Popular Music and the Digital Shift: History, Economics, Listening, Organology, and Aesthetics

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PHILIPPE LE GUERN AND PAUL J.F. FLEURY

TRANSLATED BY MARY FRANCES KNAPP

ABSTRACT: This essay reviews the state of the art of research on what might be called the "digital shift" in music. Somewhere between ontology and constructivism, our approach takes a particular interest in the pioneering work that has attempted to grasp the essence of the digital phenomenon and its many manifestations. In the first part of this article, we situate the digital shift historically, particularly in light of the controversies it has aroused: Is it an extension of the analog era or a radical disruption? In the second part, we examine the impact of the digital revolution on business models, the copyright system, and the architecture of the music industry: Has there been a complete reconfiguration of the value chain? What forms of regulation have been adopted to deal with illegal downloading? In the third part, we show that the digital shift is also affecting the experiences of music audiences and pay particular attention to recommendation algorithms. In the fourth part, we show how the digital shift introduces a new organological paradigm, redefining the relationship between instrument and musician. In the fifth and final part, we show how the development of tools such as the sampler and autotune have given rise to new forms of musical aesthetics. We also look at the crucial role of streaming platforms, such as SoundCloud and Spotify, in the spread of these new aesthetics.

KEYWORDS: analog and digital; recommendation systems; sampling; downloading; streaming; aesthetics; sociology of norms and conventions; ontology

PHILIPPE LE GUERN is Full Professor of Art Theory and the Anthropology of Contemporary Worlds at Rennes 2 University.

PAUL J.F. FLEURY is a doctoral student working on a thesis about music and artificial intelligence at Rennes 2 University.

During the early 1980s, the world of music was subject to a series of changes—social, economic, aesthetic, and related to media—accompanied by a variety of technical innovations. Driven by the globalization of the electronics and integrated circuit industry, these innovations transformed many facets of popular music. The sampler, when combined with graphical editing software in particular, established the practice of "copy-cut-paste" and popularized an aesthetic of borrowing. The terms and conditions of listening were transformed by CDs and MP3s, and the business models of the music industry and the conditions for the access and discovery of music were altered by the rise of streaming platforms and recommendation algorithms. In sum, the shift from analog to digital deeply transformed the majority of the conventions under which music was previously experienced, and this constituted a historic rupture, with consequences that impacted not only cognitive practices of music but also its social life.

Yet, if the subject of transitions and ruptures in the history of the arts proves difficult to grasp, it is because it confronts us with the necessity of deconstructing the very manner in which we define art in different eras and, as a consequence of this, the way we understand topics as diverse as the meaning of beauty, the nature of art, public attitudes toward artistic creation, ideas about the uniqueness of an artist and the works they execute, the

role exercised by institutions and markets on the formation of artistic merit, and, notably, the processes by which recognition and legitimacy are conferred. In this context, one must ask: Are these categories founded upon objective criteria, and do they correspond to the essence of *sub specie aeternitatis*? Must we subscribe to philosopher Jerrold Levinson's (2020) declaration that art would have no quantifiable ontological identity outside of the historical context in which it operates? Supporting such a position, one might consider the work of philosopher Richard Shusterman (1992), who demonstrated how rap's use of 1980s sampler technology led not only to an innovative aesthetic and served as a notorious expression of postmodernism in art but also operated as a defiant statement against the dominant conventions of the time, which were products of romanticism and modernity, highlighting the relativity of ideas about originality, uniqueness, integrity, the fetishization of a work and, even the dichotomy of art and culture at large.

In light of the digital shift in music, this article addresses the following question: If music can be defined as a type of experience regulated by specific conventions inseparable from a given sociohistorical context, from the stages of its creation to its reception, can one then say that it is the very nature of this experience, and perhaps even a work's ontology (Arbo 2021a, 2021b)—in other words, that which constitutes a work *as* a work—that is transformed as a result of this sweeping change? As a working definition, we use the term "digital shift" to refer to the changes in music brought on by computer technologies and the internet, or, more specifically, the mutations that occur when a musical ecosystem initially structured by analog technologies becomes dominated by digital ones. The article discusses the academic literature on the digital shift, written mainly in English and French, by musicologists, philosophers of aesthetics, sociologists, cultural economists, and scholars in science studies. In our discussion of the economics of music, the French music industry will be our primary case study, though other national music industries and the global music industry will also be addressed.

MUSIC AND THE DIGITAL SHIFT: QUESTIONING THE IDEA OF MUTATION

Unpacking the digital shift requires first and foremost a clarification of its chronology, an establishing of its archeology. Naturally, this is a recurring preoccupation for historians, but this kind of questioning is not a simple matter. It not only requires agreement about the identification of pivotal periods, which could demarcate the time before and after the shift, but itself involves characterizing and providing explanatory principles of what might count as a decisive mutation.[1] One might ask, for example, why the advent of digital technology would constitute a tipping point in the realm of music. Furthermore, such an undertaking implies an effort of epistemological clarification comparable to that of a historian such as Paul Veyne (1971). Veyne effectively demonstrates the means by which historical reflections are made, in the sense that what one calls history is always driven by the gaze of the historian, who proceeds to make choices about, select, and interpret historical information in order to give coherence to what otherwise presents itself as formless chaos. In other words, what the historian does is construct "plots" (*intrigues*). The use of the term "plot" here serves to remind us not only that facts are ordered according to linear chronological sequences but also that the consistency of what one calls "events" is relative. Furthermore, it indicates that each "event" is associated with the complex entanglement of material causes, human factors, chance, and other events that the historian may, in various ways, consider to be fundamental or merely anecdotal.

Such a conception of history allows us to understand why, for example, historians specializing in media cultures address the genesis of these cultures carefully and with nuance. Take, for example, historian Jean-Yves Mollier (1997). He shows that if we define the concept of a media culture in terms of leisure practices and markets, then "it seems worthwhile historically to trace its [media culture's] first appearance back to the 1960s," since "it was only after the Second World War that Taylorism and Fordism enabled the salaried masses to enjoy sufficient free time, leisure, if you prefer, to consume cultural goods appropriate to their expectations" (15).[2] In

other words, it is widely accepted that media culture is "a phenomenon typical of the twentieth century" (*un phénomène qui est le propre du XXe siècle*) (15),[3] with television and cinema as its main vectors. Nevertheless, Mollier suggests that it is neither anachronistic nor paradoxical to look for the roots of media culture as far back as the Belle Époque (i.e., the period from about 1871 to 1914). But why? Because the means of widely disseminating information existed long before the outbreak of the First World War, and the structures for establishing media culture were already in place at that time. For our purposes, this means that while it is possible to relate the emergence of digital music culture to a few, precisely dated technical innovations, the notion of a "digital turning point" varies according to how we apprehend its expression, whether as technical, economic, sociological, anthropological, or otherwise.

The first example of an attempt to grasp the nature of this kind of musical mutation, of a change of period and paradigm, is given to us by sociologist Sophie Maisonneuve and historian Ludovic Tournès. The two authors have, respectively, sought to describe the modalities and consequences of the emergence and subsequent spread of sound recording. While there seems to be a consensus on dating this shift—Maisonneuve (2009) proposes the period of 1877 to 1949 as the time frame for the invention of the record, which spans the interval from Edison's invention of the "talking machine" to the commercialization of the first LPs, which replaced the previously dominant 78 rpm format in 1948 and 1949—it is the scope of the transformation that took place during this time, linking technical innovations, new listening experiences, and new business models, that is the focus of attention here. As Tournès (2006) writes, "If recorded sound today occupies such a place in our cultural universe, it is without doubt because its emergence at the end of the nineteenth century, far from being a purely industrial and technical phenomenon, witnesses a broader anthropological change in industrialized societies, one of the essential characteristics of which appears to be the change of our relationship to time" (5).[4] What disc recording historians demonstrate here is that technical devices and social dispositions are closely intertwined, and these factors together contribute to the emergence of new practices and new sensibilities. Discophilia, in prolonging and even substituting itself for the practice of listening in concert, bears witness to this change in the experiential landscape for music lovers: the high-brow taste in music collecting and collectors' acts of classification and erudition, as well as their heated debates surrounding the definition of the "ideal" listening experience (e.g., the clash in the 1920s between champions of "romantic" listening and proponents of "realistic" listening), illustrate the emergence of a new habitus for music lovers that the phonograph was configuring, little by little, which Maisonneuve calls "the invention of a new listening" (*l'invention d'une écoute nouvelle*) (2009, 30). What such works reveal is that listening to music is not a natural condition but rather a socially constructed disposition that is constantly reworked by technical changes.

In this regard, sociologist Richard A. Peterson's (1990) attempt to explain the birth of rock and roll music in 1955 is another example of how to approach the question of musical mutations. While it is tempting to analyze the birth of rock and roll in terms of the politics of supply that the emergence of new recording stars provided (the most iconic of which was Elvis Presley), Peterson instead argues that the explanation for the emergence of this music is to be found in the weakening of the barriers that had been erected against innovation, which created space for new creators to break through to mainstream audiences, if only for a moment. Thus, Peterson demonstrates how any sweeping aesthetic change is always intertwined with other innovations, such as new technologies, markets, laws and regulations, and professional groups. From this perspective, art does not exist in its own ineffable world, one that is beyond the understanding of theories of innovation, and scholars who have approached this topic have found valuable ways of reflecting upon music's digital shift. In this context, scholars ask why certain media formats become dominant while others do not. Why, for example, did the Alesis ADAT tape machine, or even the mini disc, fail to become the standard for recording music? Can one speak about "progress" when it comes to listening to music or to the affordances linked to the digitization of music? Are the music industry's current business models significantly affected by the disruptive impact of digital innovation,[5] or

are they merely cumulative transformations within an evolutionary framework?[6] What promises, and also what controversies, have prompted music's digital shift?

Many scholars have argued that the central role played by the technical innovations of the digital shift have transformed the way music is produced and listened to, though they often relativized this phenomenon to avoid espousing technological determinism. In this context, we must emphasize that the digital shift may transform dimensions of the works that are strictly ontological; for example, the philosopher Alessandro Arbo (2021a) has attempted to understand the nature of musical works by suggesting that they are characterized by the intrinsically ambivalent signs of the performance and its traces—which is to say, recordings. Yet, could one not also consider that the world of the digital, which philosopher Lee B. Brown (2000) calls "a totally new category of music under the sun" (370, cited in Pouivet 2008, 20), notably came about with the emergence of sampling, a phenomenon that, unlike the art of performance or improvisation, introduced a new element that could be referred to as the art of the manipulation of the sound genome? For some authors, there is no doubt that digital technology constitutes the launching point of a new cultural age, where the concepts of author, public, truth, legitimacy, and related ideas are called into question. Philosopher Alan Kirby (2009) has elaborated a concept of "digimodernism," which is a new paradigm for understanding the end of the postmodern era and the cultural hold of the technical and digital. Kirby looks to the genre of house music (notably exemplified by the hit track "Pump Up the Volume") as a proto-historical form of digimodernism in music, one that highlights its characteristic features: the multiplication of versions of the song in a proliferating textuality; the eradication of authorship, which results in a sense of autonomy and anonymity in the piece; the ephemeral nature of the music; and its participation in a kind of internationalism that makes the listener feel as if any given hit did not merely hail from a specific country, like Belgium, Italy, or England, but, above all, came from "everywhere and nowhere." As Kirby concludes, "[T]he songs [of house music] existed in a forerunner of cyberspace, in a kind of autonomous musicspace, a floating realm of sound and feeling, exalted, narcissistic, sleek and euphoric" (89).

A contrario, numerous authors have advanced the idea of a "digital shift" while nevertheless limiting its scope. For example, in the introduction to their 2013 edited book *The Digital Turn: User's Practices and Cultural Transformations*, the media and communication scholar Pille Pruulmann-Vengerfeldt and her co-authors (2013) reveal themselves to be rather ambivalent when it comes to characterizing the digital shift. On the one hand, they affirm that it consists of a "significant shift not only in forms, environments and technologies, but also in the much deeper influence on the socio-cultural relations and interactions that these new forms and environments support and foster." Yet, at the same time, they believe that "the digital turn can be conceptualized only if seen as a part of a wider dynamic—the turn incorporates both digital and non-digital aspects of culture. Instead of celebrating a digital revolution, we argue that what we are seeing are evolutions within the cultural processes where the digital is only a part of the overall change" (7–8).

Sociologist Nick Prior (2012) also exemplifies this dualistic standpoint: while justifying the use of the term "digital regime," he fleshes out the list of obstacles that conflict with the study of changes brought about by the digital in music. He argues that the focus in older approaches to popular music on the classic elements of rock—guitars, adolescent rebellion, and subcultures—is hardly conducive to studying the socio-technical changes unique to the digital era. At the same time, though, he asks how we can strike the right balance between "saving ourselves from the overly utopian notion that everything digital is 'revolutionary,' without also insinuating that nothing has changed" (68).[7] Further, Prior seeks to understand how we can avoid the pitfalls of a vague determinism, according to which technical innovations would transform music *ex abrupto*. Prior's arguments walk a fine line: on the one hand, he attempts to subdivide the digital shift, categorizing the years of 1982 to 1983 as a significant turning point in the advent of digital media culture, with the invention and standardization of MIDI and the introduction of the first CDs to the music market being pivotal factors. Consequently, he identifies the emergence of a very specific kind of music culture, one in which digital technology contributed to the transformation of equipment, practices, players, and styles. On the other hand, however, he suggests "that

the copyright system within the traditional music industry, the structuring of the major media groups, and the capitalist logic that underpins them have remained largely intact [since the digital shift], even if they have had to make some efforts to adapt" (68).[8] This last assertion has given rise to a contradictory thesis, which affirms the disruptive potential of the digital on cultural industries: marketing specialist Marta Massi and her colleagues Marilena Vecco and Yi Lin (2020), for example, have demonstrated how the transition from a business model built around material goods (such as physical books and CDs) to a dematerialized model, which values the production of services, constituted a radical change, both on the organizational-managerial level and the cognitive level.

Prior's work showcases two main ideas. First, technology does not determine the way it is used, which Prior says is evinced by the fact that the turntable was not conceived for scratching or "scrubbing" and by the birth of the acid house genre, which relies on a distorted use of sounds from the TB-303 bass synthesizer. Second, he proposes the idea that an innovation does not necessarily replace the preceding configuration by making it purely and simply disappear. The resurgence of vinyl's popularity appears to confirm this hypothesis, as demonstrated by the work of Paulo Magaudda (2011), Jonathan Sterne (2012), Jeremy Morris (2015), Andy Bennett and Ian Rogers (2016), Jerome M. Hendricks (2016), Kyle Devine (2016), as well as Brian J. Hracs and Johan Jansson (2017), who question the very nature of the digital in music. Contrary to researchers that believe that digital dematerialization (the storage and distribution of music in the form of digital information) exists in opposition to the physicality of the analog era—musicologist Timothy D. Taylor (2016) comes to mind, for example—Devine, Sterne, and Morris, respectively, illustrate that the tactility and materiality of smartphones, telecommunication networks, and even files accessible through streaming should not be underestimated, since they involve material realities such as data centers, computer chips, and fiber optic cables. Devine (2015) developed a rather original reflection about the devices we use to listen to music, regarding them as potential waste products and sources of energy consumption: if music is also a matter of minerals, pollutants, and chemicals, he asks, are "dematerialized" forms of music less environmentally degrading than those from the analog era? In a related vein, sociologist François Ribac's (2012) work on young musicians using digital technologies highlights how digital technology is "analogized," that is, performed through analog interfaces, just as a piano is performed through its keyboard. Ribac concludes, "We cannot overlook the fact that all these technologies also make use of already existing systems and knowledge deeply rooted in collective bodily memory.… Consequently, to deduce that the digital has distinct powers, that it would have its own effects, is excessive—completely unwarranted" (737).[9]

Ultimately, Prior's arguments are less about refuting the existence of the digital shift than questioning the role of technology as an autonomous force in the processes of change. Not unlike theorists such as Donald MacKenzie and Judy Wajcman (1985), Wiebe Bijker, Thomas Hughes, and Trevor Pinch ([1987] 2012), and Armin Medosch (2005), his analyses relativize the strictly deterministic hypothesis to the benefit of more nuanced and complex approaches that embed social, institutional, and industrial dimensions into technology. Furthermore, as communication scholar Jim Rogers (2013) demonstrates, "the full working out and embedding of such complex sets of innovations involves…a process of social learning which may require a relatively extended phase of social struggle and of trial and error experimentation" (21). In other words, undertaking a reflection on music's digital shift involves taking into account not only the nature of the technological innovations concerned but also the socioeconomic issues and power structures within the musical sphere.

Does this mean that we need to abandon the teleological view of technological progress as an unbroken chain of successful innovations? As media technology scholar Brian Winston (1998) has shown, placing technological development in a long-term perspective helps us to realize that it is a contingent process, dependent on context, where inevitable failures coexist with successful innovations. Moreover, by proposing the notion of "ideation," Winston draws our attention to the fact that an innovation embodied in an artifact is also an idea, a hypothesis, even a phantasmagoria that ends up coming to fruition. "From this standpoint," Philippe Le Guern (2020) argues:

> one could postulate that the first *sampler* [author's emphasis] (the 1979 Fairlight CMI) was not the first digital musical instrument, since it was preceded by the Ondioline, or, in another case, the Mellotron of the early 1960s, which imitated the sounds of flutes and strings using magnetic tapes played in loop; additionally, one could look to Raymond Scott's Electronium, a compositional machine that was invented at the end of the 1950s, long before the arrival of computers and compositional algorithms, to affirm the reality that every innovation is always preceded by other innovations that are minimized or forgotten, and whose destiny could not be *a priori* foreseen, but only discerned in hindsight *a posteriori*. (259)[10]

Do not misunderstand us: we are not saying that the Mellotron—or even its predecessor, the Chamberlin—uses the same technology as the Fairlight or Akai S 900. The latter two devices use digital processing of sound fragments that have been recorded and manipulated. However, a sound device such as Pierre Schaeffer's Phonogène, to take one example, laid the foundations for sampling in the truest sense of the word—in other words, for recording and even manipulating sound extracts—even though it depended on analog magnetic tape. In this respect, it is undoubtedly worth paying attention to the nuance introduced by the English term "digital sampling," which helps us clearly distinguish the general notion of *sampling* from the more specific notion of *digital sampling*. Equipped with several variable-speed playback heads and controlled by a two-octave keypad, the Phonogène made it possible to modify the duration of a note without transposing its pitch, a capacity that corresponds to the time-stretching function of digital samplers. While the techniques used in devices from the Phonogène to the Fairlight are clearly distinct—with the former making analog recordings on magnetic tape and the latter using digital conversion into bits—we may well wonder whether they do not share the same objective, as we shall see below: to decontextualize a sound so that it may later be recontextualized. As musicologist and composer Serge Moreux wrote in the program for the Premier concert de musique concrète on March 18, 1950, at the Salle de concert de l'École Normale de Musique de Paris, "the material of musique concrète is sound, in its native state, as provided by nature, fixed by machines and transformed by their manipulations" (quoted in Schaeffer 1952, 69–70).[11]

CHANGES IN PRACTICES AND USES?

Until now, we have focused on authors who question and relativize the role of technological innovations in the digital shift. Other authors, for their part, have adopted quite a different point of view, preferring to position the effects induced by the digital at the center of their analysis. In short, they suggest that in the shift from analog to digital, it is actually creative practices, the specific uses of the digital and the reception of works, and the very conception of music—that is, its ontology (Arbo 2014; Arbo and Ruta 2015)—that have been transformed. For example, music technology scholar Daniel Guberman (2011) argues that we are currently in the "post-fidelity" age of music consumption, the inception of which should not be dated from the invention of the CD but rather from that of the iPod. Historian Rasmus Fleischer (2015) maintains the importance of this "post-" trait in music, developing a notion of "postdigital sensibility." In his opinion, the digital era is distinguished from the analog era by an overabundance of music, and reactions against this include practices like the adoption of No Music Days and a renewed interest in cassettes and their materiality (in contrast to the supposed evanescence of MP3 files). Maisonneuve (2012) suggests that the traditional music industry model of production, distribution, and consumption is impacted by the digital shift, with the boundaries between these categories becoming themselves increasingly porous: "[L]istening can give rise to self-recorded music—a personalized version of a popular song that can be put online on a personal site; *zapping* [quickly skimming through short passages of many tracks] and *sampling* [all author's emphasis], potentially integrated in the *home studio*, are also practices of rearranging someone else's product[;]…the creation of *playlists* creates a provisional image of our taste, and the

reconstitution of 'homemade' albums (complete with covers) is more anecdotal but still meaningful as a creative and protean consumer practice" (85).[12]

An example of this "post" age is provided by Marc Prensky, who has identified a disruptive factor in the digital transition. Prensky's seminal article "Digital Natives, Digital Immigrants" (2001) is pivotal here, and while it does not specifically address music, the author situates the birth of what he calls "digital natives" at the brink of the 1980s, simultaneously postulating that they bear witness to the dawn of a world in which digital technology is ubiquitous and that one generation's cultural practices could be radically different from those of the generation preceding it. In sum, Prensky's argument combines a generational approach with a kind of anthropological affirmation. To him, digital natives do not think like their predecessors, and this argument is echoed by Don Tapscott (2009), who sees technological innovation as a vector of widespread generational and cultural differentiation. Prensky's thesis has raised a number of reservations and critiques. Some have argued that cultural transformation may be intergenerational as well as generational. Others suggest that sociodemographic differences in digital abilities divide groups of the same generation; for example, the effects of class on one's digital abilities can be just as important as those of age (S. Bennett, Maton, and Kervin 2008; Garcia-Bardida, Nau, and Rémy 2015). Finally, scholars like Russell Potter (2013) contest Prensky's characterization of digital natives as naturally conditioned by digital technology, and "digital immigrants," the generations born before the dawn of the digital, who Prensky claims have had to make an effort to adapt to new technologies or resign themselves to helplessness.

