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DIGITAL MEDIA

Transformations in Human Communication

EDITED BY

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CHAPTER NINE

Jonathan Sterne

What's Digital in Digital Music?[1]

This essay directly questions the meaning of "digital" in digital music by arguing that digital technologies are best understood as always bound up with a range of cultural practices and other—"analog"—technologies. It proceeds in four parts. The first section argues that, while digital audio technology is important, it must be understood in the context of contemporary sound culture, which is not purely or even mostly digital. Following this claim, the second section examines a range of creative technologies and practices like sampling and turntablism that can be lumped under the admittedly clumsy label "recombinant music." Much has been made of the role of digital technology in these practices. I offer a description of recombinant music that does not privilege digital technology, but does take it seriously as an element in a larger cultural formation. The third part of the essay explores changing relationships between professionals and amateurs in the recording industry, and again questions the centrality of digital technology to this transformation. Although the essay is deliberately speculative throughout, the final section ratchets up the speculation quotient to suggest some directions and orientations for future research.

I write in one of those weird moments in which scholars of contemporary culture constantly find themselves. There is a growing literature on various aspects of digital music. Yet, we don't even really know what digital music is. Is all music that comes into contact with a digital technology at some point during its production, distribution, and consumption "digital"? If so, is there any electronically reproduced music in existence today that cannot be called "digital" at some level? Digital is everywhere in the production-distribution-consumption-reappropriation cycle of musical culture, and it has moved from an esoteric dimension of studio technology to an array of mundane facts that lurk beneath the surface of so much contemporary musical experience. Not only are there digital instruments and studios, but compact discs were one of the first widely used digital media in American culture. Computer programs are essential to modern studio design

and computer modeling is largely responsible for the shape and sound of modern speaker systems, not to mention headphones. Digital modeling of physical spaces has also become a central part of the sound of modern recorded music as computers and standalone devices model physical spaces from bathrooms to cathedrals and devices from guitar amplifiers to microphones. Even power supplies for amplifiers in performance venues are now oftentimes digitally regulated. File-sharing depends on digital modeling of human psychoacoustic perception, so that mp3s can lose a good deal of data and still sound like the recordings from which they are condensed.

This essay directly questions the meaning of "digital" in digital music. It proceeds in four parts: the first section explores some basic issues in thinking about the relationship between digital technology and music. The second section examines a range of creative technologies and practices like sampling and turntablism that can be lumped under the admittedly clumsy label "recombinant music." Much has been made of the role of digital technology in these practices. I offer a description of recombinant music that does not privilege digital technology, but does take it seriously as an element in a larger cultural formation. The third part of the essay explores changing relationships between professionals and amateurs in the recording industry, and again questions the centrality of digital technology to this transformation. Although the essay will be deliberately speculative throughout, the final section of this essay ratchets up the speculation quotient to suggest some directions and orientations for future research. There is, of course, much more that could be said. There are only passing mentions of listening technologies, which I take to be centrally important and intend to explore elsewhere, or changing performance practices—for instance in the whole laptop movement. But I am hopeful that the explorations in this essay at least offer a sense of my approach to the question of music's interface with "the digital" and inspire you to ask new questions that I haven't yet considered.

Undefining "Digital"

Lurking beneath the question of digital music is the question of digital technology more generally. In his *Language of New Media* (2001), Lev Manovich rejects the term "digital" because it acts "as an umbrella term for three unrelated concepts—analog-to-digital conversion (digitization), a common representational code, and numerical representation [conversion to 0s and 1s]. Whenever we claim that some quality of new media is due to its digital status, we need to specify which of these three concepts is at work. For example, the fact that different media can be combined into a single digital file [unlike film or video, digital files don't exactly have a separate "soundtrack" and "imagetrack"] is due to the use of a common representational code, whereas the ability to copy media [for instance, burning a copy of a CD or copying an mp3] without introducing degradation is an effect of numerical representation" (Manovich 2001, 52). We could go even further if we think about the examples listed above. Numerical code, for instance, allows for easy copying, but it also allows for algorithmic processing: run a recorded sound through the right algorithm and you can change its pitch, its apparent ambient environment, and countless other factors. Manovich calls this dimension of digital processing "transcoding."

