inspired by the game’s controls,” in New Super Mario Bros. it both lengthens and closes the feedback loop between player and game by conducting the performance of the human-controlled protagonist in concert with the prescribed routines of the NPCs. At the same time, the emergent “performance” breaks the fourth wall, foregrounding a playful theatricality redolent both of kabuki and of the commedia dell’arte (as discussed in Key 4–4).
Whether figured in economic, political, cultural, technological, or aesthetic terms, constrained resources have provided ludic affordances for generations of Japanese game designers. For artistic directors and composers such as Miyamoto and Kondō, restrictions on storage capacity and processing power necessitated a reliance on tiling and looping, which helped drive the sprites, themes, and sound effects associated with *Super Mario Bros.* and *The Legend of Zelda* deep into players’ intermedial networks and personal memories. These games have thereby acquired a potent affective charge that, as Woodrow Phoenix writes of Japanese toys, not only triggers “a cascade of forgotten or inaccessible memories,” but can also function as a direct “link back to intense personal experience.” Compounded by nostalgia, the power of these neurological and affective connections can be witnessed in the Pavlovian responses that these classic games continue to elicit. The iconic status attained by their configurations of pixels and notes extends beyond their specific audiovisual attributes: it hinges on their (re)creativity, on the multifarious ways in which they can be played and replayed, forming temporal loops that, like Link’s ocarina, circumvent the linear passage of time. From dutiful novices to hardened ROM hackers and from completists to speedrunners, players of *Mario* and *Zelda* join the ends of the continuum stretching between *lusus* and *paidia* to form their own loops. Acknowledgment of the arbitrary and intransigent conditions laid down by the CPU can go hand in hand with a childlike or contrarian delight in reconfiguring, short-circuiting, or simply disregarding them.

### 5-2 Analogous Digitalities

As explored in Key 2, the keyboard renders its own epistemological principles apprehensible by compiling and arraying elements to be digitally activated both serially and in parallel, enabling connections to be made that stretch beyond the immediate historical and cultural parameters framing any single instantiation. Its contiguous yet multifarious lineage thus complicates media historiography cast in the terms of discursive and technological equilibria, whether punctuated by Goethe, Hoffmann, and Turing (in Kittler’s initial configuration) or ruptured by Euler, Fourier, Chladni, and Johann Wilhelm Ritter (as they are in Siegert’s more recent iteration). In articulating the unpredictable calculus of figured bass, the playful modularity of a Mozart sonata, the imaginary inner voice of Robert Schumann’s *Humoreske*, op. 20 (1839), the nostalgic oscillations of Bizet’s *Jeux d’enfants*, the wry Mozartian allusions and gamelan-like hypnosis of Francis Poulenc’s Concerto for Two Pianos (1932), the automated frenzy of Conlon Nancarrow’s studies for player piano (1948–92), or the ever-shortening feedback loops of Georg Friedrich Haas’s *Ein Schattenspiel* (2004), the keyboard’s digital properties have neither outmoded nor been outmoded by analog technologies, but have rather set them in ever-shifting parallactic relief.

From Leibniz’s binary poetics to the Nyquist-Shannon sampling theorem and beyond, digital claims to resolve sensory signals beyond the physiological limits
of retina and tympanum have elicited analogical skepticism; conversely, analog claims to capture the essence of reality have been tempered by digital rationalizations. Today, however, more distinctive values are attached to the nominal shortcomings than to the touted strengths of analog and digital technologies, borne out by the mediated messages of vinyl crackles and digital glitches. Despite the master narratives of hegemony and resistance that seek to account for periods of reciprocal ascendancy and decline, each mode has shown itself to be capable of recursively processing the other. Digital-game soundtracks are performed by symphony orchestras and issued on limited-edition vinyl; conversely, chiptunes relentlessly digitize the analog musical archive, rivaling nineteenth-century piano transcriptions in scope and number. Games such as Guitar Hero and Rock Band render this process tangible: analog master recordings are quantified to yield a digital score in the form of an automated algorithmic analysis, presented to players in the form of a piano roll that verifies their capacity to verify the checksums thereby calculated. In the production of electronic dance music, such digital latticework constitutes a field of playback that simultaneously visualizes and renders audible reiterative patterns that stud the sequencer’s grid like an abstract mosaic, triggering vocals, sweeps, and other analog elements that have, in turn, been numerically synthesized or registered by way of Fourier’s codification of signal processing.

It is telling that the melographic iconology of the piano roll indexes—and is indexed by—contemporary digital technologies for recording, editing, sequencing, and playback. This goes to show that the role of the player piano cannot be assessed solely in terms of its fluctuating fortunes in the early-twentieth-century marketplace and its relative popularity as a reproductive device vis-à-vis the phonograph: neither its industrial nor its aesthetic attributes can fully account for its historical or media-archaeological importance. In this regard, Jevons’s logical piano (Figure 19) stands as a timely (and untimely) reminder that the mechanical play of keys and the whimsy of combinatorial procedures were aesthetically abjured at precisely the moment when the political, economic, industrial, and military impact of such instrumental logic was at its most palpable. The significance of the digital logic displayed by the piano roll lies in its oblique relations not only to the computerized sequencer, but also to Caus’s studded barrel (Figure 3), Bouchon’s loom, la musicienne (Figures 4 and 5), Winkel’s componium (Figure 45), Debain’s antiphonel, Babbage’s Analytical Engine, Baudot’s telegraphic interface (Figure 8), Turing’s universal machine, the IBM punched card, the MIDI protocol, Ablinger’s A Letter from Schoenberg (Figure 34), and Perich’s Microtonal Wall (Figure 32). In order to take account not only of the myriad factors that distinguish these digital phenomena from one another, but also of what their play(ing) might have in common, the methodological premises on which musicological, sociological, and technological investigation is typically based must be expanded.

The operation of all these devices depends not only on the making of binary distinctions, but also on their modulation into communicative analogies. As a means
of articulating both through the systemic coupling of human and mechanical systems, the interface of the keyboard is attached to them, whether materially or conceptually. On occasion, its trace endures *sous rature*; the case of the keyboardless componium, for instance, circumscribes a space “within the machine where notation and fingers become one,” in Abbate’s words. For the sake of interactivity, however, the inner workings of digital machinery are typically made macroscopically tangible via keys, buttons, or triggers that conform to the morphology of hands and fingers, most commonly through five-bit interfaces such as Baudot’s telegraphic input device and Konami’s *beatmania* keyboard (Figure 9) as well as Harmonix Music Systems’ *Guitar Hero* controller and Nintendo’s Ocarina of Time.