In a 2011 book on depictions of the past in contemporary popular music, music journalist and author Simon Reynolds has, for his part, produced a rather original analysis of the effects of the digital on popular music. According to him, the first decade of the twenty-first century marks a turning point in this history. Here, the profusion and accessibility of online works blurred the chronological and aesthetic reference points with which listeners were previously familiar. Using the example of videos to discuss this phenomenon, he argues that this results in a viewing experience that would henceforth be akin to "a wandering across time, since video artifacts from different eras are jumbled promiscuously and linked by a latticework of criss-crossing associations" (Reynolds 2011, 62). The author further argues that "[t]he Internet places the most remote past and the exotic present side by side. Equally accessible, they become the same thing: far, yet near…old yet *now* [author's emphasis]" (85). Years earlier, Reynolds (1998) argued that the sampler transcended its basic function as a citational tool to become a machine that reassembles and hybridizes musical clips, to the point where the original source can become unrecognizable; in so doing, the emergence of the sampler in the late 1970s contributed to the blurring of chronological and aesthetic frameworks in music history. The sampler's remarkable ability to borrow from other works to invent a new piece—which was also highlighted by authors such as Ulf Poschardt (2002), David Toop (2008), and Paul Harkins (2012)—makes it one of the central technological elements in the production and revelation of the digital shift.

Whether their take on sampling is critical or leans into admiration, all of these authors see its emergence as an example of the passage from modernity (the analog) to postmodernity (the digital). Shusterman (1991) sums up these views with the example of rap, where the sample is not merely used to borrow musical ideas but frequently is at the heart of an original creation. As he writes, "Postmodern art like rap undermines this dichotomy [between originality and borrowing] by creatively deploying and thematizing its appropriation to show that borrowing and creation are not at all incompatible." In this context, "Originality thus loses its absolute originary status and is reconceived to include the transfiguring reappropriation and recycling of the old. In this postmodern picture there are no ultimate, untouchable originals, only appropriations of appropriations and simulacra of simulacra" (617).

The work carried out by sociologist Le Guern offers a good example of an anthropological approach to the digital shift. Situating his work in the lineage of Jack Goody and actor network theory, Le Guern seeks to understand all of the consequences of the digital shift for the production, distribution, and reception of music.

Examining the transition from oral to written societies, Goody (1977) explored how the technological regime of writing led to new cognitive and cultural transformations. As early as the sixteenth century, Goody (2000) asserts, the emergence of the printing press and increased levels of literacy modified many features of Western society, including religion, the political system (which became organized by written decrees and public archives), and the economy (which employed new systems of accounting). In the same vein, Le Guern (2012b) shows how the digital shift in music prompted us to reconsider our conceptions of the author and copyright, of creation and its compensation. He explores how we shifted from a world founded upon the possession of music to a world governed by accessibility, how we moved from an economy of scarcity to an economy of attention, and how the discovery of new music is now primarily delegated to recommendation algorithms. Drawing on actor network theory, Le Guern attempts to steer clear of the dualism of determinism and freedom by treating the subject and technology not as separate entities locked in a perpetual standoff but rather as permanently intertwined with each other in socio-technological configurations. Thus, "taking an interest in the potentiometer of a mixing console or the graphics of a sequencer is neither trivial nor anecdotal, because the design and ergonomics convey information to us about human manipulations, skill, naturalized gestures, norms and know-how, of postures, volume level, signature moves—in short, of everything that constitutes the bedrock of a practice, sociability, identity, and aesthetic" (18).[13] Taking the experience of music as something that cannot be reduced to a single act of aesthetic appreciation but instead constitutes a kind of total social experience, and refusing to cede to what Goody (1977) described as "a simple technologically determined, sequence of cause and effect" (10), Le Guern (2018) ultimately asks us to consider the true importance of technical innovations in the reconfiguration of social phenomena and, in this case, the ways we exist in the world of music. A similar idea was defended by Fred Ritchin (2010), albeit in the context of photography, rather than music. Positing homologies between various forms of expression, Ritchin stated that the vinyl record was created to promote linear listening within a logical framework that contains a beginning, a sequence, and an end; in contrast, the music CD and the iPod were designed to encourage delinearized, fragmented listening, with no real beginning or end. In this way, Ritchin concluded that with digital media, no two listeners could have listened to exactly the same album (Ritchin 2010).

In sum, the various writings on the digital shift we have examined so far either saw digital technology as fundamentally transforming the musical landscape and constituting a decisive rupture, or, on the contrary, viewed it merely as an extension of the analog musical world, so that any idea of disruption was merely an illusion linked to what was alleged to be the radically innovative nature of digital technology. Other approaches, however, have been less interested in whether or not the arrival of the digital marks an unprecedented new epoch and are more concerned with characterizing the nature of digital music. Just as scholars of amplified music like Rodolphe Burger and Bernard Stiegler (2004), Marc Touché (2007), and Roger Pouivet (2010) sought to characterize the ontological properties of rock (examining, respectively, the topics of recording, electric amplification, and acoustic pressure), others, like Arbo (2021b), asked how we can define the ontology of digital music. As musician and theorist Paul Miller (2008), who records under the name DJ Spooky, has noted, digital processes are characterized by the transformation of a physical signal into a sequence of ones and zeros. Making an analogy between the production of digital music and the cloning of Dolly the Sheep, the first mammal to be cloned and therefore genetically identical to its original, Miller pointed out that analog copying necessarily entails alteration. Indeed, we often speak of the "generation" for each copy of an analog recording. In contrast, there is, at least in theory, no difference in quality between a digital original and digital copy. In contrast to analog technologies, digital ones necessarily operate in a world of infinite technical reproducibility. This idea is echoed by Le Guern (2018), who sees the digital as capable of moving a work of art beyond the era of technological reproducibility so famously theorized by cultural theorist Walter Benjamin ([1935] 2019), since the digital signal does not degrade when copied, unlike that of media such as vinyl records or cassettes. As Le Guern states, with the digital, "we move from an era of technological reproducibility to an era of infinite reproducibility, and this makes for the possible conditions of a highly disseminable, viral culture. If magnetic tape was the analog era's emblematic artifact, then

the sampler was the poster child of the digital era, embodying a number of its ontological properties; conceived as a tool for coding, the sampler does not produce sounds *per se*, unlike the synthesizer, which combines filters and oscillators but reproduces the genotype of any sound" (2018, 11).[14] To put it simply, samplers and synthesizers are both electronic musical instruments. As their name suggests, samplers take audio samples and manipulate them through various processes, such as pitch shifting, looping, and filtering. Synthesizers, however, generate sound waves using oscillators and manipulate them using filters, envelope effects, and modulations. Thus, it is the sampler, rather than the synthesizer, that epitomizes the digital age.

A final possible approach to the digital shift addresses the nature of the promises that this type of innovation can offer. In this context, the term "promise" refers to a well-identified sociological notion, where high-tech futures are presented as both inevitable and as the bearers of progress (Audétat 2015; Compagnon and Saint-Martin 2019), which media studies researchers David Thorburn and Henry Jenkins (2003) have dubbed "the myth of inevitability." For scholars who take this approach, the question about the digital era is defined by the specific nature of the promises its promoters make to musicians and their audiences (Vandiedonck 2007; Williamson and Cloonan 2007), a topic to which we now turn.

THE PROMISE OF DIGITAL TECHNOLOGY

In the field of cultural practices in general and music in particular, digital technology is often said to have a number of salutary effects. It gives large numbers of people access to a plethora of cheap or even free works. It weakens the logic of distinction, in Pierre Bourdieu's ([1979] 1984) sense of the term, as the proliferation of inexpensive media makes high-status works less effective as symbols of social difference. The power of cultural experts is reduced, as the growth of recommendation engines reduces the influence of professional critics. Uncertainty about the value of works is diminished by the sheer abundance of cultural information. The falling cost of production technologies, exemplified by the rise of the home recording studio, enables more people to be creators of culture, and the role of editors and other mediators is reduced, since anyone can now distribute their creations and make them accessible on the internet.

From this standpoint, the transition to the digital appears to neatly tie up several aporias specific to analog cultural markets. For example, economists have argued that one of the characteristics of cultural goods is that their value (i.e., the satisfaction they produce) can only be known *a posteriori*. This principle of uncertainty about the value of artworks has been summed up by economist Richard Caves (2002) in a single phrase: "Nobody knows." While any facet of the performance of a new car can be measured during its design or production process (e.g., its level of CO^2 emissions), we cannot define objective criteria for the quality of a novel or a song before it goes to market; thus, it is impossible to predict with any certainty which artworks will be successful with the public (Karpik 2007; Menger 2009). As a result, economists often refer to cultural products as "experience goods." The problem of uncertainty in culture explains why audiences are constantly on the lookout for informational signals or trust devices that enable them to select one work or another (Maisonneuve 2019). While cultural works appear to be more plentiful and accessible in the digital world, consumers of culture today are confronted with too many choices, which not only calls into question their ability to optimize time in the face of abundance—a problem addressed by the notion of "the attention economy" (Simon 1959; Citton 2014)—but also challenges consumers' ability to "make the right choice" when selecting cultural goods. In a world where supply is abundant but attentional resources are scarce, how can a consumer make a rational choice when they seek to discover new music or other cultural works?

Digital technology is said to offer a triple response to this challenge. First, digital media can provide the consumer with samples, allowing them to test a small part of a work over the Web before acquiring it. Second, digital technology may engage help in the "crushing of forms of [cultural] authority and the redistribution of roles [of traditional mediators] in relation to classic institutional hierarchies" (Croissant 2018, 361).[15] In this

context, internet users' cultural journey no longer relies solely on the opinion of traditional experts, such as music critics, though these are often replaced by the opinions of well-known amateurs, who often operate as the new intermediaries of recommendation. Finally, streaming platforms' algorithmic recommendation engines help consumers navigate culture. Nevertheless, there are limits to all of these tools. For example, Valérie Croissant's (2018) communication studies research on the SensCritique social network shows that cultural recommendations by amateurs play a critical role in mitigating the uncertainty of cultural goods and operate as gatekeepers of social distinction.

Another example of the way that digital technology is believed to have a positive impact on culture is regarding barriers to entry. With digital technology, more people are able to become artists, because the cost of entering the art market has been reduced. Further, social media is said to provide free publicity, enabling unknowns to gain recognition through their talent alone. The Arctic Monkeys, a rock band from Sheffield, UK, is often cited as an example of the effects of internet virality on access to success. As music industries scholar Justin Morey (2009) has observed, their "success was widely attributed in national, music and music industry press to the dissemination by fans of the band of copies of demos across MySpace and other user generated content and social networking sites" (para. 2).

Finally, the digital shift is said to improve social well-being, since the number of works produced and rendered accessible has significantly increased, and works that would not otherwise be economically viable find their audience in niche markets, whose existence is made possible by the Web. This phenomenon is partially explained by the notion of "the long tail," which was popularized in a *Wired* magazine article written by its editor at the time, Chris Anderson (2004). While Pareto's Law dominates brick-and-mortar stores, with 20% of products accounting for 80% of sales, Anderson argues that the reverse is true of internet retail, which allows consumer demand for products such as music to be spread over a wide range of niche products over a long period. (This term "long tail" refers to the shape of a product's sales distribution curve under conditions of internet sales, with a spike of sales at the "head" of a product's release and a long tail of sales continuing indefinitely into the future.) According to the long tail theory, discussed further below, digital technology facilitates the distribution of goods, including even the most obscure niche products, by dematerializing them as digital files and making them available in perpetuity on the internet (Anderson 2006).

What is the reality of this economy of promises? Several studies have tried to test predictions of the long tail theory, with mixed success (see, for example, Coelho and Mendes 2019). That the internet provides creators with new ways of making their work visible to the public does not seem to have put an end to the anonymity that the mass of artists have encountered online, nor does it seem to have offered them wide access to recognition (Coelho 2013). From this perspective, the star system business model of the traditional popular music industry, discussed in further detail below, still appears to dominate. The sociologist Jean-Samuel Beuscart (2008b), for example, has shown how the website MySpace, which appears to establish "a formal equality between those aspiring to fame" (142),[16] did not guarantee access to the world of professional music-making, which remains largely out of reach for amateur musicians. While easy access to the tools of digital creation may have been a breath of fresh air for a greater number of amateurs, a gap still exists between the musical standards imposed by the dominant media and vernacular production. And if the power of certain gatekeepers appears to be diminishing—insofar as their ability to control the entirety of the chain of production and mediation has weakened—the impact of marketing on the visibility of works does not seem to be waning. On the contrary, the work of Beuscart and Kevin Mellet (2012) on the use of advertising in cultural sectors of the economy and research by sociologist Irène Bastard and her colleagues (2012) on the hierarchies established in the traditional world (i.e., offline), which are not really challenged on the internet, to the detriment of lesser-known artists, shows that marketing remains an important part of the economics of culture.

THE ECONOMICS OF MUSIC IN THE DIGITAL LANDSCAPE: RESHAPING INDUSTRY PRACTICES AND REGULATORY POLICIES

In a recent article, communication studies scholars Christophe Magis and Lucien Perticoz have observed:

> As early as the turn of the twenty-first century, the music industry was the first of the cultural industries to pay the price for its lack of adaptation to the digital shift. In the early 2000s, it was the object of numerous studies whose primary aim was to document the crisis of the sale of physical media, theorize about the fading socioeconomic model (which was centered on the piece-rate payment of a cultural good and inherited from the sale of sheet music), or even predict the advent of a new boom [in the music industry], driven by collaborative web tools, refocusing [business strategies] on rights management, or the emergence of various international artists. (2020a, 5)[17]

As scholars like Philippe Bouquillion (2008) and David Hesmondhalgh (2013) have pointed out, the digital revolution has had a significant impact on the way capitalism works in the culture industries, just as it has on aesthetics, consumption patterns and other aspects of music. Of course, the popular music industry has seen rapid shifts before. Sociologist Richard A. Peterson (1990) and Peterson and David G. Berger (1971, 1975) have argued that in the period from 1954 to 1956, a myriad of small record labels challenged the dominance of what had been a four-firm oligopoly, and this was accompanied by a change in aesthetics from the values associated with jazz music and pop crooners to the aesthetics of rock and roll. In this context, contemporary scholars have asked whether the digital shift is exceptional in its effects and scope or if it simply constitutes another variant of the multiple crises that have left their marks on the popular music industry, from the breakthrough of radio in the 1920s to the crisis of vinyl records that came about with the arrival of the CD in the 1980s, and beyond.

We will begin by observing that the digital shift has produced differing effects over time in differing cultural sectors. Writing about the culture industries of the day, the Collectif PANIC (2011), a group of French researchers led by the late Nicolas Auray, reminds us that music was affected early and extensively by the digital shift, with the recorded music sector losing more than half of its value between 2002 and 2010; however, books, "whose digital market was barely emerging in the 2010s, have also been affected, albeit in a more cushioned manner," while "cinema is experiencing a mixed evolution" (i.e., that the impact of digital technology in film varies from one movie production to the next; 10).[18] Nevertheless, the various branches of the culture industries presented common structural characteristics—in particular, a high level of concentration, which saw established oligopolies dominating a competitive fringe—that was impacted in roughly similar ways by the rise of digital technology. According to economists Marc Bourreau and Michel Gensollen (2006), in the first decade of the twenty-first century this concentration affected production processes, individual musical works, promotional spending, and distribution and broadcasting, with the notable collapse of a number of independent record stores. Bourreau and Gensollen note, "The digitization of musical works, which allows for their duplication and format-shifting, transforms not only music's distribution but all elements of its value chain, from the dynamics of production to modes of consumption" (31).[19] So how can we explain the fact that music was the first to be affected by the transformation of the value chain within the cultural industries?

Economic theory allows us to address this question, indicating that the unique characteristics of recorded music as a commodity differ from those of other cultural goods (Schweitzer 2019), and this is the case for several reasons. As we noted above, music is an experience-based product, making it possible for the consumer to form an idea of the satisfaction they will derive from listening to a particular track or album by listening to a short sample of it. Further, the utility of a piece of music, as opposed to, say, a film, does not necessarily diminish after several listenings. And unlike film, the production of recorded music is less dependent on large investments,

which ensures that a modest number of successful musical works suffices in making the production of a large number of recordings profitable. In this relatively favorable context, how would one expect the arrival of digital technology—including both the digitization of music and internet distribution—to affect the economics of the music industry?

In France, the first studies devoted to the links between music and digital technology came relatively late. This can be seen, for example, when we look at the journal *Réseaux*, which was founded in 1983 and is the primary journal for studies of the social impact of technology. As Le Guern (2014) has observed, the first articles published there on the effect of digital technology on the music industry date from the early 2000s, for example, the article by Giovanni B. Ramello (2001) on Napster and the development of peer-to-peer (P2P) file trading, and Christian Licoppe and Valérie Beaudouin's (2002) article on music fans' personal websites and their online editorial practices.

At this time, a number of other authors highlighted the possible effects of digital technology on the music industry. On the supply side, digital distribution of works is thought to encourage a greater diversity of music, thanks to two main catalysts: the availability of a more extensive catalog (with digital technology removing the barriers imposed by physical sales outlets) and the support provided by new recommendation tools. Analyzing data from the Chart Information Network, published weekly in *New Musical Express* since 1962, economists Eric Strobl and Clive Tucker (2000) showed that from 1980 to 1993, a very small number of artists were responsible for the majority of charting records, and one could imagine that the arrival of digital technology would ease this bottleneck. This would result in another consequence of digital music—an increase in the fragmentation of audiences, with consumers segmented into increasingly narrow aesthetic categories and niche markets. While, in the period before the digital distribution of music, the promotion of works was dominated by traditional influencers (radio stations, specialized journals, etc.), the rise of the Web allowed the public to take part in the process of evaluating and recommending works, with information signals on the quality of goods no longer depending solely on opinions of an "expert." In theory, this would result in the rise of a community of influencers who would make music less dependent upon the kind of environment that sociologist Olivier Donnat (1994) described as a "media-advertising economy" (*économie médiatico-publicitaire*). Finally, digital technology could also be a factor in lowering production costs, as the emergence of digital recording equipment and the rise of the home studios allowed more musicians to record their own music, while music's dematerialization had a direct effect on lowering the cost of copies.

THE LONG TAIL AND THE STAR SYSTEM

The idea that has most effectively crystalized the promises of the digital music economy is Anderson's notion of the so-called long tail. As we have seen, Anderson's 2004 article argued that the internet opened up a market for a great deal of recorded music that would not have been profitable in the traditional music economy. Many authors responded to this article, and Anderson expanded his ideas in a 2006 book, where he develops his idea that the internet fosters diversity in cultural markets. There he suggests that the internet

- removes the bottleneck of physical distribution
- diversifies the sources of information regarding the quality of works
- lowers distribution costs, decreasing the break-even point for the profitability of recorded works

As a result of all of this, Anderson argues, digital technology resolves the problem that Pareto's Law produces regarding the sale of cultural goods: in the past, works may have been abundant, but demand was concentrated on a minority of them; this created a star system and produced an economy dominated by hit records that limits the diversity of cultural products (Benhamou 2002). Was the phenomenon of the long tail likely to make the

economy of recorded music shift away from the star system and toward a diversity of products? From a certain perspective, one could hypothesize that the better match of supply and demand fostered by the internet would lead to the fostering of niche markets, and Anderson argues that, when aggregated together, the myriad of new listener communities would compete with the mass audience for best sellers. The long tail model is emblematic of the theories put forward to explain the effect of the digital economy on cultural industries and has aroused numerous objections and responses. The economist Anita Elberse (2008) is particularly noteworthy here. Her analysis of DVD and VHS sales in the United States between 2000 and 2005 does not question the existence of the long tail; nevertheless, she notes that the tail's shape is extremely flat, with a relatively stable number of small sales in the long run. In addition, she argues that when comparing those who consume the most music and those who consume the least, both groups tend to opt for hits, rather than niche products. Finally, she suggests that despite the existence of the long tail, niche products still produce low sales. Elberse—who considers Anderson a "romantic"—concludes that the development of online music sales still favors the star system, even when the long tail is accounted for. Further, the number of superstars has been reduced by the new digital technology, but those stars end up selling more music. In the mid-2000s, this trend toward concentrating sales on a reduced number of products was elsewhere confirmed: in 2006, the Syndicat national de l'édition phonographique (French Phonographic Publishers' Association; henceforth SNEP) reported that 90% of the total sales volume corresponded to 4.1% of released recorded music (see Le Guern and Sagot-Duvauroux 2008).