As he dissects the term "digital," Manovich objects to the use of the term because it is too blunt a conceptual instrument for his purposes. While his points are well-taken, his alternative term, "new" media, creates at least as many problems as it solves.

"Newness" carries with it a whole set of connotations in our consumer-capitalist society; we're used to advertisers who tell us that new, amazing products will change our lives; commercial culture brings with it a cult of youth to which ideas of the "new" are always tied; and the predisposition to dispose of our technologies—as in, literally, throwing them out—also fuels and is fueled by an ideology of "the new" (I discuss this point at greater length in a forthcoming essay that explores how digital equipment becomes garbage).

Manovich's periodization is also problematic, since by privileging cinema he promotes a very particular view of "new" and "old" in 20th-century media history. Put simply, there is no simple, useful, "unproblematic" adjective that describes current changes in media technologies. We are stuck in a web of description and prescription. As followers of French sociologist Pierre Bourdieu would note, we never have any other alternative when we analyze society—we cannot simply describe a social phenomenon without invoking a prescriptive dimension in our prose—so take this as a cautionary statement, and not an apology (Bourdieu 1991).

Definitional problems aside, there is the more basic social theoretical question of how to study technology. A vast literature on technology exists, but regardless of whether one is a fan of the Science-Technology-Society (Bijker 1995; Bijker, Hughes, and Pinch 1987; Collins and Pinch 1998) approach or the older "philosophy of technology" (Ellul 1964; Heidegger 1977; Ihde 1993; Illich 1973; Mumford 1934; Winner 1986), they all pose the same central challenge for us: if we study the specifics of creation, listening, or other music-related practices that occur in the neighborhoods of digital technologies, then to what extent are we simply making too much of a coincidence between the practices and the technology? This essay largely considers practices normally grouped under the rubric of musical "production" as the creation and composition of music (and to a much lesser extent, distribution performance). In some senses, the approach isn't quite fair. A more holistic approach is really necessary because things start to look very different when we turn from what we normally think of as the production of music to its consumption. To anticipate a point I'll raise again in the conclusion, it's not at all clear that digital technology has affected or accompanied significant changes in listening practices.

Even in the realm of production and distribution, too much is often made of the "digital" aspects of current practice. Take mp3s, for instance. If one reads the newspaper, it might seem on prima facie that the technological form of the mp3 changed the music industry. But in a broader historical and international context, the so-called crisis of the American recording industry doesn't look all that different from the "crises" of regional recording industries all over the world with the introduction of cassettes (Manuel 1993; Wallis and Malm 1984). There are some new twists to be sure: the obscene profit margins and growth indices demanded by the conglomerates that own the major labels are certainly skewing business practice, as did their business strategy of the last couple decades, where profits sagged before the introduction of the compact disc. But CDs artificially boosted sales, especially in back-catalogs, where baby boomers replaced their vinyl LP collections with CDs. As that boom ran out in the mid 1990s, the industry began to look elsewhere to maintain its inflated profit margins, despite the fact that profit margins on CDs are considerably higher *per unit* than on LPs because of improved mass-production techniques and cheaper raw materials (Negativland n.d.). On the distribution side, it is certainly faster to share mp3s than tapes if you've got a high-speed Internet connection. While that describes a relative minority o f people, the industry is right that these people—college students and early adopters of new forms of consumer electron-

ics—are the people most likely to spend a good deal of money on records. This fact leads us to the consumption side and the latest twist in the mp3 saga: the recording industry is now suing potential customers (and implicitly threatens thousands or millions more with litigation) in order to get them to buy its product. That scenario is in equal parts comic, tragic, hilarious, and disgusting. But this too shall pass. The majors may or may not remain intact as they are now, but as long as capitalism exists, people will continue to create and perform music, and other people will find ways to profit from it.