The question of how the genealogy of such instruments might be mapped from the vantage point of Nintendo’s games, and in particular by the isomorphism of digital code and memory (whether programmed, stored, retrieved, or executed by human or machine), can be broached by way of a curious object that is at once a toy, a musical instrument, and a locus of recreative play. In 1972, Nintendo released the “Ele-Conga” (Figure 85), a “new kind of instrument from the electronic age” that constitutes an intriguing point of contact between its history as an “analog” toy company, its future as a digital-game company, and the musical technologies that connect the two. Designed by Yokoi, and ostensibly inspired both by Yamaha’s popular Electone series of electronic organs and by the popularity of “Latin”-styled music in

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**Figure 85.** Ele-Conga, Autoplayer, and paper disks (Nintendo, 1972). Photograph reproduced courtesy of Erik Voskuil (beforemario.com).
Japan, the Ele-Conga was a battery-powered drum machine featuring five buttons that triggered the sounds of a snare drum, maracas, and hand-claps in addition to high- and low-pitched congas. The Ele-Conga was a toy insofar as its membranophonic form was merely skeuomorphic; at the same time, it could also be played as a serious instrument and even connected to an external amplifier for live performance.

Accompanied by scores instructing players how to recreate the patterns of familiar dance rhythms, the Ele-Conga also featured an optional accessory known as the Autoplayer, which could be programmed to trigger such patterns by way of the hand-cranked revolution of paper disks punched with holes corresponding to the Ele-Conga’s five buttons. Made available to players lacking the will or dexterity to produce complex rhythms manually, the Autoplayer evokes the gramophone in form and function; in contrast to the analog peaks and valleys of vinyl, however, the Autoplayer’s paper disks sequence playback by strictly digital means. As noted in Key 1-4, the archaeology of this recreative method can be traced via technologies of musical automation associated with the disks and cylinders of music boxes as well as church, fairground, and barrel organs. As a device to be attached to a musical instrument in order to play it automatically via punched paper, moreover, the Autoplayer itself replicates the functionality of Debain’s antiphonel. Along with its paper software in the formats of scores and disks, the hardware of the Ele-Conga and Autoplayer thus simulates time-honored mechanical means of programming, performing, and recreating musical data.

In contradistinction to the spiral of the gramophone record, the rotations of music-box cylinders and the Autoplayer’s disks can also create loops of indefinite length: digital information stored in such a format can be set in perpetual mechanical and musical motion, as was the case with Caus’s automated staging of Apollo vs. Pan (Figure 12). Kircher published an analogous design for a hydromechanical organ, modeled on the sixteenth-century instrument at the Villa d’Este in Tivoli, which also demonstrates how digital data could choreograph musical performance and movement (Figure 86). The blacksmiths on the left constitute a tribute to Pythagoras, who legendarily stumbled upon the principles of tuning while listening to the relative pitches of hammers ringing out from a forge. As it revolves, the studded barrel of Kircher’s organ programs the blacksmiths to hammer out a loop- ing triadic pattern. In analogously digital terms, Miyamoto and Yokoi’s staging of an agonistic confrontation between Jumpman (later to be renamed Mario) and the eponymous gorilla in Donkey Kong (1981, the heavily adapted Game & Watch port of which is illustrated in Figure 7) also involved barrels, hammers, ostinati, and bodies in repetitive motion: as Lerner points out, Jumpman’s acquisition of a hammer triggers a Kircherian triadic pattern of sound.

A morphological relationship is also perceptible between Kircher’s organ and the music creation mode in Nintendo’s WarioWare D.I.Y. for the DS (Figure 87). As well as featuring a keyboard and animated humanoids, WarioWare D.I.Y. allows the player to tag a virtual barrel (which performs a complete revolution

FIGURE 87. Screenshot from *WarioWare D.I.Y.*’s music creation mode (Nintendo, 2009–10).
every eight measures) with note markers, just as Yokoi had provided purchasers of
the Ele-Conga’s Autoplayer with the “seasoned technology” of blank paper disks
(also capable of storing eight measures of data) and a hole punch.91

Unlike the Ele-Conga and WarioWare D.I.Y., Kircher’s organ was far from

a vehicle of light-hearted play: the macabre figure of the skeleton, serving as a

memento mori, warns of a deadly serious theological agenda.92 As with Kirch-

er’s other spectacular depictions, the organ was intended to arouse awe, fear, and

piety rather than frivolous curiosity.93 That notwithstanding, juxtaposing it with

Donkey Kong and the Ele-Conga places all three in ludomusical and technological

relief, revealing that the foundational attributes of digital games are recursively

bound up with how sound has been conceived, captured, stored, organized, trans-
mitted, recreated, and transduced by mechanical means.

As explored in Keys 1 and 2, the digital epistemology underpinning the sound-
ing rotation of Caus’s and Kircher’s barrels and Yokoi’s Autoplayer has ramified
throughout the realms of material and visual as well as musical culture. It is
closely associated with the patterns of industrialized automation that transformed
Europe and North America over the course of the long nineteenth century, par-
ticularly insofar as they facilitated the production of textiles and the processing of
information as well as the commodification of music and the manufacture of the
self.94 Yet while these functions were harnessed for utilitarian purposes, they could
also play out as ludic, aesthetic, or autotelic phenomena that, like the synthetic
fabrics that bear Jacquard’s name, are intricately arbitrary in design and effect.
The ambiguity of such (in)consequence reflects the straight-faced frivolity of digi-
tal computation, its Janus-like capacity to under- and overdetermine the fabric of
events and their impact on human fortunes. From Babbage’s Analytical Engine
(conceived under Jacquard’s influence in nineteenth-century London) via IBM’s
electric accounting machines to the optical media and hard-disk platters of PCs,
generations of computing devices have been designed to process data stored on
punched cards and their discoid successors.95 The mosaic-like array of informa-
tion on the cards that program a Jacquard loom can thus be seen as a “prophetic
relic” not only of Herman Hollerith’s tabulating machine and the player-piano
music of Hans Haass and Nancarrow, but also of the grid of pixels that configures
the sprite designs of raster-based digital games such as Space Invaders and Super
Mario Bros.96