Writing at the same time, economists Pierre-Jean Benghozi and Françoise Benhamou were among the first researchers in France to carry out empirical studies of the effects of digital technology on the culture industries and the validity of the long tail theory. Regarding the music sector of the cultural economy, Benghozi and Benhamou (2008) concluded that while the tail of the long tail increased for online sales, sales of physical media still supported the superstar effect. Furthermore, they observed a seasonal impact for the long tail: the superstar effect is particularly marked at times of strong sales (especially at Christmas), while sales of long-tail products increased during other times of the year. In the mid-2000s, the development of new business models was not sufficiently advanced for the music industry "to move from the myth of reassurance ([i.e., the idea that] 'all products have a chance' [in the marketplace]) to [the establishment of the long tail] as an effective economic reality" (10).[20] Nevertheless, some authors retained a positive vision of the future of the long tail, believing that its success will depend on the invention of new ways of promoting music on the internet. Media consultant David Jennings (2007), for example, asserted that the music of the future would require such individualized recommendations that consumers would become invested in niche markets, rather than just superstars. In a review essay published in 2015, Bourreau, Sisley Maillard, and François Moreau reached a mixed conclusion, to say the least, regarding Anderson's initial hypothesis about the internet's ability to transform the star system economy to the benefit of niche goods. They concluded: "Research shows that the long tail phenomenon does not yet appear to be taking place at the scale that had been anticipated. While the sales distribution tail is indeed getting longer, as more and more titles are available and utilized at least once, the conditions for a massive shift in demand toward the long-tail products do not yet seem to have been met. Further, the superstar effect appears to be more prevalent online than offline, with an increase in sales at the head of sales distribution" (Bourreau, Maillard, and Moreau 2015, 209).[21]

THE DIGITAL SHIFT AND THE RECORD CRISIS

Looking at the market for music today, the situation seems particularly positive. In France, for example, the Syndicat national de l'édition phonographique (SNEP; National Organization of Phonographic Publishers) reports that in 2024, the French music market grew for the eighth consecutive year. This was due to a number of factors, including a steady increase in streaming, with 17.7 million people subscribing to streaming services and sales from subscriptions reaching €522 million, an increase of 11.4% (SNEP 2025). The increase in sales

of CDs and vinyl was 1.3% (€2.5 million), and vinyl outstripped CDs, with sales up by 5.4%. There was also an intensification of music-listening practices; the amount of time people in France spent listening to music each week increased by 42 minutes, to an average of 19 hours a week. These positive figures are confirmed in the global music market. According to the International Federation of the Phonographic Industry (IFPI), in 2024 sales had reached US$29.6 billion, an increase of 4.8% in one year. Paid streaming is one of the main drivers of this growth, with 752 million users generating $20 billion, an increase of 9.5% (IFPI 2025).†

To more fully understand the current state of the music market and how it is changing, it is useful to look back to the turn of the millennium, when a major crisis—generally blamed on massive piracy—shook the existing economic model. Although music entered the digital era in the early 1980s, its "major changes are more recent and relate to the emergence, since the end of the 1990s, of legal digital distribution (iTunes, Deezer, etc.) and illegal distribution (piracy via peer-to-peer networks in particular)" (Collectif PANIC 2011, 66).[22] How can we describe the recording landscape in the early 2000s and how should we interpret the market "crisis" observed at that time? Many studies and reports see the end of 1999 as a turning point. According to an article by Bourreau and Benjamin Labarthe-Piol (2004), change in the US market since the 1970s came in "four main periods. Between 1973 and 1986, album sales rose slightly, from 386 million to just over 526 million units, representing an average annual growth of 2.4%. Between 1987 and 1994, with the development of the CD, sales growth was very strong: the number of units sold rose by an average of more than 7% a year over the period,

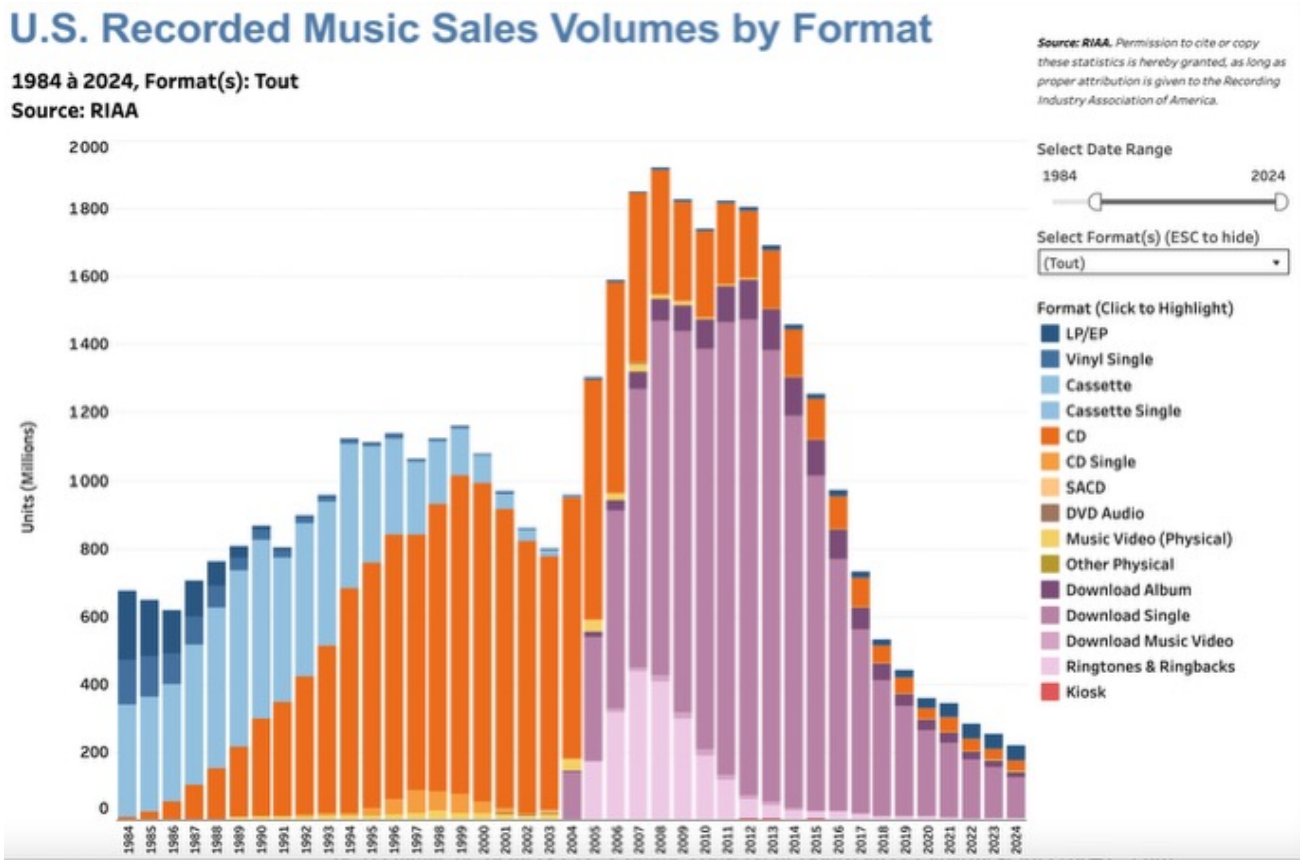

Figure 1: US recorded music sales by format, 1984 to 2024. (Source: Recording Industry Association of America, https://www.riaa.com/u-s-sales-database/)

† All statements in this publication attributable to IFPI represent our interpretation of data, re-search opinion or viewpoints published as part of the IFPI Global Music Report in March 2025, and have not been reviewed by IFPI. Each IFPI publication speaks as of its original publication date (and not as of the date of this publication).

from 619 million to 1,020 million. Between 1995 and 1999, sales stagnated (+1.8% per year on average). Finally, since 2000, album sales have fallen sharply, the steepest decline in the industry over the last thirty years" (36).[23]

Figure 1, which comes from the US Music Revenue Database from the Recording Industry Association of America (RIAA), shows the state of the American record market between 1984 and 2024. While Bourreau and Labarthe-Piol base their study on sales of singles and albums, this chart shows changes in sales volume for each format (vinyl, CD, etc.). What does it tell us? After years of virtually uninterrupted growth (with the exception of 1986, 1991, and 1997), from 2000 and 2003 the US record market for all formats combined went into recession. *A priori*, we can therefore hypothesize a link between this fall in sales and the appearance of P2P file trading in 1999.

Considering sales figures between 1999 and 2003 for different formats, Bourreau and Labarthe-Piol (2004) observe that "the drop in sales is particularly sharp for the 'single' format. In the case of CD albums, the change in sales is less marked."[24] They go on to compare the sales figures for various formats in the five biggest record markets, noting that "there is considerable heterogeneity between markets. While some markets (Germany, Japan, United States) have seen a decline in sales, this is not the case for the French and British markets, which have seen an increase in sales volume" (33).[25]

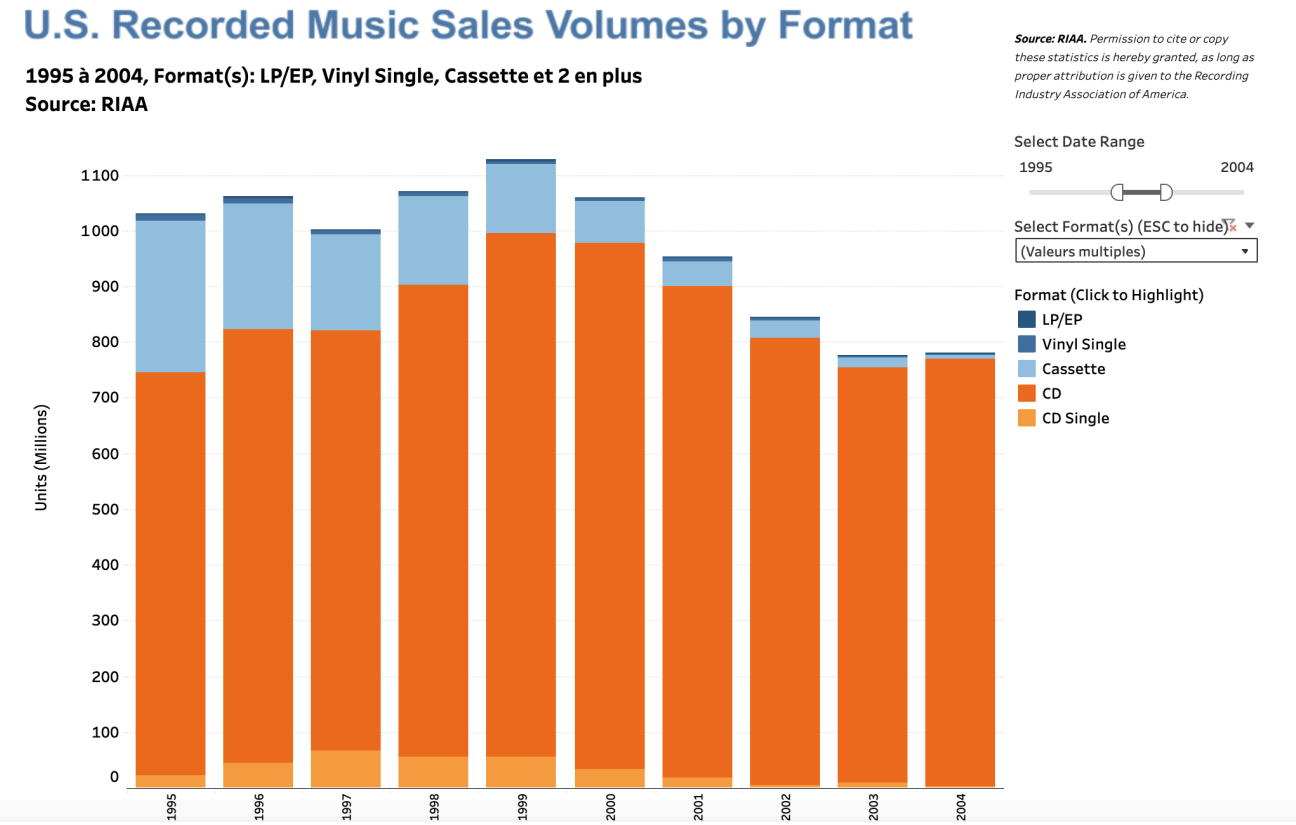

Figure 2: US recorded music sales by format, 1995 to 2004. (Source: Recording Industry Association of America, https://www.riaa.com/u-s-sales-database/)

If we look at the number of units sold for each format in the US between 1995 and 2004, which includes both the period before the record industry "crisis" and the period when it began to recover, we see that all formats declined from 2000 onwards, with the exception of CDs, which rose by 0.4% in one year (see figure 2). However, the sales trajectories differed markedly from one format to another. The decline in sales of vinyl singles began well before 2000. As for CD singles, after years of growth (including a doubling in sales between 1995

	1996	1997	1998	1999	2000	2001	2002	2203	204
Vinyl single	-1.0	-25.7	-28.0	-1.9	-9.4	-14.6	-20.0	-13.6	-7.9
CD single	+100.9	+54.4	-16.0	-0.2	-38.8	-49.4	-74.0	-84.4	-62.7
LP/EP	+31.8	-6.9	+25.9	-14.7	-24.1	+4.5	-24.2	-13.9	-6.7
CD	+7.7	-3.3	+12.5	+10.9	+0.4	-6.4	-8.9	-7.1	+2.8
Cassette	-17.4	-23.4	-8.2	-22.0	-38.5	-40.8	-30.9	-44.7	-69.8

Table 1: Annual change in sales, by volume, for the main recorded music formats, 1996–2004. (Source of data: Recording Industry Association of America, https://www.riaa.com/u-s-sales-database/)

and 1996), they declined from 1998 onwards. The album formats also vary in their trajectories. The audiocassette was already on a downward slope in 1996, and this trend was not to be reversed. The trajectory of LPs and EPs also has a downward slope; its decline began in 1997 and was confirmed from 1999 onwards, though it eased in 2003. The fall in CD album sales began in 2001, but the downward trajectory remained fairly stable (between–6.4% and –8.9%). Table 1, which we have compiled from percentages from the RIAA, compares the trajectory of each format.

If there is one thing to take away from these figures, it is that the US record market appears to have been in structural decline from 1999–2000 onwards. However, the decline of the single format began before the creation of Napster, with the CD single declining in 1998 and the vinyl single declining as early as 1980. (See figure 3.) Therefore, the relationship between the rise of P2P file trading and the single crisis does not seem to have been directly established. Similarly, the effect of P2P file trading on CD sales does not seem obvious at first sight, since an unprecedented number of over 9 million units were sold in 1999 and 2000. Thus, we must ask: Was the effect of piracy simply delayed? How can we analyze its impact on developments in the music industry? Furthermore, are the changes in the American market comparable to those of other national markets? Judging by the table reproduced by Bourreau and Labarthe-Piol (33), it would appear that the main markets were indeed affected by the "crisis," but there are nuances here. For example, Bourreau and Labarthe-Piol note that between 1997 and 2002, sales of singles fell in the United States, while in France "they remained relatively stable." However, "the trend in singles sales in France between 1996 and 2003 is similar to the trend in singles sales in the US between 1991 and 1998. One could therefore make the hypothesis that the French market is following a few years behind the American market" (34–35).[26] When we translate the trend in singles sales into percentages, we can see that, between 1999 and 2003, sales fell without exception for the main music markets—France (–16%), Germany (–53%), Japan (–32%), the UK (–54%), and the US (–84%). However, the sales of CD albums over the same period varies from one country to another—France (+6%), Germany (–30%), Japan (–22%), the UK (–32%), and the USA (–25%).

For comparison, we can consider in more detail the case of France (Dauncey and Le Guern 2013) and note that a number of explanations have been put forward to account for the French lag. One of these centers on issues of supply and demand. Bourreau and Labarthe-Piol observe that while the quality of the match between supply and demand in music is difficult to calculate, it is known that record sales are higher when the link between consumer tastes and the genres of music on offer is at its closest. With this in mind, Beuscart (2008a, 68) has argued that while the French record market as a whole lost 33% of its value between 2002 and 2006, the demand for French variety (a term that refers to a wide range of musical genres sung in French) remained relatively strong, at 42.6% of sales in 2006, compared to 35.9% for international variety (a French term that refers to a wide range of popular music from outside of France). Can we correlate this market resilience to the fact that the major record labels in France have a greater market share of French pop (89.4% in 2003) than they

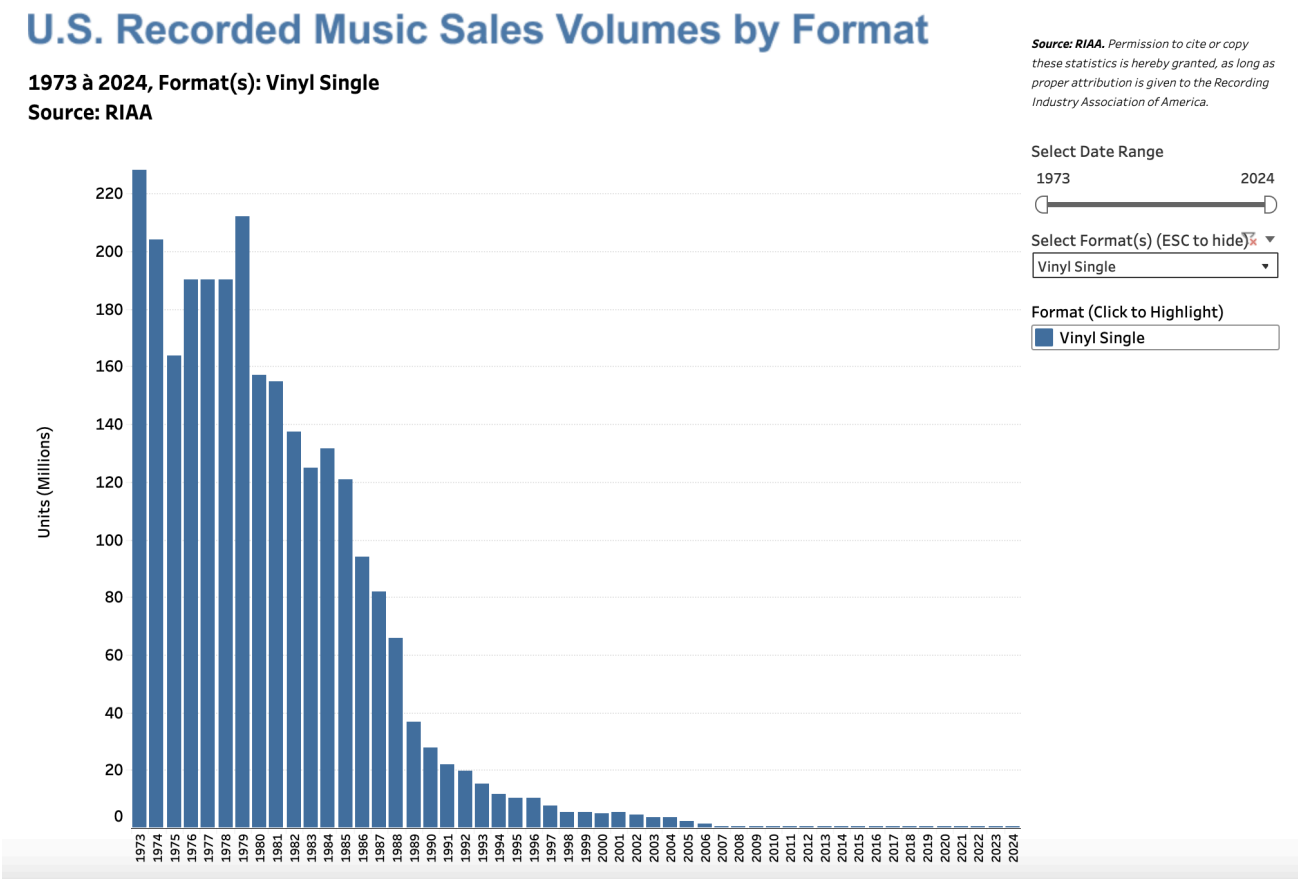

Figure 3: US recorded music sales by vinyl single format, 1973 to 2024. (Source: Recording Industry Association of America, https://www.riaa.com/u-s-sales-database/)

do of pop music from other countries (63.8%) and have thus benefited from increased support? This hypothesis remains to be proven, but it is certainly worth considering, and there is evidence to support this position (Bourreau, Moreau, and Senellart 2011). If we look at the top ten best-selling albums in France in 2001, we see that nine were created by French artists. In 2002, the ten best-selling albums were French (Tubes en France 2002). Another explanation for the French lag is that France had a lower proportion of computer equipment and internet access than other countries, such as the US or Germany, and this may have temporarily limited the effects of piracy.

Turning from the reasons for the French lag to the reasons for the crisis in general, we can observe that scholars have put forward various explanations. The primary reason, or at least the one put forward by the music industry, is, of course, the music piracy made possible by P2P networks. In fact, this was not the first time that a music industry crisis was attributed to piracy and new music technology. There was a decline in record sales in the late 1970s, which came to a head in 1979 and was widely attributed to audiocassette piracy. Responding to music industry claims about cassette piracy, researchers like the communication scholar Robert Burnett (1996) and sociomusicologist Simon Frith (1988) have pointed out that while record sales fell during the late 1970s, the cause was multifactorial, including competition from other forms of leisure and a decline in the quality of music. However, for the music industry, the practice of copying records on cassette was solely responsible for this situation, and this view led the British Phonographic Industry trade association to launch a campaign in 1980 against cassette piracy, epitomized by the slogan "Home taping is killing music. And it's illegal" (Bottomley 2015).

In the early 2000s, various organizations and individual scholars tried to put the harmful effects of P2P into perspective, and some even argued that the practice has certain advantages. For example, the Organisation for Economic Co-operation and Development (OECD) noted in a 2004 report that "it is actually the availability of content which drives broadband up-take and not the other way around" (OECD 2004, 10). On a different note, a study of the Canadian music market (Champeau 2006) found that album sales by Canadian artists—and, in particular, French-speaking Canadian artists—increased by 25.3% from 2001 to 2004, while sales of foreign albums fell by 20.2%. From this data, one might conclude that increased internet adoption is favorable to sales of records by local artists and that the practice of P2P file trading has not had a negative impact on sales.