The mp3 case is actually a good example of the issue: by reducing a complex social issue to its technological dimension, we elide the agency of both institutions and individuals in the scenario. This is not to argue for an instrumental theory of technology, that it is simply a neutral "means to an end"—far from it! But every technology exists in multiple systems: systems of social relationships, systems of technologies, and systems of physical or so-called natural phenomena. One could substitute "histories" for "systems" in the previous sentence and get just as far. We cannot directly assess the "impact" of digital music technology, because "impact" studies tend to steer us away from the larger questions of history and culture that are central to understanding musical practice—or any other social practice. In the mp3 case, it simultaneously steers us away from interrogating the current form of the music industry, the relationship of that technology to *other* reproduction technologies (cassettes, CDs), and actual practices among people who listen to or collect music. Indeed, talking with undergraduates who compulsively stockpile mp3s on their hard drives, I am reminded of Walter Benjamin's famous essay on unpacking his library (Benjamin 1968, 59–68): the acquisition is the aesthetic experience, and not the listening.

So much has already happened in the "digital "world that we need not set our sights on the future: the immediate past and present are powerful enough. Here, I follow Lev Manovich who says that instead of prognosticating about the future of new media, which was a major pastime of intellectuals in the 1990s, he would simply look at what had already happened and what practices had developed around and through new media (Manovich 2001, 6–8). I find his stance useful because I don't think we're ready to assess the impact of digital technology per se in music because we haven't even really yet gauged its nature or extent. Here I'm taking a slightly different position than Timothy Taylor, who argues that the "advent of digital technology in the early 1980s marks the beginning of what may be the most fundamental change in the history of Western music since the invention of music notation in the ninth century" (Taylor 2001, 3). Though Taylor goes on to specify and qualify his provocative claim, I'm less ready to take up that position, probably because I've written so much on the origins of sound-reproduction technologies like the phonograph, telephone, microphone and radio.

Partly, this is so because I'm still hung up on transducers. Technologies that change sound into something else, like electricity, and change it back into sound are called transducers. A microphone is a transducer, and so is a speaker. They define modern sound-reproduction devices, whether we are talking about studios, CD players, or telephones for that matter.[2] In *The Audible Past: Cultural Origins of Sound Reproduction* (Sterne 2003a), I argued that sound recording, radio, and telephony indexed a whole set of practices of acoustic modernity. I won't recite those details here, but in the conclusion, I wrote that the jury was still out on digital technology because in essence it was just another step between transducers (ibid., 335–339). For example: to record and play back a tuba

performance in a digital setup, the tuba player plays into a microphone, which transduces the sound vibrations into electricity. That electrical signal is then digitally sampled 44,100 times-per-second through an analog-to-digital converter, and stored as binary data. When you're ready to play the tuba solo back, the digital data goes through a digital-to-analog converter that turns the 44,100 samples-per-second back into an analog electrical signal, when then goes through a speaker or headphones that turn the electricity to sound. Technologically speaking, the digital conversion adds a step to the process of sound reproduction, it doesn't reorganize the process. You still need a speaker to hear the music, and in some cases you still need a microphone or pickup. From the standpoint of the history of sound-reproduction technology, digital audio makes the scenario more complicated, but it does not transform its most fundamental components. If we move outwards a bit from the technology to its function, digital audio devices are pretty similar to analog devices: we delegate the human powers of hearing and sounding to them in a manner very similar to the way that early users delegated their faculties of hearing and speech to 19th-century telephones and phonographs.

One could argue that synthesizers, both analog and digital, have dispensed with the microphone for the most part, and therefore have eliminated the first transducer in the process. Instead, they start with electrical signal that is eventually converted into sound. This is true in many cases. But even here, there are qualifications to be made. One look at advertisements for Korg's MS2000 and Microkorg synthesizers shows the continued importance of a transducer on the front end of the performance. The ads prominently feature microphones that are included with the synthesizers so that musicians can process their voices along with the synthesized sounds (Korg 2003). Another popular Korg product, the electribe, also includes an input feature so that any sound—once transduced into electricity—can be run through the synth.

So you can see why I argued that digital audio just added a step in the middle of the process of turning sound into electricity and turning electricity back into sound. In many ways, I think that claim holds. But in many other ways, that seems too quick and too glib. A more supple position requires a somewhat stretched definition of what counts as digital music and digital technology, and since those terms will remain in question for the rest of the essay, I will dispense with the annoying scare quotes.