Such pixelated representations can be apprehended as both miniaturizations
and magnifications, both of which render them toylike. In Agamben’s terms, they
materialize in shrunken form the potent historicity of the objects—whether real or
imaginary—that they represent, filtering them through a symbolic grid that makes
them amenable to playful manipulation.97 From the computer’s perspective, how-
ever, they perform a gross enlargement of the invisible and inaudible protocols
by which strings of data are processed as code and scattered across memory loca-
tions. As we saw in Keys 1–5 and 3–5, the digital game flattens history by enabling the copresence of chronologically disparate phenomena via the subjunctive moods of mimicry and simulation. But while such ludic foreshortening accelerates, compresses, and distorts the passage of time as registered by human perception, it involves a drastic slowing down of the ultra-high frequencies at which the computer operates.

The infantilization of digital technologies of ludomusical recreation can thus be attributed to factors within and beyond the stigma attached to toys and games. On the one hand, the rapid ontogeny of late-twentieth-century developments in digital-game audio technologies has been mapped onto the millennial phylogeny of Western music history by way of narratives leading from “primitive” monophonic beginnings to increasingly “sophisticated” and “florid” polyphony. On the other, the protocols by which the computer makes data available for audible processing and visual presentation via digital performance take the form of patronizing concessions to our sensorial and motoric limitations: to the computer, pixels and keys are as juvenile as Duplo blocks or the Ele-Conga might seem to us. They are nonetheless indispensable if we are to take advantage of the machine-shaped opportunities digital media afford to “enter into the musical process, to intervene in its playback, to participate in . . . creation,” as Eric W. Rothenbuhler and John Durham Peters put it.

From the experiments of László Moholy-Nagy and Hans Heinz Stuckenschmidt in the 1920s to the virtuosic manipulation of records by hip-hop DJs later in the century, analogous ludomusical possibilities have been created and exploited in relation to phonographic media. In the interests of freeing phonography from its reproductive functions, however, Moholy-Nagy felt the need to submit its oscillographic traces of the real to the symbolic order of a “groove-script alphabet,” despite the obstinate fact that such order could only be imposed by way of Fourier’s computationally cost-prohibitive processing of its inscrutable signals. In a similar vein, as Cosima Rainer observes, the contemporaneous visual artists Viking Eggeling and Hans Richter sought the basis of a new “combinatorial language of graphemes” whose rules would underpin what Eggeling evocatively dubbed a Generalbass der Malerei.

In 1930, their dreams were realized by Rudolf Pfenninger, who devised a technique of generating any sound via optical means: after drawing the desired waveform on a paper strip, he photographed it in order to incorporate it into an optical film soundtrack. As Thomas Y. Levin notes, Pfenninger’s curves comprised “discrete units,” which is to say “semiotic entities that can be combined to produce sounds in a . . . thoroughly technical and rule-governed manner.” Inscriptions of such sounds were not forgeries of phonographic signatures, but synthetic simulacra whose plotting of Fourier’s equations “destroyed the logic of acoustic indexicality.” As such, and despite their handmade qualities, they
exhibited the symbolic logic according to which the computer would translate between sounds and images that need never have existed elsewhere. Once again, the interface of the keyboard formed a digital point of contact between the two: the New York Times reported Pfenninger’s intention to construct “a contrivance resembling a typewriter which, instead of letters, will set together sign [sic] waves in succession.”

Tellingly, it was at precisely this juncture that doubts concerning the maturity and seriousness of Pfenninger’s achievement entered the picture. Critics questioned the “primitive,” “strangely unreal” qualities of Pfenninger’s “‘mechanical’... carousel music” in terms that prefigure the common critique of digital games as “trivial and cartoonish,” as Lerner puts it. In their remediation of “classical” musical materials via the synthetically generated monotony of simple waveforms, the sounding shapes of Pfenninger’s films such as Pitsch und Patsch (1932) and digital games such as Amstar’s Phoenix (1980) converge in ways that reflect long-standing tensions between Kling and Klang, play and work, toys and aesthetic objects, commerce and art, even the mainstream and the avant-garde. Like the sounds generated by the code of Adorno’s barrel organ, which processed and recycled all “unclaimed musical goods,” the music of Pitsch und Patsch and Phoenix obtrudes from its immediate contexts by virtue of the contrivance of an audible and visible world from technological means that depend on fabricated simulation rather than fidelity and mimesis. Both sound at once atavistic and futuristic, both older and younger than their vintages indicate.

Under the economic, cultural, and ludic conditions of postwar Japan, the qualities shared by Pfenninger’s work and its media-genealogical relations resonated in unexpected ways. While one might posit tenuous historical connections between Kircher (a prominent member of the Society of Jesus), the music boxes brought to Japan by Jesuit missionaries in 1549, the importation of German-made pianos in the 1880s and their subsequent mass production under the corporate direction of Torakusu Yamaha, the global dissemination of musical, cinematic, and computational technologies throughout the twentieth century, and the aesthetics of ludomusical play espoused by Yokoi, Miyamoto, and Kondō, such links need not take the form of unidirectional vectors of transmission from Europe and North America to East Asia. On the contrary, the lattice formed by this intersection of cultural and technological vectors can be analyzed as a digital dispositif that, as Hiroki Azuma has written of otaku, operates as a database of elements assembled from both within and beyond Japan. When these elements have been arrayed by Nintendo’s developers into ludic programs, they have sustained diverse yet distinctive forms of playful engagement. Constituted and activated digitally, they nonetheless foster analogical play that crosses medial and geographical boundaries as it shuttles across the ludomusical interface to relay stimulus and response between human and machine.
As a digital-game player and media artist who came of age in the 1980s, Toshio Iwai quickly familiarized himself not only with the ludic systems of *Super Mario Bros.*, but also with its creative possibilities. He approached the game in a manner that responded obliquely to Kondō’s methods of choreographing music and action: “I started playing around . . . , producing sounds by making Mario jump, which made me feel like I was playing instruments while playing the game.” Iwai had a similar quasi-artistic experience “shooting along to the background music” of Namco’s *Xevious*, released as an arcade game in 1983 and ported to the Famicom the following year. The game features invulnerable spinning tiles known as *bacura*, which emit a high-pitched metallic sound when struck by the player’s blaster. This sound was adopted as a musical element in the track “Xevious,” produced by Haruomi Hosono (a founding member of Yellow Magic Orchestra) as part of the album *Video Game Music* (1984). In turn, Hosono’s track inspired players in arcades to try to reproduce its infectious rhythms by shooting *bacura*. This wasteful deployment of ludic resources might be interpreted as cocky, whimsical, contrarian, or masochistic; in any case, it flies in the face of the optimal strategy derived from game-theoretical precepts since, in terms of both score and utility, it is utterly pointless.