Writing about piracy and the crisis in the 1970s music industry, journalist Mark Coleman (2004) notes the link between the two did not seem to be entirely self-evident: after all, it was in fact established that, in their day, fans of audio K7s were also the biggest buyers of records. Regardless of such objections, the piracy argument returned once again in the 2000s, after Napster began offering access to music files to a growing number of fans. From February to June of 2000, the number of Napster users spiked from 524,000 to 4.6 million (Kot 2009). To the music industry, the culprit was obvious: the P2P network and the behavior of "pirates." There is little doubt that the number of exchanged files was substantial. In 2003, this figure was estimated at 8 billion files per year (Bourreau and Labarthe-Piol 2004, 44). Responsible for shifting the music industry from producing "rival goods" (i.e., products, like vinyl, that can only by consumed by one person at a time) to "non-rival goods" (ones, like MP3s, that can be consumed by several people at the same time), digital music seemed to pave the way for free access to music. The transition also seems to have disrupted traditional economic laws, notably by calling into question the concept of intellectual property.[27] Nevertheless, one might ask if piracy was the sole or main factor in the crisis. From an economic point of view, piracy raised two main questions. First, scholars asked whether downloading really had replaced the purchasing of music. In other words, would consumers have bought what they had downloaded if the P2P network did not exist? (For a remarkable perspective on this topic, see Bastard, Bourreau, and Moreau 2014.) Second, scholars asked whether the practice of downloading also produced a "sample" effect, which enabled P2P network users to discover and test music that they were then more likely to purchase.

The various surveys carried out on this subject resulted in some rather ambivalent results. Contrary to the dominant view, Felix Oberholzer-Gee and Koleman Strumpf (2004) concluded that the effect of illegal downloading was virtually zero, a finding challenged by economist Stan J. Liebowitz (2004, 2005, 2006), who asserted that without P2P, there would have been an increase in record sales from 1998 to 2003 that would have been quite close to the industry's historical average. Eric Boorstin (2004), Martin Peitz and Pierre Waelbroeck (2004, 2006), and Alejandro Zentner (2006) argued that downloading does have negative effects on record sales, but these effects are relative, especially as a high level of downloading is positively correlated with a willingness to buy recorded music. Nevertheless, the results of the analyses carried out by these authors are varied. For example, Beuscart (2008a) points out that some scholars found that most of the decline in record sales was attributable to P2P, while Peitz and Waelbroeck (2004) suggested that piracy was only responsible for a quarter of the drop in sales. Other factors that might have contributed to the sales decline include the exponential growth of the internet and cell phones, which competed with physical recorded media for user attention; the emergence of new retailers, such as Walmart or Tesco, which lowered the selling price of CDs, thus reducing the music industry's sales; the beginning of the decline of CD technology in the early 2000s; an increase in competition from other forms of entertainment, such as games and DVDs; and a reduction in the variety of musical styles on offer. According to Bourreau and Labarthe-Piol (2004), aside from P2P file trading, the most credible explanation for the crisis in record sales in this period seems to be the end of the life cycle of the CD format—i.e., the evolution of its sales, from the moment it is placed on the market until its disappearance—which began in the very late 1990s.

DRAWING MUSIC PIRACY INTO THE LEGAL SYSTEM

As Frith (2002) points out, the economic difficulties encountered by the recording industry were almost universally interpreted as a legal problem for the courts to consider. Faced with falling sales, the music industry reacted in various ways: with the implementation of digital rights management (DRM) systems on CDs; the filing of complaints, first against file-sharing sites and then against P2P network users (with the Recording Industry Association of America [RIAA] filing 18,000 lawsuits between 2003 and 2006); job cuts among big industry players (Warner Music Group cut 20% of its workforce in 2007) (Southall 2009); and the reduction in the number of signed artists, the number of produced albums, and the sums invested in their promotion (Knopper 2009). As far as filed complaints were concerned, courts—particularly in the United States and France—found that users of P2P networks who connected computers together to exchange digital files could not benefit from the private copy exception found in copyright law (i.e., the right of exception for private use that exists in France, or the principle of *fair use* in American copyright law, which authorizes an individual to reproduce a creation if this is done for personal or scientific purposes). In the 2000 case of A&M Records vs. Napster, which was tried in the US, "the court noted that the copies made by users were in all likelihood identical to the originals, and that those copies were mainly intended for commercial rather than private use. Moreover, it regarded sharing as a source of economic harm to the plaintiff by directly reducing demand for the products, and by creating an entry barrier in the paid (and legal) music downloading market. The court therefore ruled that the defendant infringed upon the plaintiff's copyright. Napster was ordered to cease its activities" (Desrochers 2006, 6; see also Langenderfer and Cook 2001).

However, a similar case in Canada had a different result. On February 11, 2004, the Canadian Recording Industry Association (CRIA) asked a federal court to require five internet service providers to disclose the identity of twenty-nine users who had downloaded more than a thousand music files via the KaZaA and iMesh networks. Justice Konrad von Finckenstein of the Federal Court of Canada ruled that "there was no evidence that the users who were the subject of the application for disclosure had broadcast or distributed copyrighted works; they had merely deposited works in P2P service directories" (Cloutier 2004).[28] Depositing was therefore not distributing. Indeed, one explanation of the ruling stated that the judge found that it was "hard to see the difference between a library that installs a photocopier in a room full of protected works and a user who uploads a personal copy of a protected work to a shared directory on a P2P service" (Finckenstein quoted in Cloutier 2004).[29] Writing about the case, journalist Jean-Pierre Cloutier observed: "The exclusive right to make a work available is included in the World Intellectual Property Organization's Performances and Phonograms Treaty (CRNR/DC/95 Rev.), but this treaty has not been implemented by Canada, and is therefore not part of the Canadian copyright legal framework" (2004, under "Musique sur Internet: Et le juge a dit…," para. 12).[30] What meaning can we find by comparing these two cases? That behind the apparent unanimity of the judgments handed down condemning piracy, there are nuances that deserve to be highlighted.

Be that as it may, it is undoubtedly the case that in France, which is our focus here, public policymakers are clearly willing to regulate "piracy." In this respect, France has set itself apart by introducing a law designed to crack down on pirates exchanging works over P2P networks and creating the Haute Autorité pour la diffusion des oeuvres et la protection des droits sur Internet (High Authority for the Dissemination of Works and the Protection of Rights on the Internet, HADOPI) to warn and punish offenders. An initial version of the law that created this new high authority was invalidated in June 2009 by the Constitutional Council of France, on the grounds that it did not have the power to cut off a citizen's internet connection. A final version of the law was adopted in September of that year; it instituted a graduated response mechanism and entrusted a judge with the authority to decide whether or not an offender's internet access would be cut off (Le Guern and Bastit 2011). Consisting of three levels—a warning email, a warning delivered by registered mail, and a monetary penalty—the system warned over three million internet users between October 2010 and July 2014 and penalized over a

thousand. It remains to be seen whether or not this type of system has had any effect on consumers or restored the older dynamics of recorded music sales. Ultimately, this regulatory regime toyed with the new mechanisms of digital distribution, and its effects on the economy of the music industry can only be evaluated in terms of its impact on the social utility (or disutility) of free downloading. Thus, as we have seen above, one can postulate that file sharing actually increased the demand for music and broadened the diversity of works that are heard; this could be beneficial for artists who have little media exposure and even increase CD sales. However, as we have also seen, one might also conclude that downloading music had become a substitute for purchasing it, resulting in lost income for musicians and a disincentive to create new works (Bacache-Beauvallet, Bourreau, and Moreau 2019). In France, regulatory measures thus gave rise to numerous debates, with well-known artists serving as representatives of the mainstream music industry and the regime of copyright management, while small labels (of which there were six hundred in France in 2009) and independent record stores took the opposite view (FÉLIN 2009).

Until the mid-2010s, the music industry made the fight against piracy the spearhead of its safeguarding policy, but today the very notion of illegal downloading seems to have disappeared from the public's radar, as the market has been realigned by streaming platforms and their paid-subscription business model (SNEP 2021).

LISTENING TO MUSIC IN THE DIGITAL LANDSCAPE

In proposing the concept of "discomorphosis," sociologist Antoine Hennion sought to move away from the objectivist conception of taste upon which critical sociology, and in particular the works of Pierre Bourdieu ([1979] 1984), were based. From Hennion's pragmatist perspective, taste is not an abstract property or a tool for individuals to sort out their position in a social hierarchy; rather, it is an activity that, as Hennion (2004) states, serves as "a means of attachment to the world" (*une modalité d'attachement au monde*, 9). Further, such forms of attachment presuppose the outlets and means through which music lovers experience music. In this context, the notion of discomorphosis refers to the way that the invention of a new musical format (the disc recording, known more colloquially as a "record") served as a new means of attachment to music. Thus, the record structures the experience of music lovers—we do not listen to music on a record as we would at a concert—and is part of a larger network of mediations (the vinyl pressing plant, the record shop, the album cover, etc.). In a book published in 2000, Hennion, Maisonneuve, and Emilie Gomart describe how the disc involves specific modalities of choice at the time of purchase, including modes of listening to, classifying, and collecting music. In sum, the

> disc format for listening to music is a very recent development, which centers music on the consumption—generally in a private manner or in very small groups, at home or in intimate spaces—of music, which we use "at will," whose dynamics we regulate, and whose sequences and organizational logic we recompose at whim. All these dimensions, which are rather banal features of our current listening experience, are in fact fundamental rewritings of our relationship to music. (60)[31]

The role that vinyl has played in the development of music lovers' skills and tastes has been explored through a rich variety of questions. What does it mean to collect records (Calamar and Gallo 2009)? How does the business of independent record stores work (Goss 2010)? And, furthermore, how have record shops been affected by the physical media crisis (Jones 2009)?

With this in mind, we ask: What exactly occurs when media change? What is involved in the switch from vinyl or cassette to CD, then from CD to MP3s, and, finally, to streaming? How do these changes in listening

media transform our relationship to music, as both an idea and an experience? Sociologist of media cultures François Debruyne (2012) has examined these questions in a very concrete manner by conducting a nine-year ethnographic study of a specialized brick-and-mortar record store that gradually became a music retail website. Here, Debruyne observes how the record serves as the vector for an experience that is both social and bound to the senses, bringing into play dimensions of taste, bodily engagement (e.g., the ability to handle the record with dexterity), the identification of categories and classification systems, and various social skills, statuses, and figures (e.g., the archetype of the record connoisseur). Having become an online sales site, the store partially transformed the configuration of its customers' musical experiences, notably by adopting new means of recommendation that favor "the intelligibility and reflexivity of the music experience, rather than its sensitive and somatic dimensions, which were also at the heart of shared listening in the store's physical space" (Debruyne 2012, 60).[32] What this study tells us is that digital music changes the way in which the phenomenological and social experience of listening—the veritable "history of our ears" (*une histoire de nos oreilles*), we might say (Szendy 2001)—is constructed. This has brought many changes: free music is becoming the new paradigm of music consumption; algorithmic recommendations transform the process of discovering new music; the portable nature of listening devices is making listeners mobile; compressed formats, notably MP3, are becoming a topic of objective and subjective audio quality evaluation; the sense of ownership and the practice of curating engendered by the mentality of the grail-seeking collector of material artifacts (vinyl records in particular) are dwindling in the face of streaming; the auditory parameters of listening to music expand to the scopic level, as videos on YouTube, for example, become a more common part of the music lover's experience; and the album as a unit of reference is dethroned in favor of the track.

What Debruyne shows us, through a series of ethnographic observations, is how the experience of listening to music at the end of the 1990s was organized in the very specific context of the record shop—a place of local sociability and the sharing of music cultures, where various categories of customers (the regular, the DJ, etc.), classes of objects (e.g., records, in CD or vinyl formats), and their classification structured the participants' interactions. Across the early 2000s, the record shop that Debruyne studied changed gradually; during this time, it set up an online sales site, though the physical store was maintained till 2007. (The website was shut down in 2010.) What Debruyne observes is that the categories that had only been implicit in the record shop, such as "new releases," became explicit on the online sales site. Similarly, from the mid-2000s onwards, music recommendations, which used to be based on interactions between the record shop staff and its most regular customers, were replaced by an automated recommendation system on the shop's website. However, the intersubjective relationship between the record shop staff and its customers had not disappeared altogether with the shift to an online store. Instead, that relationship became embodied in the exchange of comments on records posted by customers and staff. For all that, one would ask if this type of online record shop is nevertheless a long way from the model of metadata-based recommendation systems that dominate online music today, ones that operate on the principle of "those who bought this also bought that" and are built "around an ideal of symmetrical relations, without intermediaries, between the production and reception of music" (Debruyne 2012, 65).[33]

TECHNICAL INNOVATIONS AND NEW USES

It must be stressed that the MP3 represents a particularly important step in the history of the digital shift, not merely because of its technical innovations but, above all, because of the way it transformed how people listen to recorded music, in all its social dimensions. Most compression algorithms, like the one used in MP3 file encoding, operate on the same principle: eliminate frequencies that the human ear perceives very little or not at all and use the principle of "masked" frequencies to suppress harmonics that are within the human hearing range but would be inaudible in a given context, so that the final music file takes up less space. These algorithms are referred to as "lossy," because some amount of audio information is lost in the process of data compression.

Standardized since 1992, the MP3 format is derived from the sound compression method used for video in the MPEG-1 format. (MP3 stands for "MPEG-1 Audio Layer 3.") While MP3 files remain very popular among users, the holders of the patents associated with the MP3 standard announced in 2017 that they would not be renewing them (Fraunhofer Audio Blog 2017).

Since then, streaming services have launched formats designed to offer a better compromise between the amount of data used and sound quality. This has given rise to various compressed formats, some lossy and others lossless: in the first category, for example, we find the OGG and AAC formats, and in the second, formats such as FLAC, AIFF, and ALAC. The issues involved with MP3, on which we place particular emphasis here, are therefore of historic value, since they no longer correspond to the new standard of and condition for listening to music on today's streaming platforms.

The digital shift is first and foremost a matter of technical change, and before the MP3, the compact disc was the first vector of this change to the status quo. Developed jointly by Philips and Sony, "the first compact discs came out in Japan in 1982 and arrived in the rest of the world in 1983, with [companies promoting them using] the same sales talking points put forth for the release of the LP in 1948: increased listening time and better sound quality" (Tournès 2008, 60).[34] The CD not only transformed the nature of the recorded sound but also the listener's relationship to music (Barry 2020), and portability was a major concern for the CD's designers. When Sony released its D-50 portable CD player, its portability served as one of the factors that drove the adoption of this new format (Shapiro et al. 2012). Music portability was widely discussed at the time (Hosokawa 1989; Green 2004), and even before the advent of the CD, the Walkman, a personal cassette player, became emblematic of music portability. The Walkman encouraged its users to listen through headphones, thus allowing private listening to permeate public space (Cave and Cotten 1984; Chambers 1995). The Walkman has received significant attention from scholars, who analyzed it from the angle of social interaction: the use of a Walkman can signal its owner's desire to withdraw from others (Thibaud 1994), for example, and it can also serve as a marker of identity, with people using the device to show off personal wealth (Du Gay et al. 1997). These properties are echoed in MP3 technology, which gradually replaced the CD. Appearing in 1992, this music compression system "reduces the size of audio files, improves their storage capacity, and [encourages] the proliferation of [file] exchange" (Rouzé 2010, 18).[35] In this way, the MP3 was a significant departure from the CD, a digital technology that is, in many ways, strongly defined by its materiality (e.g., the existence of a sleeve or jewel case, a set maximum amount of music it could store).

Released in 2001, Apple's iPod was to become the vector of a new set of listening practices linked to computers and the internet. The revolutionary nature of the iPod lay in the fact that it is "an all-encompassing product (*the entire solution* [author's emphasis], as Apple calls it)…offering in a single package a playback and storage device, a content management interface, and the possibility for [file] transfer via the Mac computer" (Rouzé 2010, 20–21).[36] The listening experiences offered by the iPod have been extensively analyzed by Michael Bull (2000, 2007), who situates his approach at the crossroads of urban sociology and the sociology of communication. He sees the iPod as a tool for isolating oneself in an urban public space, which gave rise to listening practices that can respond to their context (e.g., by adjusting the volume or choosing one track or another), thus playing a significant role in the contextualized, controlled musicalization of everyday life and the listeners' appropriation of urban space. In addition, with the iPod, we bear witness to a shift in the focus of the value placed on music. As Michael Bull said in a 2005 interview, "with vinyl, the aesthetic was in the cover of the record. You had the sleeve, the artwork, the liner notes. With the rise of digital, the aesthetic has left the object—the record sleeve—and now the aesthetic is in the artifact: the iPod, not the music. The aesthetic has moved from the disc to what you play it on…and the iPod Mini will appeal to those who want an artifact for style…" (Bull in Khaney 2005, 26, ellipsis points in the original).

As we noted above, numerous authors have pointed out how the MP3 format and, more generally, the ability to download music, have had many impacts on the role of music in everyday life and its musicalization

(Le Guern 2017). In this context, the reference format is no longer the album but the track; listeners can build up and organize their personal music collections according to their own criteria, with an abundance of titles far beyond what once prevailed; moreover, discophilia, as an impulse associated with collecting, is transformed by the effects of streaming, which partially renders the material possession of albums obsolete. Music becomes less a physical good and more of a service. Before the spread of audio streaming, which is now the dominant mode of music consumption, listening practices were also transformed by technologies that allowed the easy exchange of files, which freed the listener from the previous ties of the *hic et nunc* of the album and the hi-fi. These changes were particularly noticeable in the controversies they aroused, one of which concerns the allegedly inferior audio quality of the MP3—due to signal digitization and compression. As communication studies scholar Jonathan Sterne (2006) notes, "[T]he MP3 is a medium which, in most practical contexts, gives the full experience of listening to a recording while only offering a fraction of the information and allowing listeners' bodies to do the rest of the work." In other words, the key point is not whether MP3s offer a subpar listening experience compared to the audiophile ideal but rather that MP3s "are meant for casual listening, moments when listeners may or may not attend directly to the music—and are therefore even less likely to attend to the sound of the music" (835) (see also Ghosn 2013). In this sense, the MP3 appears to be a compromise between sound and function and, as such, is neither more nor less compelling or genuine than vinyl, which is oft reputed to be warmer or more authentic. In other words, the perception of sound and the value judgments that accompany it—which are as much aesthetic as they are ethical—are, above all, a matter of conventions. As Sterne states, "To estimate which sound is 'good' or 'bad,' musicians have criteria corresponding to the socio-aesthetic dimensions of specific musical contexts and practices. We must do the same" (2005, 53).[37]

MUSIC CONSUMPTION

Furthermore, what the digital shift has brought into play in terms of music consumption is a new economy of musical discovery, or, rather, an economy of attention. Indeed, while the dominion of analog music was characterized by scarcity, it is the abundance of works and their accessibility that characterizes the era of the digital. P2P file trading made a plethora of works available to listeners at little or no cost, and, as Clément Combes and Fabien Granjon (2012) have pointed out, before subscription-based streaming became the dominant model for music consumption, bringing with it another form of abundance.

Unfortunately, it is not so easy to measure changes in music listening in quantitative terms. To demonstrate the transition from discomorphosis to digimorphosis in this way would require strictly comparable data over years, or even decades, which, for a number of key variables, is not available. Matt Brennan and Kyle Devine, who addressed this topic in a 2020 article, further emphasize the challenges here, noting the vast "number of variables one could potentially factor" in a quantitative study of this change (46). Scholars have tried to address this problem through two main types of analysis. One is to calculate the cost of buying music before the rise of streaming relative to the average purchasing power of an individual in a given population and compare that with the same relative cost after the rise of streaming. This is the work that Brennan and Devine do, and we will return to their discussion below. The other approach involves measuring listeners' investment in music not in terms of the money they spend but rather the amount of time they devote to music listening each day or week.

Regarding the economic cost of music, Brennan and Devine explored various archival sources, including those of the Sound Library in London, *Billboard* magazine, and the US Bureau of Labor Statistics. Taking the US as their case study, they sought information on the cost per unit of each format in its peak production year and the average weekly wage of an American citizen in those same years. This allowed them to calculate the percentage of an average weekly wage a consumer would have had to spend to buy recorded music in each format during its peak production year. Brennan and Devine show that a vinyl record cost $28.55 in 1977, a cassette cost $16.66 in 1998, a CD cost $21.59 in 2000, and a digital album cost $11.11 in 2013. While the price of

vinyl represented 4.83% of an American's average weekly wage in 1977, the price of its digital equivalent was just 1.22% of the average wage in 2013. Thus, the price of recorded music seems to have fallen over time for listeners.

Shifting to the streaming era, Brennan and Devine report that the average cost of a monthly subscription for an ad-free streaming platform is $9.99, which was just over 1% of the average weekly wage in 2018. The authors thus conclude that "this does not necessarily mean that consumers currently place less value on recorded music than at prior moments in history, but it does illustrate that the market value of recorded music is, broadly speaking, lower than it has ever been" (48–49). But price is not the only variable determining willingness to listen to more or less music. In France, the Département des études, de la prospective, des statistiques et de la documentation (DEPS) has for over fifty years conducted both quantitative and qualitative studies of French cultural practices. The interest of their work lies in its ability to outline long-term trends, with the DEPS conducting six major surveys between 1973 and 2018. From their research, music appears to be the most dynamic of all cultural practices. Drawing on these data, Philippe Lombardo and Loup Wolff observe that "Eight out of ten people aged fifteen and over living in metropolitan France listened to music in 2018: in 1973, the figure was 66%.… And while occasional listening has grown, it is daily listening in particular that has seen the most spectacular growth: in 2018, 57% of people listen to music every day or almost every day, compared with 34% in 2008 (a near doubling in a decade) and only 9% in 1973" (8).[38]

To explain this dynamic, two factors are put forward. On the one hand, DEPS surveys show the existence of a generational component: regardless of age, each generation listens to more music than the previous one. For example, for the 15-to-28-year-old age group, 20% of those born between 1945 and 1954 listened to music on a daily basis. This figure rises to 39% for the generation born between 1955 and 1964, 49% for the generation born between 1965 and 1974. The trend continues to the present, with 86% of those born between 1995 and 2004 listening to music daily. The DEPS survey covering the period from 2008 to 2018 shows a second factor contributing to the rise in daily music listening: the ever-increasing use of digital technologies. While one might think that this increase affects only parts of the population, such as the youngest or the most affluent, the opposite is true. Lombardo and Wolff (2020) note:

> It is striking to see the extent to which this dynamic, which is linked to the development of the digital, has affected all generations, and has done so in similar proportions. Ultimately, the combination of the generational dynamic, which began in the 1970s, and the dynamic linked to the digital turn in dematerialized music consumption over the last ten years, has resulted in a drastic reduction in the gap in [listening] practices between the youngest and oldest generations over the whole period.…
>
> The massification of daily music listening, which can be observed from one age group to the next, is also reflected in a reduction in behavioral gaps, not only between social categories and levels of education but also according to type of territory [rural versus urban listeners]. (10)[39]

It's easy to see how the digital shift could gradually lead to a profound change in the landscape of music consumption: by the end of 2023, 73% of people used licensed audio streaming services to listen to music, as highlighted in a note from the IFPI in December 2023. Further, the average weekly time spent listening to music increased steadily, reaching 20.7 hours in 2023.