Recombinant Music

Ask any musician about the role of digital technology, and he or she will quickly get to its power to edit, transform, mangle, and combine sounds down to the most basic waveforms. Digital editing allows people to easily change the pitch or pace of recorded music, and it allows them to easily alter the timbre of the sounds in a wide variety of ways. With even a basic sampler or audio-editing program, a person can change one sound into something completely different in a matter of seconds. Of course, much of this was possible with analog audio technologies as well, and in fact turntablism reappropriates an analog technology—the record player—to create new soundscapes. But it is difficult not to be struck by the vast proliferation of music that uses other recorded music or sound for its basic building block as digital technologies have become more widely available to musicians. Sample- and mix-based music has taken over many dance clubs: as a live form, it has superceded performance on more "traditional" instruments in venues all over the world; it has influenced a whole fleet of its own genres and mixed with many genres that once eschewed recombinant practice; and, in a truly bizarre way, it has more or

less obliterated more "traditional" forms of background music (the best-known American brand is Muzak) in Europe.

Why call this trend in music-making recombinant? I'm not really excited about biological metaphors for cultural phenomena, but if you talk to any DJ, the art in the music is in the combination and *recombination* of different elements to create new sonic textures. The art is in the choice of sound object, the way it is processed, and the musical mix into which it is put. I first came across this term in a scholarly context in an essay by James Hay on advertising (Hay 1989). His point was that advertising reorganizes cultural forms that exist outside the ads and puts them to new ends. So the "recombinant" metaphor is not necessarily an assessment of the impact or significance of digital technology—it may in fact simply be a cultural form that appeared in music at a time coincident with the introduction of digital audio equipment.

Sampling is a phenomenon that would, at first glance, appear to challenge my earlier thesis about the centrality of the transducer.[3] All samplers work on the premise that music has been recorded somewhere else and that the recording can be imported into the sampler for manipulation and reproduction. Samplers are a classic example in the recording world of a phenomenon that social theorist Ulrich Beck has termed "reflexive modernization" (Beck 1994; Beck, Giddens, and Lash 1995). Beck wrote about the environment, among other things, and used the concept of "reflexive modernization" to describe phenomena that were "the results of *the results of*" modernization. So, for instance, ozone depletion results from pollution, which results from industrialization. Like all good academics, I'm taking Beck's words and twisting them around for a completely different use—music, in this case. Let me explain. There is a common idea out there that recordings reproduce "live" performances, with more or less fidelity. But this is not exactly the case. Rather, "live" events are usually fabricated specifically for the purpose of recording or reproduction. Musicians who know they are going to be recorded perform differently—sometimes the performance is *radically* different from a live performance. Even something as simple as a telephone does not simply reproduce live conversation. People say specific things into phones so that they'll be transmitted over phone lines. While this seems like a small and obvious distinction, it is philosophically significant because standard academic appraisals compare recorded music to "live" music as if the former were a degraded version of the latter. As I argue, such comparisons are really of the "apples and oranges" variety because recording is a fundamentally different (though related) form of social practice from live performance.

So, in essence, when people invented recording, while the device was important,[4] the whole field of practices that go with sound recording made it what it became: studios (which were a new kind of musical space), new types of musicianship, new attitudes toward what music was and how it sounded, new ways of listening, and of course the whole recording industry itself (see Sterne 2003a, 215–86).

This is where sampling comes in. Sampling, along with turntablism (where the playback medium becomes a musical instrument), loop-based audio composition, and even most modern synthesizers, *presupposes and builds upon* this whole culture and economy of recorded music. To apply a geological metaphor to technological practice: as recording practices have formed an increasingly sedimented cultural layer, sampling and other recombinant practices are like a new layer settling on top of the recording layer. Of course the metaphor is not exact, since any historian of avant-garde sound art, most notably Douglas Kahn (1999), can point out the long history of messing with recordings

in the form of cut-up, musique concrete, and other artistic practices that took for granted and played with the medium of recording. The difference between those earlier practices and the more recent explosion of recombinant music-making is a matter of degree, dissemination, and emphasis. Those early composers were somewhere between playing with and fighting with the medium.

Today, a thousand species of recombinant music-making thrive (including a few platypuses), and a vast equipment industry accompanies each one. One can find specialist DJ turntables; samplers designed for recording, performance, or both; software packages designed to emulate DJ-style performance or hardware sampling; recording- and performance-oriented software packages that allow musicians to compose music from short, measure-length repetitive loops; and on and on. Even karaoke machines might fit this model.