The Wildean inutility of such ludomusical play echoes Stein’s conflation of the toy with artistic creation, pointing toward an aesthetic that Iwai’s media installations and software have consistently exhibited. The influence of *Xevious* is clearly perceptible in *Otocky* (Scitron & Art and SEDIC, 1987), an improvisatory music-themed shoot-'em-up developed by Iwai for the Famicom Disk System. In many respects, *Otocky* is structured as a traditional game that tallies the score as players navigate diverse land- and dreamscapes (including the topography of a “cubic keyboard,” illustrated in Figure 88 and Video 10), evading patterned enemy attacks and encountering “bosses” in the form of notes and other musicographical symbols. Yet, as Yoshikazu Tozuka reports, nonplussed players perceived *Otocky* as “a kind of children’s toy that produces sounds,” a reaction that reflects the software’s ambiguously ludomusical orientation.

*Otocky* blurs distinctions between game, toy, objet d’art, and the instrumental performance of improvisation. In part, its soundtrack is procedurally generated from the player’s actions: upon the depression of the A button, the game’s eponymous protagonist launches a bubble-like projectile in one of the eight cardinal and ordinal directions that inflicts damage on any enemies it strikes before returning to its sender. The speed and scope of this fort-da motion vary according to the timbre of the musical instrument that Otocky is currently wielding. At the same time, the pitch of the musical tone triggered by each button press varies in accordance
with the current harmonic backdrop, which modulates as the player moves through the stage. The player’s elimination of successive enemies concatenates these tones into a melodic chain, but, as with *Xevious*, the player may choose to prioritize the creation of an optimally pleasing soundtrack over the efficient pursuit of ludic goals. To allow players to focus exclusively on aesthetic matters, Iwai incorporated an unlockable “B.G.M. (background music) Mode” that removes all traces of *ludus* from the game. While Otacky is invulnerable to damage in this mode, he also cannot complete the stage: the obviation of risk is synonymous with the prohibition of progress.¹¹⁹

In either gameplay mode, the modular means by which *Otacky’s* soundtrack is generated are closely akin to those of eighteenth-century *Würfelspiele* and Winkel’s componium.¹²⁰ For each harmonic module, eight melodic possibilities are assigned, any one of which can be activated by the launching of Otacky’s projectiles. Regardless of the player’s intentions, the arbitrariness of the informational content and timing of digital input via the Famicon controller serves to inject randomness into the game’s operationally closed system, performing the same function as the roulette-like selective mechanism of the componium. While each sequence of events is contrived from a limited set of parameters, the
number of different permutations in which music can emerge from gameplay is virtually countless.

Throughout *Otoky*, however, the singularity of emergence is entwined with the analogical and recreative logic of the loop, which is operative on local and global levels ranging from individual sonic and graphical modules and a power-up item that “records” and “replays” Otocky’s ballistic discharges to the game’s macrostructural principles. Players must circle around each stage until they have absorbed sufficient “note energy” to initiate the “boss” battle: each time around, previously collected notes transform into enemies, making the task more challenging and testing their memory of past events. In highlighting the emergence of idiosyncratic figures from repetitive grounds, this form of replay sets sameness and difference in reciprocal relief. It also suggests how the “horizontal resequencing” typical of *Würfelspiele* can be complemented by the concept of “vertical layering,” which approaches modularity from an orthogonal angle by way of the lateral operations through which memory becomes code (and vice versa) when “turned sideways in time.”

Once determined by the aleatoric sequencing of single measures, a minuet produced by a *Würfelspiel* can itself be treated as a textural layer to be overlaid on or intertwined with any other by way of further arbitrary permutations. In digital-game composition, vertical layering often involves devising complementary but internally coherent generic or timbral realizations of a single harmonic and metric template that can be combined, separated, and crossfaded in response to player actions or environmental shifts. In such cases, emergence is less synonymous with the moment-to-moment determination of musical events and more implicated in the braiding of their strands over longer spans of time. Whether reckoned as a response to player input or as the outcome of internal calculations, the consequences of vertical layering play out over temporal swathes measured as linear strips, the ends of which are in turn joined into circular loops: to rephrase Gumbrecht, the music does not undo but rather recreates itself as it emerges.

In 1996–97, Hosono’s former bandmate Ryūichi Sakamoto and Iwai collaborated on *Music Plays Images X Images Play Music (MPIXIPM)*, a conspicuously chiasmic multimedia performance staged in Mito and Tokyo. The program included *Ongaku no chesu* (“Musical Chess”), an apparent homage to Cage and Marcel Duchamp’s *Reunion*, although the mechanics of the game played by Iwai and Sakamoto (Figure 89) were closer to Go than to chess. In Tokyo, the playing of *Ongaku no chesu* started with the insertion of counters into a sixteen-by-sixteen “board” that doubled as a real-time step sequencer. When swept by the looping sequencer, each counter was momentarily illuminated and appeared on a rotating visualization of the game board projected above the players; at the same time, it activated a key of a Yamaha Disklavier grand piano, selected according to the mapping of a Dorian modal collection programmed by Iwai. Once satisfied with the sequencer’s state of play, Sakamoto and Iwai abandoned the game board and resorted to key-
Boards: while Sakamoto improvised at another piano, Iwai continued to manipulate the sequencer from a computer. Seeming to travel from the soundboard to the screen above, the notes played by Sakamoto triggered bursts of light redolent of shoot-'em-up projectiles such as those launched by Otocky, revealing the ludic iconology underpinning Iwai’s audiovisual counterpoint as well as the commutative relation of sound and image promised by the event’s palindromic title.\(^{126}\)