Thus, it is no longer economic scarcity that limits listeners' music consumption but the time that is available to listen to music and the ability to draw relevant distinctions. How can we maximize our efficiency when discovering new music, when this process takes place in a universe saturated with recordings and when the inexhaustible availability of goods reduces our capacity for attention? Here we run into a question that is well known among economists who study consumer processes that take place when consumers have a high degree of uncertainty about the quality of a given product. In the case of digital music, the market is characterized by

an abundance of available goods, but the quality of those goods is difficult to observe *ex ante*. The challenge of the internet has therefore been to control information about musical works, and several studies have sought to evaluate the efficiency of the production of informational signals by examining the mechanisms of music discovery.

In this context, we should first note that the ways in which music is discovered have changed considerably over the last few decades. For example, some listeners remain attached to the experience of buying physical music. In 2014, independent shops accounted for just 3% of all music outlets in the UK, compared with 23% today (Beaumont-Thomas 2024). Despite this increase, it is clear that rummaging through the bins of a record shop to unearth a new album is no longer the dominant experience. One source states that in 2025, paid streaming, video streaming, and radio alone account for 61% of music consumption (Duarte 2025). Further, the catalogues of streaming platforms are expanding. In 2025, each of the main platforms (including Spotify, Deezer, Apple Music, and Tidal) claim to offer more than 100 million tracks (Newman 2025) and are constantly perfecting their recommendation and personalization systems. Deezer, for example, offers collaborative playlists, an AI recommendation tool (called Deezer Flow) that bases its suggestions on the taste and emotional state of the user, the display and translation of song lyrics, and detection of AI-generated content. While there were 1.5 million tracks on Deezer in January 2008 (Sharit 2021), there will be around 130 million tracks on the platform by 2025. In a world of abundance, one of the main questions facing listeners is how to find the right music among the plethora of tracks that are available.

Among the research on music discovery in the digital world is a 2019 study by Maisonneuve, who from 2013 to 2015 conducted interviews with music listeners between the ages of 17 and 34. After developing a typology of ways that listeners discover new music (e.g., algorithms, "likes," radio, the use of information categories such as artist name or genres, and interpersonal trust networks) and analyzing her data, Maisonneuve concluded that the population of digital natives is not homogenous, with the social class to which a listener belongs being a determining variable in their use of digital technology. Ultimately, traditional recommendation systems do not seem to have been abandoned for digital tools but rather coexist alongside them. She notes that

> if the circulation of [music] tastes, choices, and recommendation systems has changed in scale, this survey shows the persistent tension, on the individual level of the domestic economy of discovery, between the supply of music from *mainstream* [author's emphasis] sources and an individual's singular taste….
>
> …In short, while technologies have partially changed the ways in which amateur music fans make and consume music, they are still the ones who tinker with their discovery devices in the midst of a complex and partially opaque economy. (2019, 81)[40]

A related study was conducted by Louis Mélançon (2015), then a master's student and intern at Orange Labs, who interviewed ten Deezer and Spotify users. From a methodological point of view, his survey has the advantage of not targeting the most knowledgeable or committed music fans but rather those whom the author describes as casual enthusiasts. Partially echoing Maisonneuve's conclusions, he states: "The participants in the study still discover music largely through the traditional media channels of radio and television and show a reaction of indifference, if not distrust, toward the new recommendation tools found on Deezer and Spotify. That said, [in this study] we observed a greater openness to these automated tools among younger participants, which suggests that recommendation and promotion systems for new music streaming platforms will gain more influence in the near future" (Mélançon 2015, under "Conclusion").[41]

These systems, which involve in particular the deployment of recommendation algorithms, were studied more than a decade apart in two landmark theses, one by library and information science scholar Audrey Laplante (2008) and another by sociologist Quentin Gilliotte (2019). In 2008, Laplante interviewed fifteen

French-speaking Montrealers between the ages of 18 and 29, and she found that they depended mainly on their network of friends and family to discover new music. Nevertheless, their searches on the Web or in record stores were essentially serendipitous and were not driven by specific informational needs. Completed eleven years later, Gilliotte's thesis makes it possible to measure the changes that have taken place in music discovery. Based on some sixty semi-structured interviews and a questionnaire sent to two thousand internet respondents, his thesis—whose richness is impossible to summarize here—has the advantage of not focusing solely on young audiences. While Gilliotte studied the ways that many forms of culture are consumed online, music played a major role in his study. He observed an "astonishing articulation that takes place between the physical and the digital, and the high degree of singularity of practices. It is difficult to set in opposition the old and new worlds, because they continue to coexist, even if the development of digital technology has clearly changed the situation and balance of power. We [contemporary consumers of culture] are in a mixed landscape" (457).[42] This is particularly true when we place the use of individual media platforms or media technologies into context: choosing to listen on YouTube or Deezer corresponds to distinct aesthetic and experiential intentions. Likewise, listening to vinyl, rather than a digital file, is a way of "recreating the singular in a universe that lends itself to commonality" (*recréer du singulier dans un univers qui se prête à la standardisation*, 458), which the current vinyl resurgence seems to confirm (Hracs and Jansson 2017; Hracs and Webster 2021). Gilliotte observes: "The majority of those surveyed who consumed digital goods in the 2000s accumulated, stored, and ordered them according to criteria specific to those goods (e.g., by medium, author, date, genre, trend, etc.).… Things have changed, and today we observe a very clear weakening of interest in possessing cultural goods, a lack of file organization, and the deletion of content very quickly after consumption" (462).[43]

The use of recommendation algorithms constitutes a major turning point in the history of the process of music discovery. Psychologist Barry Schwartz (2005) and sociologist Nicolas Auray (2011) have questioned the aporias of unlimited cultural offerings and the effects that prodigal consumption is likely to have on consumers, which might include both a sense of increased well-being or, conversely, a sense of frustration and feeling of being paralyzed by too many options. Auray characterized this situation as a state of illimitation, one that arises from three factors—the profusion of titles, the immediacy of access, and the coexistence of new works with a plethora of historically significant ones. It is easy to see that the unlimited access does not merely confront the consumer with a situation that is time-consuming and depletes their energy; it also forces them to find efficient strategies for reducing the costs of discovery. Here, even the most insatiable music lovers can find themselves overwhelmed, and therefore paralyzed, by the immensity of the choices proposed to them. In such a context, algorithmic recommendation has become one of the main methods of cultural discovery and, implicitly, is capable of reconciling consumers' needs for familiarity, novelty, and relevance, which are the determinants in their confidence in the system. But does the promise of unlimited choice lead to an objective broadening of listeners' taste portfolios? Or, on the contrary, do algorithmic recommendations render the music lover's preferences more uniform?

Based on surveys about music consumption on streaming platforms, Bourreau, Gensollen, and Moreau (2017) sought to understand how consumers behaved when faced with unlimited offerings. At first glance, this landscape of abundance seemed to disorient music lovers, who prefer "star" products. And yet, in-depth analyses suggest a diversification of listening practices, as compared to the purchase of CDs or tracks listened to on the radio. Taking a different approach to the topic of music streaming, computer scientists Pascale Kuntz and Nicolas Greffard (2017) used automated methods to understand listeners' digital footprints, collecting music files saved on their personal computers and tracing tracks listened to on the internet, gathering a total of 100,000 file names and 10,000 tracks streamed; in addition, over a three-month period they captured the time of day and duration of each listening session. Although their method was experimental and needs fine-tuning, this way of observing the content and organization of personal digital music libraries offers an interesting epistemological alternative to traditional questionnaires and interviews. If we consider as an indicator the musical genres that

consumers listened to (on average, 30 per auditor), their findings suggest that downloading and streaming seem to promote eclectic tastes. Nevertheless, participants listened to some genres frequently and over long periods; they also listened to other genres in moderation but persistently over time, while they listened to a third group of genres with great frequency (though this seemed unsustainable, as they accessed this music for a shorter period of time). This analysis seems to be confirmed by data analysts Mark Levy and Klaas Bosteels (2010) in a survey of users of Last.FM, which showed that recommendation systems do not necessarily favor the most popular works.

DOES THE RECOMMENDATION STANDARDIZE TASTES?

Responding to the complexity of music listening in the context of abundance, streaming platforms have developed increasingly sophisticated recommendation tools (Celma 2010). According to one hypothesis, well summarized by sociologist Nancy Weiss Hanrahan (2016), "Instead of expanding our experiences by surprise or differentiation, [contemporary streaming] listeners instead expect to exert far greater control over the listening experience than those in the past, and for music to adapt to their needs" (75).[44] Should we thus conclude that recommendation systems, organized around similarities between tastes or aesthetic forms—and increasingly contextualized, personalized, or even adjusted to the emotional states of the listeners—necessarily lead to widespread musical conformism? Debruyne (2016) offers a nuanced perspective on this topic, noting that the internet is not the only way of accessing music, especially for great lovers of music "who are capable of pairing enough varied music sources to avoid conformist choices." He argues that we are witnessing "an ever-widening gap between [on the one hand] the great and specialized music lovers, who practice erudite listening…and, on the other, users confining themselves to the information distributed by the major sites and to the convenience of recommendation systems (satisfying their needs for [music] discovery that is well in line with their regular uses)" (85).[45] In related work, Beuscart, Coavoux, and Maillard (2019) analyzed "a corpus of activity traces from a random sample of 4,000 users of a music streaming platform that collectively constituted 17 million track streams over a five-month period of observation," seeking insights into the ways that "individuals may rely on these devices without relinquishing control of their experience to them" (21).[46] Their study was intended to help ascertain whether or not recommendation algorithms were creating passive, heteronomous listeners (i.e., those who delegate their tastes to a platform's software). They concluded that autonomous (self-directed) listening predominated over "guided" (i.e., heteronomous) listening, and algorithmic tools tended to enable an in-depth exploration of the richness of the music on offer. Indeed, regardless of the tools employed, 76% of users were autonomous listeners; algorithm-driven recommendations for titles, artists, and playlists accounted for just 8% of all listening; and guided listening accounted for less than a quarter of all listening. What is more, the use of recommendations varied according to musical genre: for example, recommendation tools are rarely used for film music, but they were much more widely used for genres such as blues or jazz. How can this difference be explained? The authors suggest that the second group of music genres is particularly well suited to "social activities other than [focused] listening and [these genres] are therefore more likely than others to be used as background music" (42).[47]

While these results are suggestive, precise information on the social characteristics of the listeners studied and the context of their use of streaming platforms would be needed to determine what they understand by the term "music discovery" and what is at stake—particularly in terms of attentional engagement—in their use of recommendation systems. (We would hasten to add that this caveat was not ignored by the aforementioned authors.) Additionally, such research would, ideally, make distinctions between the various recommendation tools offered by today's digital technology. Thus, one might ask whether a recommendation algorithm is comparable to an online music review site that makes prescriptive judgments about music or a discussion forum.

Further contributing to the literature on this issue, a 2018 article by sociologist Samuel Coavoux showed that it is necessary for researchers to clarify what is meant by the term "listening diversification." He shows that

"this diversification is relative, notably because it most often concerns artists with similar characteristics.… Thus, it appears that, because of digital recommendation systems, we listen to music that is slightly different [from what we would have selected without such a system], but not necessarily more varied" (36).[48] More recent work by Beuscart and Coavoux (2022) refines their theoretical model of algorithmic recommendation systems while continuing to assert they do not dominate user listening. Here, the central question is not whether algorithms guide our musical choices but whether they guide them well or poorly. The two authors propose to distinguish between two main uses to which recommendations are put: discovery uses (such as finding new artists or genres) and practical uses (finding ambient music best suited to an activity, such as riding on public transit or practicing a sport). In the second case, "the choice [of music] and the power to influence it is delegated to the algorithm, even if it seems unwarranted to speak of a loss of autonomy: it is precisely because the listener *prefers* [authors' emphasis] not to choose (i.e., not to spend their temporal and cognitive resources [on music selection and instead] devotes them to their main activity) that he delegates this choice" (5).[49] Looking to the future, the authors conclude that personalized recommendations will evolve toward an increasingly idiosyncratic model, where music suggestions will be tailored to each user in a fine-tuned way, taking into account not only their tastes but also their emotional states, activities, and other factors.

The impact of music recommendation engines on listening practice is complex, but as Magis and Perticoz (2020a, 2020b) point out, the fact remains that to focus on the question of the extent to which recommendation tools structure listeners' tastes is, perhaps, to miss the essential point—the commodification of listening activity by streaming platforms. Rather than developing these systems to better match supply and demand, the main aim of the new players in the digital music industry and their recommendation technologies is to monetize musical practices and tastes. To confuse the means (the recommendation system offered to listeners) with the ends (the commercial exploitation of listening practices) is to run the risk of losing sight of the entire industrial underpinning of the music economy (Bouquillion 2020). In this context, the few streaming platforms that have chosen an alternative recommendation model stand out. 1Dtouch, for example, has developed its own recommendation system based not on similarities but on dissimilarities, offering each listener works that are neither too close to, nor too different from, their existing music tastes and promoting a catalog of independent artists and labels (Claquin 2014).

However, it is quite possible—and this is an understatement—that between the time when Magis and Perticoz wrote their articles in 2020 and today, the stakes have radically shifted: with the growing sophistication of AI systems and the generalization of their uses, new issues have emerged that the music industry finds threatening. For example, in July 2025, the online magazine *Music Business Worldwide* discussed the case of Aventhis, a country music artist with over a million monthly streams on Spotify (Tencer 2025). However, there is no person named Aventhis: his music was created using two generative AI models, Suno and Riffusion. A June 23, 2025, article in *Le Monde* quotes Deezer AI's detection tool as saying that "18% of the music uploaded every day—that's more than 20,000 tracks—is entirely generated by AI models" (Chaperon 2025);[50] the article goes on to note that that rate was only 10% in January. What problems have emerged from this? First, the production of an overabundance of content in an already plethoric universe has had the effect of reinforcing listeners' dependence on recommendation systems and accentuating their heteronomy. Further, it is becoming more difficult for young artists to get noticed in an environment saturated with artistic offerings, one in which it is difficult, if not almost impossible, for listeners to distinguish between a song created by a human musician and one created by an AI. Finally, the phenomenon of "fake streams," in which algorithms initiate streams of AI-generated content, distorts the remuneration system of streaming platforms. Spotify has even been suspected of using AI models to generate "fake artists," which are then included on popular playlists; since these artists do not exist, they are not paid royalties (Goldschmitt 2020). Clearly, the eruption of AI on streaming platforms is raising issues ethical, aesthetic, legal, and economic.

THE DIGITAL SHIFT AND ORGANOLOGY: FROM INSTRUMENT TO DEVICE

THE MUSICAL INSTRUMENT IN THE DIGITAL LANDSCAPE

The composition and interpretation of a score by an instrumentalist is one of the foundations of Western art music. Whether described as scholarly, traditional, or popular, pre-electronic music is based on the instrument and the instrumentalist's playing (Sève 2013). If it is not played, an instrument is in effect mute, and it is the action of playing that is thus decisive in bringing music to life (Schaeffner 1936). In his book on jazz, ethnomusicologist and anthropologist André Schaeffner (Schaeffner and Coeuroy 1926) insists on this point by bringing up the unique use of the saxophone by Black jazz artists in the United States, asserting that only a particular body engaged in a particular kind of musical performance on an instrument can generate a particular sound. In 1998, the musician Prince declared, "I'm a musician… I don't sample. I go onstage, my microphone is *on*" (BET Tonight 1998). His famous adage "real music by real musicians" refers to the idea that music must be played before it can be considered as such. Any foray into new technologies is often viewed with skepticism, if not rejection, and playing is often seen as the only form of authentic musical practice. The making of acoustic musical instruments depends upon a fairly simple principle, one that is closely related to these ideas: the sound produced by an instrument is directly related to the instrumentalist and their playing technique. In the digital landscape—if we take the operation of a digital synthesizer, sampler, or drum machine as an example—everything is radically different. Their construction responds less to principles of acoustics than to technical or electronic logics. "Given these fundamental differences," writes music and technology researcher Paul Théberge (1997), "the speed with which these new instruments have been adopted as a part of general practice in the production of popular music has undoubtedly contributed to a sense of unease with technology" (2).

The invention of the telephone and the phonograph, which marked the beginnings of music's industrial revolutions, transformed our relationship with sound, voice, and music, which could hereafter be transmitted remotely and recorded. The developments that followed—first with analog electronics and later using digital technology—further distanced the playing body from the instrument. Electricity replaced the manual energy of playing traditional instruments, and the symbolic encoding of computer technology brought about a radical detachment that increased this distance. This idea aligns with computer music researcher Claude Cadoz's concept of the "cut-off" (*séparation*) (1990, 3), which describes how the computer introduces a rupture between sound and its physical cause, severing the direct gestural connection between a performer and the production of sound, which is now achieved through the digital music interface. The evolution of music technology bears witness to a new definition of social value that sees us move away from a world that valued manual labor and toward one based on technical information. Musicologist Nicolas Donin and philosopher Bernard Stiegler (2004) speak of an "industrial invasion of music" (*invasion industrielle de la musique*) to describe the expansion of organology that came about through music's industrial revolutions: the consequences of this robust transition are as much artistic as they are cultural and social. For Donin and Stiegler, people who practice music are no longer only musicians, listeners, or performers but also consumers and users. For Cadoz (1999), there is no way to compare music based in new technologies and traditional, acoustic instrumental music. Indeed, traditional musical gestures are based on the energetic continuity of sound and do not call upon any other source of energy outside of the human body. This is not the case with amplified music. These new technologies have transformed the material conditions of sound production. Here, the sound production chain cannot be analyzed according to past criteria, and electronic systems cannot simply be defined as a new form of lutherie. Digital music involves transforming mechanical phenomena and gestures into symbolic computer code, and, later, turning that code into sound. With this in mind, Cadoz (1994) describes a musician's gestural interaction with an electronic instrument as transduction, a process that converts one physical phenomenon into another. This understanding

of the gestural interaction between musician and electronic instrument applies to both digital music and analog electronic music, thus folding the period of analog synthesizers and magnetic tape players into the digital era.

Conversely, the term "electronic music" is often used to refer not just to that of the older synthesizers and tape machines but also to that of digital computers. As Miller Puckette, who invented Max/MSP (a visual programming language designed for creating and processing sound) and Pure Data (an open-source visual programming environment for real-time audio and multimedia processing), states in the preface to his book *The Theory and Technique of Electronic Music*, "Nowadays most electronic music is made using computers, and this book will focus exclusively on what used to be called 'computer music,' but which should really now be called 'electronic music using a computer'" (2007b, xi). (Max/MSP and Pure Data are discussed further below.) It is worth noting that this passage appears to use the term "electronic music" to refer to both a musical genre and a mode of production, thus conflating these ideas. While electronic instruments and computers are commonly used in music production today, the term "electronic music" has, in the past, referred to specific genres and artistic movements, rather than a mere technological process. Further, Puckette's statement must be understood in its historical context. Since it was written nearly twenty years ago, it reflects a time when digital production tools were still evolving, and the distinction between "computer music" and "electronic music" was more pronounced. Since then, the widespread adoption of hybrid technologies has blurred these boundaries, making the relationship between digital tools and musical genres even more complex.