All of these devices *presuppose* the culture and economy of sound recording. They exist on top of the massive archive of existing recordings and listener knowledge and experience of those recordings. In this sense, Beck's "reflexive modernization" perfectly captures the spirit of the recombinant musical enterprise. In fact, there is probably an essay to be written on sampling and the recombinant dimensions of cultural memory. Many authors (e.g., Dimitriadis 2001; Ramsey 2003; Rose 1994) have noted that hip-hop musicians, for instance, use sampling to index a particular moment, period, feeling or ideal by quoting other music. This point is already taken as gospel (and therefore is not worth another essay). But recombinant music-making goes even a step further than that—many DJs and mix artists purposely choose obscure music that their audiences *won't* remember (and for which they are less likely to be sued). But all recorded music bears a timbral imprint of its place and moment, partly because of the room, techniques, and technology used to make the recording and partly because of the cultural sensibility from which the recording emanates. All recordings have a *sound* to them—and this sonic part of the sample, even if listeners don't know the exact recording, may be powerfully evocative. One could imagine that a study of such a phenomenon might wind up arguing that this ability to index a moment or "feeling" might well be one of the most powerful affective dimensions of recombinant music.

Although recombinant music seems to have built a giant edifice on top of the cultural archive of recorded music, there is an important way in which it dishonors that archive as much as it honors it. Recombinant music, at least the process through which it is created, elides the difference between ambient (a more accurate term than "live" in this particular case) sound and recorded sound. Since many digital devices and programs are able to record as well as reorganize sounds, musicians can use them to mix-and-match elements from the ambient environment and found recordings to create new or musical sonic textures. In a certain sense, then, it doesn't matter if it's "live" or "recorded" because recombinant musicians do not—in this one sense—discriminate. Again, one could imagine the historian's objection. This practice goes at least as far back as multitrack recording. In the 1940s and 1950s, Les Paul played along with himself first on acetate recordings and later on audio tape. Though as Albin Zak has perceptively pointed out, multitrack recording did not catch on until the second half of the 1960s (Zak 2001, 14–17). Once again, it is not the technology per se but practice that we are after. Digital technology is clearly a significant component: anyone who has used the new loop-based software must concede that it is a qualitatively new instrument for music-making. But as an instrument, it is no more or less central than any other musical instrument. Is the dig-

ital sampler or loop-based software a more important or fundamental innovation than the electric guitar or analog synthesizer? This seems to be a comparative-historical question, and one that requires us to move outside the narrow realm of the digital in order to truly understand both the agency of digital technology, and the larger system of power within which it operates.

The Digital (Home) Studio

In a manner homologous to the ways in which commentators have credited samplers and other digital tools for the rise of recombinant music, the rise of the "home studio" and the explosion of small, niche-based "project" recording studios has been widely attributed to the development of cheaper, digital versions of analog audio devices. Paul Theberge has written eloquently on the rise of the MIDI-based synthesizer home studio. At the end of his book, he notes the explosion of home- and mobile-recording with a modular multitrack digital-tape system called the ADAT, manufactured by the Alesis corporation (Theberge 1997, 248–51). ADATs were released in 1992, and by the late 1990s they were ubiquitous, both in professional recording studios and in smaller home or project studios. The device is an eight-track recorder (it can record sound from eight separate microphones or sources at once, which can later be mixed) and it is modular, which means that you can buy three ADATs, hook them up to run together, and record 24 tracks at once, which was the standard analog "track count" in professional studios when the ADAT came out. At the time of its release, the ADAT was also comparatively cheap because it used analog-to-digital converters and recorded its digital data onto VHS tape (instead of the expensive 2" tape reels used by analog machines). As a result, the ADAT became the best-selling multitrack recorder ever within a few years of its introduction.

ADATs were also symbolic of the democratization of audio recording and changes in the audio industry. But the ADAT shared its distinction with a relatively inexpensive mixer manufactured by another audio company—Mackie. Mackie mixers were less noisy and of higher quality than other sub-$1,000 mixers, and they were a very common choice for ADAT-based studios because of their low price, high build quality, and portability. Like the ADAT, they did impart a certain sonic character to the music.[5] And like the ADAT, it was the best-selling mixer of all time.