Like the pegs on Caus’s barrel and the holes in the Ele-Conga Autoplayer’s paper disks, Iwai’s and Sakamoto’s counters were processed as both pitch and rhythm, code and memory. Their quantized convertibility was represented not only by the metronomic digitality of the sonic results, but also by the analogical looping of the sequencer and the cyclical rotations of its Jacquard-like image projected above the stage. Ongaku no chesu thus enacted a digital analogy that complements the high-resolution grid of Perich’s Microtonal Wall (Figure 32). Whereas Perich’s installation proposes and challenges perceptual boundaries between the analog and the digital as they emerge via shifting spatial relationships between the wall and its listeners, the magnified pixelation of Iwai’s sequencer reveals how discrete phenomena can become continuous when constantly (re)played via the tethering, twisting, and tangling of temporal loops.\(^{127}\)

These mutable qualities are also on display in prior and subsequent projects developed by Iwai for Nintendo’s hardware. The best known of these is
Electroplankton for the Nintendo DS (2005), a launch title for the device that has been described both as “touchable media art” and as a “set of ten small musical toys.” Electroplankton makes no attempt to keep score: instead, it presents the player with audiovisual representations of biological and physical phenomena that invite and respond to input in the form of touching, scribbling, drawing, blowing, speaking, and singing. When designing the software, Iwai drew on his media installations Music Insects (1992) and Composition on the Table (1998–99) as well as the experience of his ludomusical toying with Super Mario Bros., Xevious, and Otocky.

Both Electroplankton and Ongaku no chesu also echo elements found in Sound Fantasy (1994), a project for the Super Famicom (known in the West as the Super Nintendo Entertainment System) that Iwai designed under Yokoi’s supervision. In “Star Fly” (Figure 90 and Video 11), one of Sound Fantasy’s four modes, players use a mouse to plot constellations of stars against the invisible backdrop of a step sequencer that sonically activates them as it repeatedly scans the sky. In this format, discrete audible and visible phenomena become observable and manipulable in direct relation to one another. As in C.P.E. Bach’s Versuch (Figure 21), Iwai provided a skeletal backdrop against which the player’s sonic fantasy could take visible shape. Unlike Bach’s cross-domain mapping of notes, numbers, and letters via the clavichord’s digital analogy, however, Iwai’s process of emergent creation and automated recreation are at once performed and indexed via a grid-
ded game board that, like that of Ongaku no chesu, figures a pixel and a note as one and the same thing.

His credentials as a media artist notwithstanding, Iwai has hewn closer to Yokoi's toy-like aesthetic than to the art world proper: his productions are characterized by the extent to which they not only make elements of compositional design, improvisation, performance, and recreation available to their players, but also map musical attributes onto Caillois's ludic modes. On being awarded a prize by the Multimedia Content Association of Japan, Iwai revealed the wistful desire, akin to that behind the pianistic inflections of Bizet's Jeux d'enfants, that motivated him: “I’ve been longing for the feeling of my childhood in the digital world.” Iwai’s pursuit of paidia via digital channels was matched by Yokoi’s commitment to recreating the pleasures of childhood through the misappropriation of “serious” electronics, thereby “making old things possible with current technology.” Whether framed as toys, games, or art, the Nintendian creations of Yokoi and Iwai share the nostalgic orientation of Agamben’s diachronic axis. Beyond that, their morphological materials disclose the media-genealogical heritage underpinning the ludomusical experiences, both digital and analogical, that emerge from and are (re)created through the process of play(back).

Reflecting both globalized and localized aspects of conservatory culture, Nodame Cantabile is an anime, live-action TV drama, and digital-game franchise based on Tomoko Ninomiya’s popular manga that centers on the relationship—at once musical, dialectical, and romantic—between two students at the fictional Momogaoka College of Music. The arrogant Shin’ichi Chiaki is an aspiring conductor who insists on impeccable standards of performance as legislated by the letter of the score; conversely, the whimsical Megumi Noda, known as Nodame, plays by ear and relies on intuition to guide her. Assigned Mozart’s Sonata for Two Keyboards by their teacher Hajime Tanioka, each student initially struggles to come to terms with the other’s approach: as a strict proponent of ludus, the overbearing Chiaki is frustrated by Nodame’s departures from the score, whether deliberate or inadvertent. Ultimately, however, he is charmed and won over by her paidia, typified by the liberties she takes with what Kinderman describes as the “cute winks” that punctuate the first movement’s second theme in the anime adaptation of the episode (illustrated in Figure 91). Elevating each other to new musical heights as they perform the piece for Tanioka on a pair of Yamaha pianos, the two share an epiphanic moment that foreshadows the blossoming of their relationship.

Gendered asymmetry lurks behind the dialectical resolution enacted by the performance of Chiaki and Nodame. The authority assumed by Chiaki and the
submissiveness of Nodame, whom he casts in the role of his pupil, recapitulate the
dynamics that presumably obtained between Mozart and his own pupils Auern-
hammer and Ployer. Staged by the sonata, the encounter between Chiaki and
Nodame proceeds to synthesize a set of binary oppositions that incorporates and
extends beyond the former’s *ludus* and the latter’s *paidia*: while the transforma-
tive freedom of her playing arises in part from the strict constraints he imposes,
Chiaki’s obsession with discipline and technique ultimately gives way to Nodame’s
playful expressivity in a manner akin to the shifting dynamics between Figaro and
Susanna in the opening *duettino* of *Le nozze di Figaro.*

The presentation of these attributes stays relatively constant throughout the
episode’s remediations via *manga,* *anime,* or live-action TV. When reformatted
as a digital game for Nintendo’s Wii, however, the performance of Mozart’s sonata
reconfigures these musical qualities. In *Nodame Cantabile: Dream Orchestra,* the
player simulates Chiaki and Nodame by mimicking their pianistic gestures with
the Wii remote and *nunchuk* controllers, both of which register motion via gyro-
scopic sensors. Since the game’s mechanics adhere to the norms of the rhythm-
action genre established by games such as *beatmania,* *Taiko no Tatsujin,* and *Gu-
tar Hero,* however, players’ performances are quantified solely according to the
accuracy with which they time their motions with the passage of stylized notes
and symbols that stream across the screen (Figure 92 and Video 12). Consis-
tent demonstration of “excellent” or “acceptable” timing is rewarded by a high
score and acclaimed by the in-game audience; “bad” timing is punished by the
severing of the player’s “combo” streak, the temporary detuning of the piano,
and even the abrupt curtailment of the performance. According to these metrics, Chiaki’s uncompromising absolutism trumps Nodame’s playful disregard for the rules: obedience to the score and precise execution win out over less conventional approaches to the matter of musical recreation.