THE QUESTION OF INSTRUMENTALITY

In this text, we do not use the term "instrumentality" in its usual sense (i.e., the quality or state of being "instrumental," using someone merely as a means to an end) but rather to refer to an instrument's "transformative capacity," its inherent ability to transform and express sound in creative ways. Understanding the shift in instrumentality that came with electronic and digital technologies in music requires us to trace the larger evolution of musical instruments themselves, particularly the emergence of electric sound production techniques in the nineteenth and twentieth centuries, which served as a precursor to the upheavals brought about by digital technology. These developments enabled composers to explore new timbres with instruments such as the Telharmonium, Hammond organ, ondes Martenot, and theremin. Phonography, which enables the fixation and reproduction of sound, also becomes gradually integrated into the act of musical creation. Thus, in John Cage's (1939) *Imaginary Landscape No. 1*, for example, the sound of traditional instruments is mixed with electrophones and record players. While this approach incorporates prerecorded sounds, it differs significantly from Pierre Schaeffer's later development of *musique concrète*. Cage's experiments, which relied on indeterminacy and live manipulation of electronic sound sources, were conceptually and technologically distinct from Schaeffer's method of capturing, manipulating, and recontextualizing recorded sounds as compositional material. As musicologist Marc Battier (1995) notes, with Schaeffer's *Étude pour chemins de fer* (Study for railroads) in 1948, we witness the paradox of a music that is sometimes without instruments, and constructed through "the search for new sources of sound" (*la recherche de nouvelles sources sonores*, 50–51). The "art of fixed sounds" (*musique de sons fixés*), introduced much later and primarily associated with Michel Chion (1991), is not synonymous with musique concrète in a general sense but rather represents Chion's own theoretical refinement of the concept. While musique concrète emphasized the manipulation of recorded sounds as compositional materials, Chion's musique de sons fixés places greater emphasis on the finalized, definitive nature of recorded sound as an autonomous medium. Chion introduced the notion of musique de sons fixés to account for the evolution of electroacoustic composition beyond Schaeffer's initial framework, incorporating advancements in digital technology and broadening the scope of fixed-media music beyond Schaeffer's original theoretical and aesthetic boundaries. Whereas musique concrète was initially tied to Schaeffer's ideas about reduced listening (*écoute réduite*) and the sound object (*objet sonore*), musique de sons fixés encompasses a wider range of practices,

including contemporary acousmatic music, and highlights the finality of recorded works as unchanging entities that exist independent of live performance. With electronic music, the object of research is sound itself, whether it is recorded or synthesized. The challenge here is to "compose the sound itself; to play time directionally, instead of arranging sounds in time" (Risset 1999, 24).[51] In other words, composers of electronic music do not merely arrange sounds sequentially on a time line; instead, they actively "play" with time itself—manipulating its flow, direction, and structure as creative elements. Rather than simply positioning sounds in time, they treat time as a malleable medium that can be stretched, compressed, or reoriented to generate dynamic musical effects. As Battier (1992) explains, the synthesizers built by Robert Moog and Donald Buchla allow "an interconnection of functions, each with its own mode of access and settings. Control [of these functions] is either manual or obtained via control voltages from various devices: keyboards, amplitude-voltage converters (envelope follower), pitch-voltage converters (pitch follower), [or] specific sources of control voltages.… [T]hese controls allow live performance" (62).[52] In a similar vein, Gille Deleuze and Félix Guattari ([1980] 1987) note that the synthesizer "makes the sound process itself audible, and puts us in relation with other inky elements that go beyond sound matter" (423–424).[53] With these new instruments, the musician gains additional agency by being able to control, on a microscopic level, sound itself.

In the new world of digital technology, we are witnessing the development of entirely new devices for making music, from simple gestural interfaces to instrumental objects that challenge the very notion of the musical instrument. In the field of experimental music, Pierre Couprie's (2018) study of these new interfaces—including Max Mathew's Radio Baton, Tod Machover's hyperinstruments, the Lady's Glove of Laetitia Sonami, or Atau Tanaka's BioMuse—has identified many of the questions that these new devices raise. Couprie (2018, 4) quotes Atau Tanaka (2011, 238), who writes: "Is the instrument just the sensor hardware [for registering the performer's gestures], or does it include software components like the mapping and sound synthesis software subsystems? Where does the instrument end and the composition begin? Is the entire system specific for one musical work, or can parts of it (e.g., the synthesis or compositional components) be altered or generalized to create different works for the same instrument? What happens to the boundaries distinguishing traditional roles of instrument builder, composer, and performer?" Drawing on the work of Anne Veitl (2001, 69), Couprie (p. 4) asks: "Are these new interfaces merely [what Veitl calls] 'quasi-instruments' that 'lean towards an instrumental relationship' without ever succeeding? Is the computer irremediably doomed to never become a musical instrument, or to remain a simple interface for instrumental communication?"[54] Clearly, the novelty of music in the digital landscape is a result of the central place that the computer occupies in the process of music creation. As for the question of the computer's instrumentality, musicologist Bruno Bossis (2010) holds that a device used for music-making

> can only be considered to be [a musical instrument] if it includes the complete chain from gesture to sound emission, or at least to an electrical signal analogous to this emission. An amplifier is not considered a musical instrument, unlike an electric guitar, keyboard synthesizer, sampler, or modular synthesizer. A computer is not any one of these things, but if it has a sound input or gestural interface, synthesis or processing software, and a sound output, then the whole device can be considered a musical instrument. (120)[55]

From this perspective, the instrumentality of the computer necessarily requires its integration within a device that includes sound-producing interfaces. It should also be noted that the ability to connect a computer with an external interface and other devices was made possible by the introduction in the 1980s of the MIDI standard, which enables communication between these different elements (Rothstein 1995). Also relevant here is the work of musicologist Madeleine le Bouteiller (2020) and music theorist Mark J. Butler (2014), who clearly demonstrate the performative and instrumental dimensions of laptop use in electronic music. They underline

the importance of Ableton Live, a well-known software package, in the democratization of this practice and the development of interfaces whose very design reproduces the graphic interface of recording applications to create new gestural control possibilities.

INFRASTRUCTURES AND DEVICES

As Puckette (2007a) observes, "The main advances in live computer music performance have largely consisted of building an infrastructure, so that now a musician can combine a computer, audio and control hardware, and software (Pd [Pure Data] being one possibility) to make a live interactive computer music application" (1). In digital music, the term "device" is used to refer to such an apparatus—a heterogeneous ensemble of technologies (e.g., a computer and interfaces) operating in a network (i.e., communicating via MIDI) that functions to produce music. In sum, digital music places the computer at the center of a device, around which a set of interfaces form an infrastructure. This infrastructure creates the possibility of live music performances that include the computer and thus enables us to inscribe computer music in the continuity of traditional musical practice. In this context, Bossis (2010) states there are three elements to any digital music device: sound inputs or gestural interfaces, synthesis or processing software, and sound output.

As far as entry points or inputs are concerned, there can be several types. They can include instruments, in the traditional sense of the term, either amplified ones (e.g., the electric guitar) or electronic ones (e.g., the synthesizer). Typically, the musician plays their input device, and the sound signal enters the computer to be processed to varying degrees. In a 2019 interview on the website of Cycling '74, the software company that publishes Max/MSP, Austrian musician Christian Fennesz describes his transition from instrumental to digital music and the way that traditional instruments can serve as entry points: "I played in punk, rock and jazz bands when I was young. Virtuosity was my first goal. This completely changed when I got my first sampler. Sound and sound manipulation became the real challenge. I play simple. Just a few tones, a few chords, but it has to sound strong.… My setup consisting of laptops, Max/MSP, guitars, pedals and a mixer works perfectly well for me. The guitar is basically a sound generator now" (quoted in Martin 2019, under second question).

It is interesting to note how digital technology has shaken up our relationship with the traditional instrument. Virtuosity and the quality of playing, which were critical for musical practice before the digital shift, have now lost their centrality. In a digital context, the instrument becomes a sound generator—one input among many. The sound produced by a traditional instrument like the guitar, for example, enters the computer via an audio interface, where it is processed by software like Max/MSP. Describing his work in developing that software in the 1980s at IRCAM (Institut de recherche et coordination acoustique/musique, the noted French research centre), Puckette (1997) states that "Max was an attempt to make a screen-based patching language that could imitate the modalities of a patchable analog synthesizer" (37). Enabling sound synthesis, analysis, recording, and MIDI control, Max/MSP allows the user to create such virtual "patches," linking together components through a visual interface that is similar to the electrical cables and input jacks used in the previous generation of analog synthesizers. In effect, this gives the user the capacity to program the software's functions visually. This is how Fennesz describes his use of Max/MSP's patch interface: "I've been using this for many years, and I've gotten really used to it—this is my main software for live playing. It gives me everything I need: a sampler, loop player modules, a few synths, effects, audio in, audio unit/vst [Virtual Studio Technology plug-in] connections, MIDI controllers, etc. It's like a toolbox or a studio on your laptop" (quoted in Martin 2019, under fourth question).

Here we find an excellent example of a device where all the elements that could have been present in the form of external hardware (e.g., samplers, synthesizers, effects pedals) are brought together in a single box and connected by the software patch itself, giving the musician the possibility of controlling everything through the same interface. Puckette went on to develop Pure Data, a piece of open source software that built on the work in Max/MSP and included many additional functions. According to Puckette, Max's success resulted from

the conjuncture of several events: "the rise of the Macintosh, the arrival at IRCAM of [Giuseppe] di Giugno's 4X machine (which provided the problem that Max had to solve), David Zicarelli's brilliant work in getting Max published (not to mention his almost rewriting the entire program, much to its improvement), and the contributions of Zack Settel, Cort Lipper, Philippe Manoury, Chris Dobrian, David Wessel, and literally dozens of others to the design, documentation, and creative abuse of the program." As he concludes, "The success or failure of Pd [Pure Data] will ride as much on its finding a similar community [to the one Max did] as on its design specifics" (1997, 40). In other words, the best measure of a software's success is its community of users, as demonstrated by Digital Audio Workstation (DAW) applications like FL Studio, Ableton Live, and Logic Pro, which are some of the world's most popular software products.

Above, we gave a technical definition of the term "device" as a networked collection of digital music-making technologies, like a computer and its interfaces. Here, we give another definition and go beyond this to suggest that digital music itself can be understood as a "device" or "apparatus" in the Foucauldian and Agambenian senses—an interconnected system of technological, institutional, and discursive elements that shape musical practices and subjectivities. According to Michel Foucault ([1976] 1978), the *dispositif* (often translated as "apparatus" or "device") is not merely a collection of tools but a strategic configuration of heterogeneous forces—including technologies, institutions, norms, and knowledge systems—that govern behavior and define modes of experience. Giorgio Agamben ([2006] 2009) extends this notion to define an "apparatus" as a structure that captures, controls, and orients human actions, producing specific ways of being and interacting with the world. Within these frameworks, the computer and its associated interfaces do not function as neutral tools but as active agents that structure the very conditions under which music is produced, performed, and conceptualized. DAW software environments, like Max/MSP and Pure Data, and MIDI-based control systems mediate artistic expression by imposing particular workflows, aesthetic norms, and technical constraints on the user. Further, the apparatus of digital music, in the senses defined above, is not limited to hardware and software; it also includes the institutions that regulate digital music production (e.g., record labels, streaming platforms, and copyright frameworks), the knowledge systems that define its practices (e.g., computer music pedagogy and algorithmic composition methods), and the broader cultural and economic forces that shape its dissemination and reception. This perspective highlights how digital music operates within a network of power, knowledge, and aesthetics. The increasing reliance on algorithmic recommendation systems, the standardization of production techniques through popular DAWs, and the emergence of AI-assisted composition all exemplify how digital tools do not merely facilitate creativity but actively shape the possibilities of musical expression. In this sense, digital music is not only a creative medium but also a site of negotiation between artistic agency and the structural forces embedded in the apparatus that governs it.

DIGITAL AUDIO WORKSTATIONS: BETWEEN THE DEMOCRATIZATION AND THE NOMADIZATION OF CREATIVE PROCESSES

The notion of "software omnipotence" (the ability to include all music-making functions in a single application) has been a development strategy for many DAWs. FL Studio (which was originally released under the name "FruityLoops") is a good example. According to artist and writer Jace Clayton (2016), FL Studio, unlike Max/MSP, offers users an almost disconcerting ease of installation and the ability to begin composing instantly once installed thanks to the software's pre-installed sample packs and virtual instruments. This accessibility has led to the widespread democratization of digital music-making. As Clayton explains, "People who couldn't afford studios or instrumental lessons (or didn't want them) could coax an idea into form while the inspiration lingered. Newbies were able to sketch out a rough song in minutes, then copy/paste in quick variations. All of this proved particularly handy to kids who'd grabbed pirated versions without instruction manuals or couldn't read the language(s) they were written in" (179). The ease with which FL Studio can be installed and used makes it

exemplary of the democratization and globalization of digital music-making, and its basic, pre-installed sounds can be heard in music genres from reggaeton to rap and even techno. The 2007 hit "Crank That (Soulja Boy)," by the rapper Soulja Boy, from the album *Souljaboytellem.com*, is said to have been composed in ten minutes using the famous pre-installed sample library Stock Sample Legacy Kit. The highest paid international DJs, such as Avicii, Deadmau5, and Afrojack, produce with FL Studio. Thus, from the biggest EDM festivals to the home studios of Cartagena, which gave us the sounds of Colombian Champeta (Paulhiac 2018), FL Studio dominates many genres of music. As Clayton notes, "It's safe to say that FL Studio [simply] is digital music-making across sizable chunks of the planet" (2016, 179).

The computer's central role in the music production process has come about through the software omnipotence of contemporary DAWs, which concentrate the sonic and musical possibilities of an entire studio into a single object (Strachan 2012, 120). Thus, more than just a recording space, the studio has become a tool of composition (Bell 2018) and is being transformed yet again by digital technology, which has shrunken the studio, integrated it directly into the personal computer, and made it portable.

To use the terminology of Deleuze and Guattari ([1980] 1987), one could say that the digital audio workstation "deterritorializes" and "nomadizes" creative processes, severing them from their link to a single physical location. "Every place, every journey becomes a recording session," notes a TV5 Monde reporter in a video that showcases the DJ David Guetta composing his next hit in a cab between his hotel and the airport using an Apple MacBook laptop and a small 25-key MIDI keyboard (TV5 Monde 2012).[56] Curled up in the back of a cab with this ultra-minimalistic device, Guetta declares, "Before it would have been a huge tape recorder that would have taken up a crazy amount of space."[57] The next sequence shows him working on the same track with Ableton Live aboard a private jet. The TV spot ends with a scene in a large Moscow nightclub, with the artist at the turntables playing the demo during his set, in order to test the track's potential "in real life." Later, that humble melody composed in the back of a cab would become the gold- and platinum-selling hit "Who's That Chick?" featuring Rihanna, which topped the world charts in 2010 and 2011. The digital shift has been pivotal to the current globalization of music, where recordings are untethered from the process of manufacturing physical media and are broadcast through as many loudspeakers around the world as possible.

Inspired by the graphic processing of early consumer office software, the DAW reinvented the language of composition, resulting in new mechanisms of abstraction and gestures that are new to the act of composing, such as pointing, clicking, zooming, and cutting and pasting (Duignan, Noble, and Biddle 2010). In the mid-1990s, software functions and interfaces were standardized, and the new software enabled the user to perform all of the tasks involved in producing a piece of music. These included using audio recording and processing functions, playing virtual synthesizers and samplers, controlling step-by-step sequencers, and applying audio and MIDI effects, all of which are visually organized around superimposed windows and drop-down menus. These visual and conceptual elements of DAWs—which, at this point, are considered indispensable—have become fully integrated into the practices of users, the vast majority of whom are digital natives who view this approach to information processing as completely logical. The standardization of the DAW's functions and the elements of its graphical interface show that the intuitiveness and affordances of this technology are the fruit of a gradual process of acculturation, through which users acquired the specific skills needed to work with the software (Strachan 2012). We are therefore witnessing the birth of a new model for being a musician: that of the software user who extends their skills beyond mere interpretation or composition. As music education researcher Adam Patrick Bell (2014) shows in his case study of a home studio musician, the introduction of DAWs not only enabled the musician to play everything on their own but also progressively broke down the barrier separating musicians from sound engineers. It is worth noting in closing that while the sonic results produced by today's home studios can rival those of professional studios (particularly for electronic-based music), professional studios continue to offer distinct advantages for recording acoustic or acoustic-electric music—especially those projects involving large jazz ensembles or rock bands tracking live in multiple spaces.

GOING DIGITAL: TECHNOLOGIES, AESTHETICS, AND (POST)GENRES

Just as amplification led to the development of rock music, the digital shift spawned a host of new musical genres, a process that started in the 1990s. Moreover, just as it is impossible to imagine the golden age of the sonata without the development of the piano forte, it is impossible to think of the advent of genres such as jungle and drum 'n' bass without the sampler. Here, we shall show how the practice of sampling, combined with the use of the internet, has given rise to subcultures specific to the Web. As independent researcher Victor Dermenghen (2019) has argued, "With the advent of the internet, a musical landscape composed of a finite number of genres and subgenres has been replaced by an indivisible spectrum. The constellation of semi-autarkic scenes has been transformed into a complex, border-blurring network.…It is as if this history…[of] pre-internet music that is still attached to spaces and people is swallowed, digested, and spat out, feeding a constant flow of protean music" (141).[58] Indeed, what is new about the digital shift is that it is impossible to understand the notion of genre or aesthetic without grasping its online development. Genres are born on the Web, in connection with streaming platforms. For example, the aptly named genre SoundCloud rap (also known as "cloud rap") bears the name of an online audio distribution platform, and the genre of hyperpop, discussed further below, was created by Spotify after the eponymous playlist created by that service. These Web subcultures are at once genres, scenes, styles, and aesthetics, and they develop as part of a network. Oscillating between modernism and postmodernism, these new cultural forms are the product of politically engaged and even critical subject positions that, nevertheless, occasionally strike one as detached or obscure their meanings under a layers of irony (Morrissey 2021).

SAMPLE, COPY, AND PASTE

It is important to note that the increased speed of music production in the 2000s is largely due to new digital composition techniques, including sampling and the ability to copy and paste. Sampling is the fruit of much controversy, and today the term can be used in four ways (Kvifte 2007). The first involves the transition from analog to digital, from continuous to discrete. Sampling in this sense is the process of turning an analog signal into digital information using an analog-to-digital converter; here, a continuous signal is converted into discrete values, with the physical waveform measured at regular intervals. Each of these measurements is called a "sample." The second use of the term "sample" refers to instruments called "samplers," which play digital recordings (called "samples") of a note or sound from an acoustic or electronic instrument. Generally speaking, samplers are played using a keyboard or controlled using music production software. Following the principles of its analog predecessor, the Mellotron, the Fairlight CMI was the first digital sampler. With today's sample libraries and sampling software, such as the Vienna Symphonic Library and the Kontakt app, one can access recordings of every note on every instrument in a Western orchestra and play those notes back on a keyboard. The third way that the term "sampling" is used is to refer to the act of including part of a past recording in a new work or performance, a practice that is not unlike including a quoted passage in a written work. In this case, the sample is the musical passage that is recorded and then reused. Its duration can vary from a few seconds to several minutes. Below, we shall see how this technique has become a launching pad for several internet subcultures, including nightcore and vaporwave. Finally, the term "sample" can refer to practices of copying, pasting, and editing a passage of a recording made in the studio to improve a recording or erase flaws in an arrangement or performance. Contemporary music production software allows the computer to perform sampling in all four senses of the term, allowing the music to produce a track quickly. With sampling, all available recorded music, reduced to an ocean of usable data, becomes fodder for music-making.

FROM BREAKS TO DECONSTRUCTION

As the Akai S1000 sampler became a standard part of the production arsenal in the mid-1990s, sampling was elevated to an art form by artists such as Omni Trio and LTJ Bukem. The quasi-surgical manipulation of samples enabled by pitch-shifting, time-stretching, and time-compression algorithms allowed for the development of the breakbeat, which entailed its own aesthetics. Rough and syncopated, the breakbeat gave "rhythm its space and tension, even at high speed" (Sharp 2004, 178).[59] Also noteworthy in this history is the Steinberg ReCycle sample manipulation software, which enables users to separate a percussion loop into its component parts and reassemble them in various ways, giving rise to mutated, evolving polyrhythmic landscapes. Such techniques were adopted by Richard D. James, Luke Vibert, and Squarepusher, who took the famous Amen break (which was sampled from the song "Amen, Brother" by the Winstons) and raised sampling to a new level of complexity. With Aphex Twin's singles "Come to Daddy" and "Windowlicker," this extreme destructuring of rhythm, which was characteristic of the drill 'n' bass genre, met a degree of success, despite the singles' rather distant—ironic, even—attitude, an approach that contrasts sharply with the very danceable styles that inspired them (Reynolds 2012).

When pushed to the level of deconstruction through the use of audio processing software, sampling of this kind induces a distancing effect in relation to its source recordings, producing music that leans more toward ironic recontextualization than homage. This deconstruction gives rise to hybrid forms of music, such as the post-club styles born within the margins of SoundCloud. Represented by artists such as Arca, Lotic, and Fatima Al Qadiri, post-club music freely combines multiple genres. Here, "hybridity becomes the order of the day, with mixes of hardcore and afrobeat, trance and reggaeton. These crossovers open up a world of possibilities, sometimes blurring the lines to the point of articulating (or dis-articulating) a post-genre music whose genealogy becomes unclear" (Dermenghen 2020, para. 3).[60] Indeed, the post-club aesthetic can be traced back to the so-called intelligent dance music (IDM) of the 1990s. But while IDM was heavily imbued with sarcasm (Butler 2006), post-club music (also called deconstructed club, mind club, or conceptronica) is, for its part, marked by a more critical posture, which sits somewhere between post-structuralism and queer feminist activism (Reynolds 2019).

SPEEDING-UP AND SLOWING-DOWN

In "Seapunk et vaporwave: Esthétiques prospectives de deux hétérotopies virtuelles" (Seapunk and vaporwave: Prospective aesthetics of two virtual heterotopias), arts and gender theory researcher Kévin Bideaux (2022) asserts that "the internet has become an experimental ground for creating new modes of communication, socialization, and expression. Anonymity and the speed of diffusion allow for the emergence of web cultures with new aesthetics, music, and fashions" (1).[61] These micro-subcultures are born of a certain kind of sampling practice that centers on deconstruction and recontextualization. In her study of the related nightcore genre, music theorist Emma Winston (2017) draws on the notion of "micro-subculture," which was conceptualized by Helen Reddington (2007) in her writings about the early female punk scene and refers to small, highly specialized cultural groups that form around niche interests, often within music, fashion, or digital communities. These groups distinguish themselves through unique aesthetic choices, modes of communication, and shared values, often facilitated by digital platforms that allow for the rapid circulation of cultural artifacts. With nightcore, this concept—originally applied to very geographically localized music scenes—is on the move. Winston describes nightcore as a multi-sited micro-subculture within the wider context of online music. Born in the early 2000s, nightcore was originally characterized by electronically accelerating the tempi of electronic trance, Eurodance, and dance-pop tracks. This acceleration of the original track results in changes in pitch, most noticeably in the vocals, which are set much higher than those of the original. Frenetic and joyful, it bears a strong resemblance

to happy hardcore, which emerged in the early 1990s. The most interesting aspect of nightcore is the ease with which it can be produced, with the main musical ingredient being speed. The most inexperienced amateurs can create nightcore tracks by doing little more than increasing the tempo and pitch of a song of their choice, using accessible software such as Audacity. Winston (2017) notes: "Based upon the overwhelmingly positive feedback simple speed-edited nightcore tracks receive on social media, subcultural capital and status [for nightcore participants] do not seem to be tied exclusively to the addition of original compositional elements.… One result of this is that virtually all nightcore fans, at least on SoundCloud, also appear to be nightcore producers themselves, posting their own mixes of tracks as well as reposting those they have enjoyed by others" (7–8). In this, we see another example of the digital shift leading to an apparent democratization of access to music-making. Creating a nightcore track can involve nothing more than time-stretching and sampling in its simplest form, with a single nightcore track consisting of a sample of an entire song or most of one. Here, minimal techniques have served as the origin of an entire micro-subculture, one that includes a musical aesthetic, a genre, and a scene, where the boundaries between fans and producers are blurred.