So, here is an innovative digital device paired with an innovative analog device, both were often sold together, and both sold well. As they sold, they gained a certain symbolic currency. Despite a host of economic and cultural factors, the ADAT/Mackie combination came to symbolize the rise of amateur recording and a whole "semiprofessional" realm of small studios, often located in homes, or other less-than-optimal acoustic spaces. These new studios lacked the lavish acoustic design and esoteric equipment of their more professional counterparts, but they charged a lot less (or provided musicians with the facilities to make their own recordings) and they were a current in the maelstrom of musical releases that began in the mid-1990s. As Paul Theberge (1997) has put it, musicians have become consumers of technology to a degree hitherto unknown. And while more people than ever can record themselves, it is no easier than before to actually make a living in the music industry. And for some music professionals, like recording engineers, it became more difficult to make a living.

Because the ADAT and Mackie were iconic of this broader trend, they were often singled out for derision by professional engineers. At the 1997 convention of the Audio

Engineer's Society, a trade show for people in the recording end of the music industry, a controversial sculpture appeared on the convention floor. Entitled "Shit on a Stick," it featured an ADAT recorder and a Mackie mixer impaled on a four-foot metal spike. Sydney Fletcher (who simply goes by Fletcher), proprietor of Mercenary Audio and creator of the sculpture, said that his sculpture was "about the fact that they have been telling us that digital audio is great since 1980. But it doesn't sound great. They've been lying to us. Some day it's going to sound great, but not yet. It's the emperor's new clothes. Things like ADATs are good writing tools. But no more than that. They're writing tools disguised as being acceptable for pro-audio use and they're putting studios out of business. Most of the [records] I listen to [are] low budget; but the ADATs and the Mackies have taken away the incentive to make good-sounding low-budget records. They make them sound tinny. You can have great playing but the record has no soul because of the equipment" (Daley 1997). The sculpture almost got Fletcher kicked out of the show, and certainly offended employees of Alesis, the ADAT's manufacturer. (An apocryphal story has it that once he was shown the sculpture, a more good-humored Greg Mackie claimed that his company's mixer would still work if someone were to pull it off the spike and plug it in.)

Though the ADAT has since been eclipsed by hard-disc recorders,[6] and Mackie has released two updates to its mixer design, the sculpture is still a powerful icon. The story illustrates the degree to which people in the industry—and not just academics—believe in the magical power of the technology. But in Fletcher's striking sculpture, an analog and a digital device are impaled *together*, just as thousands of people had purchased them together. And as I've suggested above, the ADAT/Mackie combination did, in fact, index a larger assault on the cultural and economic supremacy of the professional audio engineer in the music industry even if the combo didn't exactly *cause* it.

Audio engineering has a mystique to it. As Louise Meintjes has pointed out, metaphors of "magic" and "wizardry" are often used in recording studio talk, and they function, in part, to mystify or explain the engineer's talent and the relatively esoteric equipment that populates most studios (Meintjes 2003, 93–98). This mystique went hand in hand with the professional engineer's economic supremacy—prior to the rise of the home studio, if you wanted to record something, you needed to rent time in a studio and hire a professional engineer.

But the home studio was not simply an effect of cheaper technology. It had been a desire and a lauded goal of musicians for decades. Trevor Pinch and Frank Trocco report the ambitions of early Moog synthesizer owners in the 1960s and 1970s to create completely mobile or home-based recording studios (Pinch and Trocco 2002). Rock stars who were lucky enough to have the money and big enough homes, could routinely set up their own studios. The Rolling Stones, famously, had a studio on a truck that allowed rock musicians to record in nontraditional spaces. Home recording was also a frequent selling point of cylinder phonographs in the 1890s and the first two decades of the 20th century, and analog tape machines in the middle of the century.