While irony abounds in the game’s mechanical suppression of Nodame’s impetuosity, its nesting of digital and analog elements resists dichotomous explication. On the one hand, and after the fashion of la musicienne, Dream Orchestra purveys Nodame’s lovable idiosyncrasies as an automatable commodity, a narrative of selfhood co-opted by the very technological and institutional forces it purports to resist. On the other, the game’s lighthearted mimicry simultaneously widens and seeks to bridge the distance that separates “real” musical performance from its ludic recreation via recursive strategies and techniques. Dream Orchestra enables the “live” recreation of a preexistent recording of Mozart’s sonata via digital interfaces that index imaginary instruments, but it simultaneously remediates characters, gestures, and even affective dispositions from Nodame’s parallel

FIGURE 92. Gameplay featuring Mozart’s Sonata for Two Keyboards in D, i, mm. 2–3, in Nodame Cantabile: Dream Orchestra (Bandai Namco, 2007).

VIDEO 12. Gameplay from Nodame Cantabile: Dream Orchestra, featuring the first movement of Mozart’s Sonata for Two Keyboards in D.

To watch this video, scan the QR code above with your mobile device or visit DOI: http://doi.org/10.1525/luminos.16.35
representations on page and screen. Beyond the quantification of the score, the *ludus* of the game’s digital logic is supplemented by the *paidia* of the analogical relations it proposes and admits.

Departing from veristic orthodoxy by virtually caricaturing the complex nuances of musical performance, the game’s unabashed embrace of pretense suggests multiple relations between Nodame at her keyboard and the player wielding a Wii remote. As Miller and Kaneda note from ethnographic perspectives, play does not only take place within digital game-worlds, but also unfolds between games and their players. At the same time, as Graeme Kirkpatrick points out, an acknowledgment of this play-space often entails a suspension of the “willing suspension of disbelief” typically induced by theater and film. This second-order awareness of the *mimicry* of *mimicry* stymies interpretive strategies that insist on mapping stimulus directly onto response and thereby “reading” games by assigning meaning and value to their iconic and sonic signifiers. Relieved of the responsibility to reproduce every note, the player is free to emulate Nodame by playing with (as well as within) the rules governing the ritual of musical performance. In so doing, she might paradoxically come closer to the playful aspects that suffuse the Sonata for Two Keyboards and its ludomusical design than an acoustic performance that faithfully observes the score *com’è scritto*.

The sense in which the keyboard-based mechanics and iconology of ludomusical gameplay exhibit a recreative logic that loops beyond phonographic reproduction is shared by Iwai and Alex Rigopulos, whose development studio Harmonix Music Systems produced *Guitar Hero* and *Rock Band*. While Iwai’s audiovisual technologies aim “to restore what has only recently been discarded” from musical experience owing to the blind disembodiment of the phonograph and its reproductive successors, Rigopulos explicitly links the piano-roll notation of rhythm-action games to nineteenth-century keyboard practice: “When there were no record players, [there were] people in the house who knew how to render sheet music into music on their pianos. I see what we are doing now as a massive historical throwback.” Iwai’s hardware and software have been oriented toward experimentation and real-time generation, whereas *Guitar Hero* and its successors have focused more on the notation-driven reenactment of preexistent recordings. Such differences of emphasis notwithstanding, the apprehension of all such phenomena under the performative rubric of recreation cuts across boundaries that, by strictly distinguishing between originary creative acts and their mechanical reproductions, accord ontological, legal, and aesthetic primacy to the former. Whether figured in the technical terms of high-fidelity reproduction, the rhetoric of historically informed practice, or Walter Benjamin’s auratic register, fantasies of immediacy can themselves be understood to reproduce artifacts of mediation.
Although the phonograph made storage and retrieval both audible and tangible, as discussed in Key 5–2, it denied human access to—and thus both mystified and fetishized—its technical means of transduction. Recreational phenomena render transmissive protocols available for observation and intervention via interfaces that explicitly distribute operative responsibility among human and mechanical agents within ludomusical systems. Describing recreation in these terms circumvents questions of whether such systems are interactive or passive, whether a given action is intentionally willed or unconsciously automated, and whether it is planned in advance or carried out spontaneously. Beyond its motivations and consequences, the pivotal significance of such an action resides in the fact that its very performance—whether figured as the depressing of a key or the flipping of a bit—can be processed by the human-mechanical system and thereby affect the course of its future operations.

Decades before the advent of digital signal processing, companies such as Welte-Mignon and Ampico took advantage of this difference-making potential when plotting rolls along the outlines sketched in the eighteenth century by Euler, Sulzer, and others. Via the precise quantization and comprehensive editorial manipulation of spatial and temporal parameters before, during, and after the recorded event, Ampico claimed to cross the uncanny valley, capturing “the soul of piano playing” and “revealing”—rather than simulating or masking—the “idiosyncrasies of artists.” Marketing claims aside, a sense of possibility that the state of play might be (or might have been) otherwise distinguishes the ludic contingency of recreation from the fatality of reproduction. Recreation performs and is performed by the activation rather than the tracing of memory: its stored elements are summoned and processed as code, whether represented as pegs, notes, or holes. While the rules governing how such processes play out might be hard-coded, the manner of their representation and the scope of the motion they afford and constrain can vary widely, even when conceived within the same topological boundaries. Via both ludus and paidia, recreational dynamics cast reciprocal and complementary roles for humans and machines, mediated via the interfaces that couple them.