This uninhibited use of sampling and the adjustment of playback speed is at the heart of another micro-genre, vaporwave, which is characterized by slowed tempi, the lowering of pitch, and the deconstruction of tracks from the soft rock, commercial background music, or easy listening repertoires of the 1980s. Assuming a critical stance toward late capitalism, the vaporwave aesthetic also draws on the history of the internet, using sonic and visual references from the early period of the Web, Windows computers, and computer-generated graphics (Morrissey 2021). In vaporwave recordings such as *Chuck Person's Eccojams Vol. 1* by Oneohtrix Point Never, who contributed to the early development of this aesthetic, sounds are cut up, distorted, and slowed down. The genre's visual elements are distorted as well and often include retro-futuristic imagery, glitch art, a kind of corporate nostalgia that draws on advertisements and the digital aesthetics of the 1980s and 1990s, and surreal digital collages. Its visual elements are commonly seen in album art, music videos, and fan-created graphics that accompany tracks on platforms like YouTube. Virtual album art frequently features neon grids, distorted text, and references to obsolete technology (e.g., Windows 95 or the signal degradation associated with VHS tape). Vaporwave artists often pair their music with slowed-down versions of commercial background music or repurposed footage from old commercials and public access television to evoke a dreamlike, eerie sense of nostalgia.

As visual as it is musical, the vaporwave aesthetic unfolds through the efforts of a new kind of figure: the digital consumer as cultural curator. Amplified by Web 2.0, curation as a cultural practice revolves around the remixing of images and sounds to create new content. Consumer researcher Sharon Schembri and psychologist Jac Tichbon (2017) observe that in vaporwave, "Use of 1980s music extracts as repetitive and reinvented samples enables a nostalgic commentary that is ironically achieved with digital technology. More than that, remixed 1980s music as an artifact of that burgeoning era of consumerism enables a critical commentary that is repackaged as an artifact of hyper-reality" (197). A similar use of sampling can be found in Lofi hip-hop, yet another internet micro-genre of the 2010s. Marked by the use of samples from jazz or popular music to make instrumental hip-hop tracks, the micro-genre's beats are characterized by the producer's intention to digitally recreate analog sonic artifacts such as tape hiss or the crackle of vinyl (E. Winston and Saywood 2019). Thus, and this also applies to vaporwave, this false sonic patina and the use of samples of bygone music invite the listener into a recontextualized nostalgia—one that imagines a past that never existed. This form of retromania recalls Simon Reynolds's (2011) work on the music of the 2000s, when the obsession with "sounding like" the records of the past first took hold (19). As art theorist Nicholas Morrissey (2021) observes,

> both Vaporwave and Lo-fi have been criticized for their ease of production; Vaporwave has been equated to slowed eighties pop songs, and Lo-fi has been mocked for its simple construction. However, these criticisms miss the main point of both genres: Vaporwave and Lo-fi are

> supposed to manifest their meaning within their listeners, not the works themselves. Artists of each style continuously follow rules and tropes because they and their audiences admire the ideas and feelings that come with these tropes over any sort of existential or philosophical discoveries they might make. This value is evident in the oscillation between sincere and ironic works within the community, and the lack of a central "manifesto." While the genre does have many conventions, there is no central authority that dictates them. Such an approach would be detrimental to vaporwave and its internet motifs, including anonymity and meme culture. (78)

DIGITAL VOCALITIES, POST-HUMANITY, AND GENDER FLUIDITY

Techniques and devices of voice manipulation are increasingly common in the digital era, and they take many forms. These can include the vocoder and similar devices, which allow a musician to sing or speak into a microphone and modulate a synthesized sound; the digital manipulation of vocal samples taken from vinyl or any other audio recording medium, which is found in a wide range of electronic musics, such as hip-hop and dance music; pitch correction using autotune software, which, when pushed to its limit, gives the voice a characteristic metallic timbre (Auner 2003, 98); and, finally, vocal synthesis applications, such as the software Vocaloid, developed by Yamaha, which can create a synthesized voice when a user inputs lyrics and melody (Kenmochi 2009). The synthetic, singer-less voice capabilities of Vocaloid gave rise to the creation of the application's globally famous muse, the virtual pop star Hatsune Miku (Le Guern and Guesdon 2016).

While many changes in vocality discussed in this section were initially brought about by early technological shifts in music production and distribution—such as the invention of the phonograph and radio broadcasting (Donin and Stiegler 2004)—the transformation of the voice truly gets under way with digital technology. In music production today, the prosthetic devices that are used to treat the human voice often confuse it with instruments (Navarret and Fontaine 2020), creating new conceptual and perceptual frameworks and introducing new archetypes for sound that gradually distort the voice, stripping it of its emotional familiarity and thus relegating it to the same level as any other sound source. Musicologist Joseph Auner speaks of "post-human ventriloquism" (2003, 98) to refer to the complex blurring of the human-machine distinction caused by the manipulation and simulation of the voice by new digital technologies. Digital voice processing has gradually become the norm in music production, so much so that hearing an unaltered voice is an exception in contemporary and popular musics.

Among these vocal prosthetic devices, two are closely related and employ the human voice as a sound source: the vocoder and autotune. Often confused by untrained ears, these devices nevertheless differ greatly in the timbres they produce and in their modes of operation, since vocoder technology is linked to analog synthesizers and autotune is a digital pitch correction effect. Developed by physicist Homer Dudley, the vocoder (an acronym for Voice Operated reCorDER) and Voder (Voice Operation DEmonstratoR) emerged in the wake of research at Bell Labs, in the US state of New Jersey, and represents the first successful attempt to analyze and resynthesize the human voice (Mills 2012). Enabling Franklin Roosevelt and Winston Churchill to communicate across the Atlantic Ocean during World War II, the vocoder was originally developed for encoding and compressing speech for secure military communications and efficient transmission over telephone networks. It analyzes and synthesizes the voice by breaking it down into its spectral components. While telephones already transmitted vocal sound, the vocoder's role was to reduce bandwidth usage and enhance intelligibility, particularly in the context of the earliest forms of digital telephony and encryption applications. After becoming interested in speech synthesis and the technology of the vocoder—reportedly demonstrated at Westdeutscher Rundfunk (WDR), the public broadcasting institution for the western region of Germany—Werner Meyer-Eppler, then director of the Institute of Phonetics at the University of Bonn, published a series of papers in the late 1940s that became key references for the emerging *Elektronische Musik* movement (Bode 1984; Mills 2012).[62]

Ultimately, it was Robert Moog who developed the first vocoder that was specially built to function as a musical instrument (Bode 1984). In the 1970s, it gained popularity with musicians and bands such as Wendy Carlos, Isao Tomita, Pink Floyd, Kraftwerk, Herbie Hancock, and the Electric Light Orchestra. In his essay on the post-human music of Black Americans, critical theorist Alexander G. Weheliye (2002) emphasizes the mechanical dimension of R&B carried by vocoded voices, writing that "the presence of speech-synthesizing devices in R&B intensifies the technological mediation of the recorded voice per se…since it dodges the naturalism associated with the human voice in so many other popular music genres" (22). The use of the vocoder by contemporary bands, such as Daft Punk, is a direct retro-futuristic reference to the music of the years that saw its birth.

As it is often used today, the term "autotune" is something of a misnomer, as it is frequently employed to refer to the use of pitch correction software that has been pushed to its maximum, a sound first popularized by Cher's 1998 song "Believe." Though it is used in various ways in contemporary recording projects, autotune has, over time, established itself as a standard part of music production (Reynolds 2018). The Auto-Tune software was invented by Andy Hildebrand, originally a geophysics researcher who used signal processing techniques to interpret infra-terrestrial seismic data. The founder of Jupiter Systems (later renamed Antares Audio Technologies), Hildebrand applied techniques from his geophysics research to the field of music and first released Auto-Tune in 1997. The application eventually became available as a DAW plug-in for studio use and as a stand-alone, rack-mounted unit for processing live performances in a concert setting. When a sound is input into the system, the processor shifts its pitch to the closest semitone (i.e., the pitch of the nearest note in the traditional Western tuning system). It can also be used as a modulation effect for the human voice when a singer glides between pitches; here, the voice jumps from note to note in discrete steps. The software enables the user to adjust the intensity of the speed at which the voice jumps from note to note, with a "zero" setting pushing the effect to its maximum and producing the metallic timbre, often described as robotic, found in "Believe" (Frere Jones 2008) and T-Pain's 2005 album *Rappa Ternt Sanga*, which is credited with popularizing the effect in rap (Ridel 2016). Since then, it has been used frequently in the international popular music scene by artists like Lil Wayne and on Kanye West's 2008 album *808s & Heartbreak*.

The use of the autotune effect raises interesting questions. On the one hand, its use to correct a singer's pitch calls into question the older value system that judged vocal performances on the vocalist's ability to sing with precise intonation: if anyone can now sing in tune, what is the point of making the effort? On the other hand, its more advanced use as an effect that endows the voice with a robotic timbre raises the question of the aesthetic value of the denatured voice: how do we appreciate a vocal part whose timbre is so far beyond the framework of the acoustic human voice? These vocal prostheses have become the norm in today's popular musics and are an integral part of most so-called urban music productions. As the rapper Ademo of the group PNL sings: "sans vocodeur, j'suis claqué" ("without a vocoder, I'm done").

A key part of internet-based pop culture, autotune has become an essential ingredient of micro-genres such as SoundCloud rap and hyperpop. Discussing the later genre, art historian Miles Luce (2021) writes:

> Hyperpop, canonized by its Spotify playlist in August 2019, functions as an umbrella term for a diversity of artists and songs that usually feature auto-tuned voices, lightning-quick tempos, and distorted 808 beats. Birthed out of nightcore, emo, lo-fi, SoundCloud rap, bubblegum pop, and countless other genres, Hyperpop describes more of a "hyper-" than apathetic relationship to genre. "Hyper-," derived from the Greek word *huper*, meaning "over, beyond," captures an alternative—or even "queer"—approach to genre rather than a music entirely untouched by it. (10)

Born in the context of digital technology, hyperpop employs a postmodern sense of irony to evoke the characteristics of our hyper-modernity. Exaggerating mainstream pop tropes (Christiana 2021) and akin to nightcore, hyperpop is made up of simple structures and melodies, catchy choruses, and fast tempos. Its maximalist exaggeration of pop language, pushed to the point of absurdity, is combined with futuristic production, making it a genre of music that converses with both the avant-garde and the mainstream. Voices that are overprocessed with autotune echo the transformations of subjectivity induced by technology and the states of hyper-connection and permanent representation brought on by today's digital social networks. Hyperpop boldly transcends genre and gender frameworks, and in this respect is close to post-club music. We can observe this, for example, in the duo 100 gecs or nonbinary artists such as Dorian Electra and Underscores. The voices of hyperpop often confound the gender binary, blending vocal characteristics traditionally associated with masculinity and femininity through digital manipulation techniques like pitch-shifting and autotune, thus manifesting their link to the queer community (Schaffer 2019). Here, the use of voice prosthesis reflects the place of identity in the transformations brought in by the digital shift. Voice, which in music history has been described as the mirror of the soul, used to be understood as speaking to what is profoundly human in music. Today, its existential value stands before us transformed: the voice speaks to us of an after (post-human), a beyond (trans-human, transgender), or, quite simply, an excess (hyper-human).

CONCLUSION

This essay has described the objective transformations brought about by digital technologies in the field of music and, in this context, has sought to answer the question of whether it is pertinent to speak of music's "digital shift"—that is, a phenomenon whose significance entails a socio-anthropological, or even ontological, rupture. Writing about an earlier era, Jack Goody (2000) analyzed the "powers of writing," and considering the contemporary moment, we might similarly ask how we can describe the cognitive, social, legal, and economic transformation that digital technology is supposed to produce. In the same way that Goody poses the question of whether there is something specific about written culture *per se*, we can inquire whether there is a specificity to music in the digital era, in terms of either musical practices or the representation of music. Our theoretical preamble to such a reflection consisted of reformulating the inescapable question of technological determinism by asserting that, while technical innovation has no autonomous performative power, it is nonetheless in permanent interaction with the social, cultural, and institutional formations in which it participates, so that technical devices and social dispositions must be thought of simultaneously and symmetrically and in relation to a plurality of agents and causal links. For example, the record, as a medium of recording, did not fall from the sky *ex nihilo* and *ex abrupto*, as the stories surrounding its genesis and the figure of Thomas Edison would have us believe. Rather, it was the product of a slow process of domestication, in which a voice-recording device, with no initial artistic vocation, gradually became the medium of melomania (an intense or obsessive love of music). In this respect, it is important to leave the territory of "cultural moralists" (*moralistes de la culture*, e.g., Maisonneuve 2012, 77–92) behind, for such perspectives would have lent credence to the idea that technology—going hand in hand with the market—would subvert the ideal of pure, altruistic art. Such a conception is problematic, both because it fetishizes the romantic paradigm of aesthetic value and artistic labor and also because it accords no place to technology other than that of negation. Approaching this topic in the same vein as philosopher Bernard Sève (2013), we can think of technology, at least as it is embodied in the materiality of the musical instrument, as the very condition of music and suggest that it deserves to be considered as such.[63]

Such an approach is taken by Hennion, who, in coining the notion of "discomorphosis," addressed music from a pragmatic perspective, emphasizing the fact that music is not an essence given *a priori* but an experience that is always "in the making." One of the merits of such an analytical framework is that it restores a place in our

analyses for all of the mediations that constitute the fabric of this musical experience in the making (Hennion, Maisonneuve, and Gomart 2000). From this perspective, the vinyl record, for example, is not an "inert" object, which the music lover can "do something" with. Rather, insofar as it is endowed with a certain agency, it is an actor or agent in the musical experience. With the invention of the record, for example, music is no longer reliant on the moment and context of its performance; rather, music becomes part of the materiality of the recording and the medium of the record collection. The 45 rpm record, for example, uses its format to impose a length and a structure on hits; on record store shelves, it induces a means of classifying and organizing aesthetic families, so that the music lover can, as the adage goes, find themself there. Thanks to the portability of record players, the 45 fosters new sociabilities. The 45 reconfigures the economic model of record companies, gives rise to new ways of judging the value of tracks, enables the exchange of records between music fans, allows for the entry of music into the intimate sphere of the home, and fosters the musicalization of everyday life (Le Guern 2017). In other words, a 45 can be understood as a concentration of adjustments and conflicts among multiple "players"—a term that is not limited to human players of music—around issues aesthetic, economic, legal, and technical. In this context, we can thus ask: What happens when you go from the 45 or the analog recorder to the MP3 and the digital audio workstation?

We suggest the notion of *numérimorphose* (digital metamorphosis) to underline the importance of the digital shift's development in relation to *discomorphosis*, and to emphasize the way in which the emergence of new forms of digital media—from creation to listening—corresponds to new practices. As we have shown in this article, these new practices do not necessarily make their predecessors disappear and we would be remiss to dub the digital world as "virtual." To the contrary, computers, headphones, MP3 players, and other contemporary digital artifacts are not virtual at all. Indeed, the digital era has produced undeniable upheavals, transforming every dimension of musical experience, including

- the business models and actors in the music industry
- ways of listening to music (most notably with the increasing portability of listening capabilities)
- ways of consuming music (especially regarding free, unlimited access to some forms of music and the use of streaming platforms)
- ways of discovering music with recommendation algorithms
- a culture of music enjoyment based on album ownership that is shifting toward one based on file-sharing
- the legal frameworks regulating copyright and the ownership of works
- the means of creating music, which have been transformed by the widespread use of computers and home studios (thus democratizing access to recording technologies)
- the process of distributing works
- aesthetics, with the emergence of new aesthetics that are marked, in particular (but not exclusively) by sampling and autotune technology
- our relationship to the spatiality and temporality of listening (see Bull 2006; Heye and Lamont 2010), and, more generally,
- the musicalization of everyday life

In sum, the environment created by discomorphosis is different in many important ways from the landscape created by numérimorphose, as new forms of digital media give rise to new ways of relating to music. Thus, can we assert that music's mode of existence, its very ontological dimension, has been transformed?

It is well known how philosopher Roger Pouivet (2010) sought to characterize the ontological dimension of rock music: by distinguishing *veridical recording* (which seeks only to capture a live performance) from constructive recording (which constitutes the work itself), and by arguing that *constructive recordings* retain a hint or trace

of the veridical, Pouivet intended to show that the essence of rock works depends ontologically on the recording process. Here, the work is not the performance of a score but the recording itself, as evidenced by the fact that rock concert audiences often expect a song to unfold onstage exactly as it does on the album. In other words, rock music does not simply involve recording a live performance in the studio; rather, the recording *is* the work. If, as Pouivet suggests, applied ontology accounts for the mode of existence of things, can we discern what the nature of music is in the digital era, or, to put it another way, is there anything that distinguishes digital works of music from nondigital works of music? In conclusion, we respond to this question by putting forth a few arguments. Pouivet argues that because the identity of a work of rock music is constituted through its recording, such works are finalized and timeless, existing once and for all, as it were.[64] In other words, if the search for a sense of unity in music that falls under the category of "rock" can in fact be carried out (and this idea has received several serious objections, e.g., Motta 2010), can we make a similar inquiry regarding digital music? It is a formidable question, since, from a socio-anthropological perspective, rock can be defined intuitively as a genre (i.e., an aesthetic family), one that has a place in a certain zeitgeist, that of particular forms of youth emancipation and social protest movements (though Pouivet shows that this is not quite the case). In this context, it would seem that we would have to define the mode of existence of digital music by linking it to the postmodern aesthetics that emerged in the 1980s and after, which hardly seems convincing or sufficient from the perspective of an ontological approach. Alessandro Arbo (2020) took this question under serious consideration and proposed that we try to discern what "new ontological (and not only economic and social) developments" (21) digital technology has brought.[65] As a technology of deconstruction (or, to use Arbo's language, a technology that possesses the ability to "remake" the things it encounters; 22), the digital relativizes the seemingly immutable nature of recorded works. The sampler, a veritable citation technology, blurs the lines between original creation and plagiarism by allowing fragments from one work to be borrowed and imported into a new one. Further, the abundance of works made possible by digital technology and the Web makes the question of their identification—and, more generally, the question of the listener's attentional economy—particularly acute. As a result, it is the morphology of works and their sonic characteristics, marked by compression, that seem to be transformed in order to hold the listener's attention. Similarly, musical works seem to lose their autonomy as they enter a context dominated by multimedia and interactive elements. Finally, digital works are located at a crossroads of two forces that may appear to be opposed: on the one hand, algorithmic recommendation systems orchestrated by platforms whose aim is the economic rationalization of listeners' tastes; and, on the other, the growing personalization of the act of listening, with each person having the tools to adapt music by including it in playlists that situate the work in the context of their daily existence and emotional states. Given these points, which are furthermore supported by numerous surveys, we cannot help but agree with Arbo (see Le Guern 2020).

For his part, Le Guern proposed that we grasp the very essence of the digital by distinguishing between the analog context, where the technical reproduction of the work of art can only be achieved to a limited extent, and the digital context, where the work is infinitely reproducible, without any degradation between the original and copies. In this respect, Le Guern considers the sampler to be the instrument par excellence of digital music. First and foremost, this is because it enables us to enter the genome of each piece, extracting the most tenuous fragments with extreme precision and sound quality and recombining them into new entities. And, moreover, with the erasure of the distinction between original and copy, the linear vision of the analog world faded away in favor of another set of perspectives and processes, ones that are well captured by Deleuze and Guattari's ([1980] 1987) notion of the "rhizomatic," which describes a nonhierarchical, decentralized mode of organization, in which elements are interconnected in multiple, nonlinear ways. And this is exactly how Fred Ritchin (2009) envisions the digital revolution in photography. The ontological characteristic of this revolution, as Le Guern has sought to demonstrate, has produced a number of effects that significantly modify our relationship to music: once considered a costly and unalterable resource, precious in its very materiality and therefore fetishizable (with vinyl records particularly), recorded music has become an abundant and easily accessible commodity, just

as access to the most sophisticated recording technology, once available only to a lucky and select few, has been democratized with the rise of affordable and pervasive computer equipment.

Up to this point, we have been reflecting upon the possibility of the essence of digital things, in this case digital music, which would be ontologically distinct from music produced by analog means. The debate on this topic is a difficult one, and it is not certain that we have managed to settle it definitively. Nevertheless—and this is undoubtedly the theoretical position to which we personally subscribe—we can consider things like expressions of art in general and music in particular as social constructions. Such a conception has been defended by scholars from Bourdieu ([1979] 1984) to Shusterman (1991, 1992): on this view, there are no absolute truths in art (e.g., the nature of beauty, *per se*, as indisputable and permanent); on the contrary, there exist only normative, contingent, and relative systems. As Shusterman reminds us in his response to a book review that he felt misunderstood his work, "pragmatism's flexibility and openness are also manifested in its rejection of essentialist divisions or absolute categories, which it transforms into heuristic distinctions that make it possible to identify dominant trends in a given complex field" (Shusterman in Chamberland 1992, 216).[66] Seen in this way, the history of art would therefore be the history of the processes and power relationships that led to the establishment of conventions about the beauty of works of art, their value, and so on. From this point of view, the transition to the digital seems to us to have in fact highlighted the conventional nature of art. As we have seen, sampling raises new questions about the distinction, which is no longer obvious, between original and copy, between plagiarism and quotation. The home studio, for its part, questions the distinction between a simple piece of recording equipment and an instrument in its own right. What does it mean to "know how to play an instrument" or "be a musician," when it is possible to create works with a computer and a mouse? And should a singer who uses autotune be systematically considered a forger? Does not the use of autotune call into question the convention regarding the authenticity of the singer and the voice, to which so much popular music adheres (Le Guern 2012a)? For those who believe that art can be analyzed in purely objective terms, perhaps the most interesting lesson to be learned from the digital turn is that the study of art can never be separated from axiological questions.

While this article has explored the digital shift and its multiple effects, a new change is on the horizon: the emergence of forms of artificial intelligence that are involved in compositional processes. Are these new, nonhuman figures likely to rattle the musical landscape? Considering the recent case of AI rapper FN Meka, who was signed by Capitol Records and attracted the attention of hundreds of thousands of music fans before being dropped by his label for using language and imagery in songs and social media posts that many felt was racist (see, for example, Cain 2002), everything suggests that a turning point has come, where humans and nonhumans hybridize, opening up new questions about the nature of future musical works and experiences…

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NOTES

1. On the notion of "mutation," see Lèbre and Rogozinski (2017).
2. "Il semble légitime de dater historiquement son apparition des années 1960 de notre siècle. Ce n'est en effet qu'après la Seconde Guerre mondiale que le taylorisme et le fordisme ont permis aux masses salariées de disposer de temps libre suffisant, de loisirs si l'on préfère, pour consommer des biens culturels appropriés à leur attente."
3. Unless otherwise indicated, all translations are ours.
4. "Si le son enregistré occupe aujourd'hui une telle place dans notre univers culturel, c'est sans doute parce que son émergence à la fin du 19e siècle, loin d'être un phénomène purement technique et industriel, témoigne, plus largement, d'une mutation anthropologique des sociétés industrialisées, dont l'une des caractéristiques essentielles semble être le changement du rapport au temps."
5. With music markets in mind, a variety of authors have attempted to formalize the criteria for considering a certain kind of innovation as disruptive. See, for example, Coccia (2020).
6. For a synthesis of diverse approaches to technology in the social sciences, see Flichy (2003).
7. "Se préserver de l'idée par trop utopiste selon laquelle tout ce qui est numérique est 'révolutionnaire,' sans non plus insinuer que rien n'a changé."
8. "Le système du droit d'auteur au sein de l'industrie musicale traditionnelle, l'architecture des grands groupes de médias, et la logique capitaliste qui les sous-tend sont demeurés globalement en l'état, même s'ils ont dû faire quelques efforts d'adaptation."
9. "On ne saurait négliger le fait que toutes ces technologies recourent aussi à des systèmes déjà existants et à des savoirs profondément ancrés dans la mémoire corporelle collective.… En conséquence, déduire que le numérique a des pouvoirs particuliers, qu'il aurait des effets propres, est abusif."
10. "De ce point de vue, on peut considérer que le premier *sampler* (le Fairlight CMI en 1979) n'est pas le premier instrument de musique numérique, puisqu'il est précédé par l'ondioline ou le Mellotron, celui-ci imitant, au début des années 1960, des sons de flûtes ou de cordes à partir de bandes magnétiques jouées en boucle, ou encore admirer l'électronium, machine à composer inventée par Raymond Scott à la fin des années 1950, bien avant l'arrivée des ordinateurs et des algorithmes compositionnels, et y voir la confirmation qu'en effet, toute innovation est toujours précédée d'autres innovations oubliées ou minorées, dont le destin ne pouvait être connu *a priori* par la prévision, mais seulement discerné *a posteriori* par la rétrovision."
11. "…le matériau de la musique concrète est le son, à l'état natif, tel que le fournit la nature, le fixent les machines, le transforment leurs manipulations."
12. "[L]'écoute peut donner lieu à l'enregistrement de musique par soi-même—version personnalisée d'un morceau apprécié qui pourra être mise en ligne sur une page personnelle—, le *zapping* et le *sampling* éventuellement intégrés à un *home studio* sont autant de pratiques de réagencement de la production de l'autre[;]…la création de *playlists* est une forme de production d'une image (provisoire) de son propre goût, et la reconstitution d'albums 'faits maison' avec pochette est un exemple plus anecdotique mais tout autant significatif d'une pratique consommatoire créative et protéiforme."
13. "S'intéresser au potentiomètre d'une console de mixage ou au graphisme d'un séquenceur n'est ni trivial ni anecotique car le design, l'ergonomie, nous parlent de manipulations, d'habileté, de gestes naturalisés, de normes et de savoirs faire, de postures, de volumes, de marques, bref, de tout ce qui constitue le soubassement d'une pratique, d'une sociabilité, d'une identité, d'une esthétique."
14. "…on passe d'une ère de la reproductibilité technique à une ère de la reproductibilité à l'infini et ceci constitue la condition de possibilité d'une culture virale hautement disséminable. Si la bande magnétique était l'artefact emblématique de l'ère analogique, on peut considérer que le sampler remplit cette fonction pour l'ère numérique, dont il incarne les propriétés ontologiques : conçu comme un outil de codage, le sampler ne produit pas de sons en-soi, à la différence du synthétiseur qui combine des filtres et des oscillateurs, mais reproduit le génotype de n'importe quel son."
15. "…un écrasement des formes d'autorité et d'une redistribution des rôles par rapport aux hiérarchies institutionnelles classiques."
16. "…l'égalité formelle entre les aspirants à la notoriété."
17. "Première des industries culturelles à avoir fait les frais de son manque d'adaptation au virage numérique, dès le tournant du XXIème siècle, l'industrie de la musique a, notamment au début des années 2000, été l'objet de bon nombre d'études, dont l'essentiel a cherché à documenter la crise de la vente des supports physiques, à investir théoriquement l'essoufflement d'un modèle socioéconomique centré sur le paiement à la pièce d'un bien culturel hérité de la vente de

partitions papier, voire à prophétiser l'avènement d'un nouvel essor, impulsé par les outils du web collaboratif, par le recentrage sur la gestion des droits ou par l'émergence de tel ou tel artiste à l'international."

18. "…[tandis que le livre] dont le marché du numérique est à peine naissant au début des années 2010, est aussi touché mais de manière encore très amortie" et que "le cinéma connaît une évolution mitigée."

19. "La numérisation des oeuvres musicales, qui permet leur duplication et leur changement de supports, ne transforme pas seulement la distribution mais tous les éléments de la chaîne de valeur, depuis la dynamique de création jusqu'aux modes de consommation."

20. "…passer du mythe rassurant ('tous les produits peuvent avoir leur chance') à une réalité économique effective (via des mécanismes de sélection et d'information renouvelés)."

21. "Les travaux de recherche montrent que le phénomène de la longue traîne ne semble pas encore revêtir la dimension attendue. Si la traîne de la distribution des ventes va effectivement en s'allongeant, car de plus en plus de titres sont disponibles et consommés au moins une fois, les conditions d'un déplacement massif de la demande vers les produits de la traîne ne semblent pas encore réunies. En outre, l'effet superstar apparaît parfois plus prégnant en ligne qu'hors ligne, avec un renforcement de la concentration sur la tête de distribution des ventes."

22. "Les mutations majeures sont plus récentes et ont trait à l'émergence, depuis la fin des années 90, de la distribution numérique légale (iTunes, Deezer, etc.) ou illégale (le piratage via les réseaux de pair à pair notamment."

23. "On observe quatre grandes périodes. Entre 1973 et 1986, les ventes d'albums augmentent faiblement, passant de 386 millions à un peu plus de 526 millions d'unités, soit une croissance annuelle moyenne de 2,4%. Entre 1987 à 1994, avec le développement du CD, la croissance des ventes est très forte: le nombre d'unités vendues augmente de plus de 7% en moyenne par an sur la période et passe de 619 millions à 1020 millions. Entre 1995 et 1999, les ventes stagnent (+1,8% par an en moyenne). Enfin, depuis 2000, les ventes d'albums ont fortement baissé; cette baisse est la plus forte qu'ait connue l'industrie dans les trente dernières années."

24. "La baisse des ventes est particulièrement forte pour le format 'single.' Pour ce qui est des albums au format CD, l'évolution des ventes est moins marquée."

25. "De plus, on observe une forte hétérogénéité entre es marchés. Si la baisse des ventes est avérée pour certains marchés (Allemagne, Japon, Etats-Unis), ce n'est pas le cas pour les marchés français et britannique, qui ont connu une augmentation des volumes de vente."

26. "...[en] France, les ventes de singles n'ont pas suivi la même évolution qu'aux Etats-Unis. Entre 1997 et 2002, les ventes sont restées relativement stables, puis elles ont diminué légèrement entre 2002 et 2003. Néanmoins, la comparaisons des figures 1 et 2 montre que l'évolution des ventes de singles en France entre 1996 et 2003 s'apparente à l'évolution des ventes de singles aux Etats-Unis entre 1991 et 1998. One pourrait donc faire l'hypothèse que le marché français suit ke marché Américain avec quelques années de retard."

27. Discussing these distinctions, Maya Bacache-Beauvallet and Charles Delattre (2016) have noted: "An economic agent can listen to music, give a digital copy exactly like the original to another consumer, and still consume it. The consumption of these non-rival goods is therefore highly disruptive to market mechanisms: one can give and yet still keep [the products in question].… Why not then give a good away for free, since, by giving it away, one still keeps it?" (206). (Un agent économique peut écouter une musique, en donner une copie numérique exactement conforme à l'original à un autre consommateur sans pour autant moins la consommer. La consommation de ces bien non rivaux a donc quelque chose de très perturbant pour les mécanismes de marché: on peut donner et pourtant garder encore.… Pourquoi ne pas alors donner gratuitement un bien, puisqu'en le donnant, on le garde encore?)

28. "Aucune preuve n'a été faite que les utilisateurs visés par la demande de divulgation avaient diffusé ou distribué des oeuvres protégées; ils n'avait fait que déposer des oeuvres dans des répertoires de services P2P."

29. "J'ai peine à voir la différence entre une bibliothèque qui installe une photocopieuse dans une pièce remplie d'oeuvre protégées, et un utilisateur qui dépose une copie personnelle d'une oeuvre protégée dans un répertoire partagé sur un service P2P."

30. "Le droit exclusif de rendre disponible une oeuvre est inclu dans le Traité de l'Organisation mondiale de la propriété intellectuelle sur les interprétations et exécutions et les phonogrammes (CRNR/DC/95 Rev.), mais ce traité n'a pas été mis en oeuvre par le Canada, et ne fait donc pas partie du cadre juridique canadien en matière de droit d'auteur."

31. "Ce format discographique de l'écoute musicale est un dispositif tout à fait récent qui centre la musique sur la consommation, en général privée ou en tout petit groupe, chez soi ou dans ses espaces intimes, d'une musique dont on se sert 'à volonté,' dont on règle la dynamique, dont on recompose à son gré les séquences et la logique de répertoire. Toutes ces dimensions qui sont les traits banals de notre écoute actuelle constituent en réalité des réécritures fondamentales de ce qu'est notre relation à la musique."

32. "... mais favorise l'intelligibilité et la réflexivité de l'expérience musicale plutôt que ses dimensions sensibles et somatiques, qui étaient aussi au cœur du partage d'écoute dans l'espace physique du magasin."

33. "…ceux qui ont acheté ceci ont également acheté cela" construits "autour d'un idéal de relations symétriques et sans intermédiaires entre production et réception de la musique."

34. "…les premiers disques compacts sortent au Japon en 1982 et dans le reste du monde en 1983, les arguments de ventes sont identiques à ceux qui ont accompagné la sortie du microsillon en 1948: temps d'écoute accru et meilleure qualité sonore."

35. "…la réduction de la taille des fichiers audio, l'amélioration des quantités de stockage et la multiplication de leurs échanges."

36. Un "produit global (*the entire solution* comme l'appelle Apple)…proposant dans un même élan un appareil de lecture et de stockage, une interface de gestion des contenus et une possibilité de transferts via l'ordinateur Mac."

37. "Pour estimer quel son est 'bon' ou 'mauvais,' les musiciens disposent de critères correspondant aux dimensions socio-esthétiques de contextes et de pratiques musicales spécifiques. Nous devons en faire autant."

38. "Huit personnes âgées de 15 ans et plus résidant en France métropolitaine sur dix ont écouté de la musique en 2018: elles étaient 66 % en 1973.… Et si la pratique occasionnelle d'écoute s'est développée, c'est en particulier l'écoute quotidienne qui connaît la progression la plus spectaculaire: en 2018, 57 % des personnes écoutent de la musique tous les jours ou presque—elles étaient 34 % en 2008 (un quasi-doublement en une décennie) et seulement 9 % en 1973."

39. "Il est frappant de constater à quel point cette dynamique liée au développement des usages numériques a touché toutes les générations, et ce dans des proportions similaires. In fine, le cumul de la dynamique générationnelle, engagée dès les années 1970, et de la dynamique liée au tournant numérique de la consommation musicale dématérialisée au cours des dix dernières années se traduit par une réduction drastique des écarts de pratique entre les plus jeunes et les plus âgés sur l'ensemble de la période.…

"La massification de l'écoute quotidienne de musique, observable d'une classe d'âge à l'autre, se traduit également par une reduction des écarts de comportement non seulement entre catégories sociales et niveaux de diplôme, mais également selon les types de territoires."

40. "[S]i la circulation des goûts, des choix et des dispositifs de recommandation a changé d'échelle, cette enquête montre la tension persistante, à l'échelle individuelle de l'économie domestique de la découverte, entre offre *mainstream* et recherche de singularisation.…

"…En somme, si les technologies ont partiellement changé les arts de faire de l'amateur et modifié ses manières de consommer la musique, celui-ci reste toujours celui qui bricole ses dispositifs de découverte dans une économie complexe et partiellement opaque."

41. "Les participants de l'étude découvrent la musique encore largement par les relais médiatiques traditionnels, soit la radio et la télévision, et affichent une réaction d'indifférence, voire de méfiance, face aux nouveaux outils de recommandation de Deezer et de Spotify. Cela dit, on observe chez les participants plus jeunes une plus grande ouverture envers ces outils automatisés, qui laisse entrevoir la montée en influence des activités de prescription des nouvelles plateformes de diffusion musicale en continu dans un avenir rapproché."

42. "Le premier constat concerne l'étonnante articulation qui se fait entre le physique et le numérique et le haut degré de singularité des pratiques. Difficile d'opposer ancien et nouveau monde, parce qu'ils continuent de cohabiter même si le développement du numérique a clairement changé la donne et l'équilibre des forces: nous sommes en régime mixte."

43. "La majorité des enquêtés qui consommait des biens numériques au cours des années 2000 avait pour habitude d'accumuler, de stocker les biens numériques, et de les ordonner selon des critères propres aux biens—par support, auteur, date, genre, courant, etc.… Les choses ont changé et on observe aujourd'hui un très net affaiblissement de l'intérêt pour la possession, une absence d'organisation des fichiers et la suppression des contenus très rapidement après leur consommation." Gilliotte (2019, 458) adds, "A closer look reveals that the management of stored digital assets has evolved, moving from a classification logic that is reminiscent of the collection of physical assets to a classification logic whose horizon is the management of consumption, which is closer to the streaming model." (Mais à y regarder de plus près, on se rend compte que la gestion des biens numériques stockés évolué, passant d'une logique d'ordonnancement, qui se déployait selon un certain mimétisme par rapport à la de biens physiques, à un ordonnancement dont l'horizon est la gestion de la consommation, plus proche du modèle de la consommation en streaming.) Examples of strategies for organizing digital music content are discussed in McCourt (2005), Kibby (2009), Hagen (2015), and Lefrançois (2016).

44. "Au lieu d'élargir notre expérience à la surprise ou simplement à la différence, les auditeurs s'attendent au contraire à exercer un contrôle bien plus grand que par le passé sur l'expérience d'écoute, et à ce que la musique s'adapte à leurs besoins."

45. "…un écart de plus en plus important entre, d'un côté, les grands amateurs spécialisés, pratiquant une écoute érudite…et, de l'autre, les usagers se cantonnant à l'information distribuée par les grands sites et à la commodité des systèmes de recommandation (satisfaisant des besoins de 'découverte' bien conformes à leurs usages réguliers)."

46. "…un corpus de traces d'activité d'un échantillon aléatoire de 4000 utilisateurs d'une plateforme de streaming musical, observés pendant une période de cinq mois, au cours de laquelle ils ont réalisé collectivement 17 millions d'écoutes.… la capacité des individus à s'appuyer sur ces dispositifs sans pour autant leur abandonner le contrôle de leur expérience."

47. "…d'autres activités sociales que l'écoute, et qui par conséquent sont plus susceptibles que d'autres d'être mis en fond sonore."

48. "…cette diversification est relative, notamment parce qu'elle concerne le plus souvent des artistes aux caractéristiques proches.…

"Ainsi, il semble que l'on écoute du fait des services numériques un peu plus de musiques distinctes, mais pas nécessairement des musiques plus variées."

49. "L'algorithme se voit alors déléguer ce choix et le pouvoir de le faire, même s'il apparaît abusif de parler de perte d'autonomie: c'est justement parce que l'auditeur *préfère* ne pas choisir, c'est à dire ne pas dépenser des ressources temporelles et cognitives qu'il souhaite consacrer à son activité principale, qu'il délègue ce choix."

50. "18% de la musique mise en ligne chaque jour—soit plus de 20 000 titres—est entièrement générée par des modèles d'IA."

51. "…composer le son lui-même, faire jouer le temps dans le sens au lieu d'agencer des sons dans le temps."

52. "…une interconnexion de fonctions qui possèdent chacune leur mode d'accès et de réglage. Les contrôles sont soit manuels, soit obtenus par tensions de commandes issues de dispositifs variés: claviers, convertisseurs amplitude-tension (suiveur d'enveloppe), convertisseur hauteur-tension (suiveur de hauteur)—sources spécifiques de tensions de commande.… Reste que ces contrôles ont autorisé le jeu en direct."

53. "…rend audible le processus sonore lui-même, la production de ce processus, et nous met en relation avec d'autres éléments qui dépassent la matière sonore."

54. "Ces nouvelles interfaces ne seraient-elles que de 'quasi-instruments' qui 'tendent vers une relation instrumentale' sans jamais y parvenir? L'ordinateur est-il irrémédiablement condamné à ne jamais devenir un instrument de musique ou rester une simple interface de communication instrumentale?"

55. "Un instrument de musique ne peut être considéré comme tel que s'il comprend la chaîne complète du geste à l'émission sonore ou au moins à un signal électrique analogue à cette émission. Un amplificateur n'est pas considéré comme un instrument de musique, contrairement à une guitare électrique, un synthétiseur avec clavier, un échantillonneur ou un synthétiseur modulaire. Un ordinateur n'en est pas un, mais s'il est muni d'une entrée son ou d'une interface gestuelle, d'un logiciel de synthèse ou de traitement et d'une sortie son, alors l'ensemble du dispositif peut être considéré comme un instrument de musique."

56. "Chaque lieu, chaque voyage deviennent des séances d'enregistrement."

57. "Avant ça aurait été un énorme enregistreur à bandes qui aurait pris une place de fou."

58. "À un paysage musical composé d'un nombre fini de genres et de sous-genres succéderait, avec l'avènement d'Internet, un indivisible nuancier. La constellation de scènes semi-autarciques se serait transformée en un réseau complexe brouilleur de frontières.… Cette histoire, cette musique d'avant le tout Internet, encore attachée à des espaces et à des hommes, est comme avalée, digérée puis recrachée, nourrissant un flux constant de musiques protéiformes."

59. "…conférant au rythme son espace et sa tension, même à grande vitesse."

60. "Les genres se mélangent et l'hybridité devient le mot d'ordre: hardcore et afrobeat, trance et reggaeton. Les crossovers ouvrent la voie des possibles, brouillent les pistes, au point de parfois articuler (ou désarticuler) une musique post-genre à la généalogie trouble."

61. "Les internets sont devenus un terrain d'expérimentation pour créer de nouveaux modes de communication, de socialisation et d'expression. L'anonymat et la rapidité de diffusion y permettent l'émergence de cultures web, avec de nouvelles esthétiques, de nouvelles musiques ou de nouvelles modes."

62. While Meyer-Eppler's influence on electronic music through vocoder research is well documented, there is no confirmed source attesting to his personal attendance at a vocoder demonstration at WDR.

63. Sève writes: "The instrument is a technique of expression, not merely an extension of the body" (2013, 69). (L'instrument est une technique de l'expression, et non une simple extension du corps.)

64. English musician and producer Mick Ross confirms this idea in a lapidary formula: "In the studio, it's about the song. The song is king. In fact, your two key things are the song and the ability of the people to play that song" (Ross quoted in Dawson n.d.).

65. "…nouveautés d'ordre ontologique (et pas seulement économique et social)."

66. "La souplesse et l'ouverture du pragmatisme se manifestent aussi par son refus des divisions essentialistes ou des catégories absolues, qu'il transforme en distinctions heuristiques permettant d'identifier les tendances dominantes dans tel ou tel domaine complexe."

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