In Key 4–4, Super Mario Bros. for Nintendo’s Famicom and its neoclassical sequel for the Wii were invoked to draw kinesthetic parallels with the digital playing of Mozart’s keyboard concertos: both present scenarios in which the protagonist must negotiate technical challenges with dexterous flair against a backdrop designed to make navigation arduous but exhilarating. The notes of Mozart’s score and the tiles that form the landscape of the Mushroom Kingdom are loosely analogous insofar as they both provide jumping-off points for the player to demonstrate grace, imagination, and virtuosity. Even though the stingers and effects in Kondo’s soundtrack for these games are carefully integrated into their harmonic, rhythmic, and kinetic contexts and his music was composed with their graphics
and gameplay in mind, it is possible to place their audiovisual elements in even closer contact by subjecting them to the commutative logic of the piano roll. As illustrated by the “super star” in Figure 89, Iwai mapped iconic representations of artifacts from *Super Mario Bros.* onto the pixelated grid of *Sound Fantasy’s* step sequencer.\(^{33}\) Thirteen years later, Yōsuke Torii, known as Jinjor on the Japanese video-sharing website Nico Nico Douga, uploaded a medley of music from *Mario* games made using Malinowski’s Music Animation Machine, introduced in Key
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4–2 (Figure 60), which visualizes MIDI data in a piano-roll format. In the course of stitching well-loved themes together after the fashion of a Lisztian operatic réminiscence, Torii’s transcripive medley (Video 13) presents ludomusical display in the most literal sense: the pixelated topography and iconography of the Mushroom Kingdom are made audible while its soundtrack takes analogous shape before the observer’s eyes.

After the ingenious combination of various themes and sprites, the medley concludes by (re)presenting the classic flagpole jump from the end of the opening course of Super Mario Bros. (Figures 93 and 94, the latter of which forms the rightmost section of Figure 69). In musical terms, the staircase of blocks becomes a stack of minor thirds, while the flagpole itself articulates cadential closure by way of a cheerful C-major resolution; indeed, the procession of harmonies heard in Audio 23, illustrated in Figure 93, and transcribed in Example 3 (diminished seventh, supertonic seventh, and tonic) just so happens to reverse and invert the harmonic sequence half-heard at the puzzling outset of Beethoven’s op. 31, no. 3 (Figure 73).154 The automatic playback of Torii’s medley nonetheless allows observers to recreate the kinesthetic experience of moving through the course’s topography while listening to the music it synonymizes.155

This aspect of audiovisual ludomusicality has been pursued by Julian Benson, who proposes the transcription of musical scores into the iconographical symbology of games such as Super Mario Bros. and Braid (Number None, 2008–10), thereby creating stages to be played through (according to the game’s own logic and mechanics) as well as back (by way of piano-roll-like notation).156 From BIT. TRIP RUNNER (Gaijin Games, 2010–13) and its sequel Runner2 (2013) to Sound Shapes (Queasy Games, 2012–13) and from Rayman Legends (Ubisoft Montpellier, 2013–14) to Nintendo’s Super Mario Maker (2015), many recent games have blended rhythm-action and platforming gameplay to varying effect (and affect): such games compel players to oscillate between entrainment and unexpected syncopation, between going with the ludomusical flow and staying alert to the threats that sonic bodies in motion can represent.157

Accordingly, the finale of Mozart’s Keyboard Concerto in F, K. 459 (discussed and displayed in Key 4–3 and 4–4), can serve as more than a musical analogy of Mario’s kinetic virtuosity: in Super Mario Maker, its melographic score can be directly converted into a landscape for Mario to navigate. The discrete quarter-note blocks in Figure 96 map directly onto the eighth notes in the right hand of Mozart’s opening measures (Figure 95), while the analog curves of Mozart’s slurs can be traced by Mario’s graceful motion as he trampolines through the air. This goes to show that the playfulness of recreation does not reside solely in its mechanical execution and attribution, but also emerges from the (e)motions it elicits in the course of performance as well as the audiovisual terms in which it figures. As mediated by digital gameplay, recreation does not take notions of origin and causality to be
self-evident; instead, it acknowledges that the presence of certain epistemological, technological, and discursive prerequisites allows for the entwining of multiple feedback loops that link elements associated with design, emergence, performance, and automated reiteration to produce the ludomusical present.

From *Otocky* and *Doom* to *Minecraft* (Mojang, 2011–16), *WarioWare D.I.Y.*, and *Super Mario Maker*, games have made the creative tools with which they were themselves designed available to players. At the same time, games increasingly bear witness to their own emergence, either via procedural generative techniques (on conspicuous visual and aural display in games such as *No Man’s Sky* [Hello Games, 2016]) or by remediating games such as *Pokémon Red* in formats suitable for critical viewing—and even crowdsourced interaction, at once agonistic and collaborative—on Twitch. Both phenomena index the extent to which digital games recursively configure first- and second-order techniques of participatory observation. The operational closure of their mechanical systems enables them
to couple with the innumerable digits of humans sitting in front of keyboards and screens, the chamber musicians of Flusser’s imagined future.¹⁶⁰

Flusser’s ambivalence toward this ludomusical prospect was grounded in the grim historical circumstances under which it was rendered conceivable: it was born of a skeptical faith in the technological forces that promised a better world to come even as they wrought destruction on an unprecedented scale.¹⁶¹ Such ambivalence is often encountered in the binary forms of utopia and apocalypse that digital games represent to their champions and detractors alike.¹⁶² As products of both myth and history, such games bear the Apollonian traces of a violent past that they all too often seek to reenact, yet their recursive attributes also endow their players with the capacity to reflect on that past, allowing it to inform the playing out of the future in ways that exceed or defy the parameters it purports to impose. Music and its histories offer a catalog of ludic resources that supplement the logic of digital play, imbuing it with affective resonances that confound Boolean logic and twist feedback loops into Möbius strips. In this regard, the sonorous and rhythmic beauty of ludomusical play is inseparable from the danger it poses, just as its momentousness hinges on its inconsequence, its value is vouchsafed by its worthlessness, and its rulership belongs to the child.

"All playing is a being-played": the chiastic and fractal logic of this final Key’s recursive maneuvers reframes the capacity of play to invert relations between subjects, objects, and musical modes.¹⁶³ Music and the techniques that shape it simultaneously trace and are traced by the materials, technologies, and metaphors of play.¹⁶⁴ Any instance of play can be historically indexed and situated only once its formal properties have been identified; conversely, such properties assume significance only when embedded in the historical and cultural milieux that furnish the terms on which their legitimacy is granted, demonstrated, and questioned.¹⁶⁵ Accordingly, the question of whether play is tragic or comic, profound or whimsical, has always been a matter of perspective as well as scale.¹⁶⁶

While all media reflect the material and ideological conditions under which they have become conceivable, the case of the digital game is particularly revealing.¹⁶⁷ Games render rationality palpable: their significance derives from a vast array of visual, sonic, tactile, and affective representations that issue from the spatiotemporal modulation of digital operations.¹⁶⁸ Negotiating between the epistemological limits of Lessing’s juxtapositional and progressive categories, the keyboard and its derivatives materialize and order bits of information, making them available for digital processing by both humans and machines.¹⁶⁹ Across its multifarious instantiations, the keyboard negotiates between the digital and the analog to the extent that via digital operations of selection and activation, input and output enter into an analogical relation.¹⁷⁰
The keyboard filters the complexity of sonic phenomena and their generative mechanisms in order to grant players comprehensive control over the processing of their spatiotemporal configurations, rendering distinctions at once absolute and relative, immediately proximate and infinitely remote.\textsuperscript{171}

In addition to accounting for the epistemological principles according to which keyboards bring concepts, minds, and bodies into communicative contact, however, it is necessary to attend to the cultural conditions under which their functions are analogized and mediated.\textsuperscript{172} As it orders and arrays musical knowledge, any given keyboard operates as an epistemological object that channels both human and non-human forces within a political ecology.\textsuperscript{173} In this sense, the very literality of analogies between music and games at the keyboard outlines the complexity of their social and political ramifications as well as the ways in which they inflect concepts of musical autonomy, form, and reference that have been primarily grounded in the ontology of the musical work.\textsuperscript{174}

As a field of play, the keyboard offers access to a wide range of ludomusical experiences, whether performed as recreations of prior events, conceived as simulative praxis under a particular set of cultural conditions, or configured in the infinitely finite terms of an emergent improvisatory process.\textsuperscript{175} Whether manifested by the strategic manipulation of notational systems or the generation of improvisatory comedy, the playfulness of eighteenth-century musical texts was coordinated by complex interactions between inscriptions, tables, calculations, mechanisms, and procedures that were typically performed at the keyboard.\textsuperscript{176} Data-driven models of ludomusical improvisation bypassed literary modes of representation; at the same time, their combinatorial principles and hierarchical formalism were inflected by sensuous and conceptual considerations that defied symbolic reduction to and by digits alone.\textsuperscript{177} From the dice game to the fantasia, ludomusical modes of behavior were framed by a fascination with (un)likelihood that was both economic and erotic, philosophical and trivial, whimsically capricious and grounded in quotidian reality.\textsuperscript{178} The point of play lay in its very pointlessness, the inevitability of its undecidability, the constancy of its capriciousness, and its time-honored novelty.\textsuperscript{179}

Insofar as it made audible the purposively purposeless oscillations of the imagination, such play chimed with the Kantian aesthetics of instrumental music.\textsuperscript{180} Apprehending improvisation as a response as well as a call, a return as well as a serve, emphasizes its dialogical performativity alongside its reiterability in a way that challenges distinctions between action and reaction, engagement and observation.\textsuperscript{181} Accordingly, any given score might be treated as a provisional sketch, as a compositional proposition or declaration of intent, as a quasi-theatrical script to be realized in performance, as a set of rules for the player to follow (or break), as a chart that maps out musical terrain to be explored, or as the tallying of a ludomusical process that serves to quantify and record prior outcomes even as it continues to precipitate new ones.\textsuperscript{182} A ludomusical approach to the play of performance neither reifies the
score nor self-consciously applies information gleaned beyond its confines, but rather acknowledges how text and praxis are systemically interwoven.\textsuperscript{183}

As Hermann Abert noted in relation to the eighteenth-century “delight in playful gestures,” Mozart’s elegant forms are at once traced and elaborated by figures set in graceful motion.\textsuperscript{184} Within the scope of a particular musical occasion, the joys of play emerged directly from a process of planning and design, whether it involved dashing off a scatological canon or scripting an entire concerto.\textsuperscript{185} Like a Mario game, the playing of a Mozart concerto primarily involves interactive digital input: in prompting both linear and looping motions through time and space, it responds to imaginative engagement rather than hermeneutical exegesis.\textsuperscript{186} Yet while Mozart’s notes on paper are readily apprehended as rules or scripts, Beethoven’s scores have been revered as unbreakable records rather than read as invitations to join the ludomusical fray.\textsuperscript{187}

From Beethoven’s bagatelles to Pinball Pianola, recreative devices and techniques form a genealogical and epistemological supplement to the dominant narrative that relates the technological mediation of sound primarily in terms of ever-increasing verisimilitude, a narrative belied over the course of the last three decades by a decisive turn away from the analogical demonstration of naturalistic fidelity and toward the digital attributes of promiscuity, economy, and mobility.\textsuperscript{188} Recreative phenomena render transmissive protocols available for observation and intervention via interfaces that explicitly distribute operative responsibility among human and mechanical agents within ludomusical systems.\textsuperscript{189} It is telling that the melographic iconology of the piano roll indexes—and is indexed by—contemporary digital technologies for recording, editing, sequencing, and playback.\textsuperscript{190} In this format, discrete audible and visible phenomena become observable and manipulable in direct relation to one another.\textsuperscript{191} From the flipbook to anime, from music boxes to MIDI, and from the Game Boy to works of art, the audiovisual elements that play into contemporary manifestations of ludomusicality can be traced along paths that wind across geographical and chronological planes, departing from and converging at the digital arrays by which pixels and notes become commutable.\textsuperscript{192}

“All playing is a being-played”: the chiastic and fractal logic of this final Key’s recursive maneuvers reframes the capacity of play to invert relations between subjects, objects, and musical modes.\textsuperscript{193}