In fact, to truly understand the significance of home recording, we would have to do a broader study of the changes in the cultural status of the middle-class home since the 1960s. Although the "home" in "home studio" is not exactly the "home" in "home office," both terms point to paired trends: 1) the explosion of consumer electronics for domestic use (fax machines and copiers, or cassette-based multitrack recorders and cheap microphones) that digital-equipment industries could pick up on, develop, and

exploit, and 2) the effectiveness of what Alice Crawford (2003) has called the e-topian fantasy of the totally enclosed middle-class home that can function as work space, private space, play space, and as a replacement for public space. This extended functionality of the home, which critics of architecture and urban design have noted for some time now (Colomina 1992; Jacobs 1961; Rowe 1991; Spain 1992), and these new appropriations of domesticity are an important ground for the figure of the home studio.[7]

We would also have to consider understandings of what it means to make your own music. Two towering trends in 20th-century music are especially worthy of consideration here: 1) the move from orchestras and "big bands" to ever-smaller groups of musicians in a wide range of popular music, and 2) the increasing centrality of recording to people's musical experience. An operation like a home studio presupposes both of these phenomena: it would be impossible to record an orchestra or big band in most private homes. The home or project studio is designed to accommodate a smaller band or even the lone singer-songwriter or artist and producer, depending on your chosen genre. Couple this to the idea that bands primarily exist through their recordings (since this is how most people experience most of the music they hear) and the drive to record one's own music becomes nothing more than an extension of the desire to pick up an instrument and make music in the first place. Many of the music genres of the second half of the 20th century are by and large *studio* genres, as critics of rock and rap have pointed out (Dimitriadis 2001; Gracyk 1996; Rose 1994; Zak 2001).

Another key factor is so obvious as to miss: the economic boom of the 1990s led to a great deal of disposable income for the upper echelons of the middle class and the upper class. Even *relatively* inexpensive studio equipment was still objectively expensive when compared with other consumer electronics. A 16-channel Mackie cost about $1,000 and an ADAT cost more than $2,000, and prices went up from there. Expensive studio toys were a new form of conspicuous consumption. One can simply do a search of the archives of Rec.Audio.Pro, read back issues of *Electronic Musician* or countless other magazines to see the degree of gear connoisseurship that developed as disposable income became available. Indeed, months can go by without a single negative equipment review in the glossy audio magazines. On Internet user groups, this is taken to the extreme, where people will recommend brands and models of sound-processing equipment that they've never actually heard, based on reputation alone. These are not professional audio engineers, who through years of experience have learned to detect subtle differences among specialized devices; these are people who wish to demonstrate their consumer knowledge to peers. One can hear echoes of Thorstein Veblen's "man of leisure" in the sniping gear-snobs of Internet audio groups: "In the process of gradual amelioration which takes place in the articles of his consumption, the motive principle and the proximate aim of innovation is no doubt the higher efficiency of the improved and more elaborate products for personal comfort and well-being [or good recording, in this case]. But that does not remain the sole purpose of their consumption. The canon of reputability is at hand and seizes upon such innovations as are, according to its standard, fit to survive. Since the consumption of these more excellent goods is an evidence of wealth, it becomes more honorific; and conversely, the failure to consume in due quantity and quality becomes a mark of inferiority and demerit" (Veblen [1899] 1953, 60). If the professionals had a legitimate gripe about a dwindling economic base (even if they misguidedly attacked the equipment rather than less-tangible but more-significant economic and cultural issues), the amateur connoisseur has no reason at all to disdain the ADATs and Mackies of the world, other

than to distinguish his (and only very occasionally her) self from the thousands of other amateur recordists.

Audio manufacturers also, of course, benefited from the explosion of disposable income. But even more, they benefited from a shift in the logic of audio-equipment replacement. Inasmuch as the forced obsolescence cycle for digital equipment of all types is much faster than that for analog, audio-equipment manufacturers have a much more robust revenue stream. Consider that the expected durability of most analog audio devices is on the order of decades, *at the very least*. And some instruments can last half-centuries or longer. Over the past ten years, audio manufacturers have managed to accustom musicians and engineers to replacement cycles on the order of years and occasionally months, rather than decades. If we are looking for a digital revolution, here it is. But it is not the digital character of the gear, but rather the culture of design and marketing that is revolutionary, insofar as it helps to constitute new social and economic relations. To borrow again from Theberge, musicians are now often in the position of *managing* their relationships to technology. While this means more creative control in the studio, it also makes music a more expensive hobby. And it can lead people (including me, to my embarrassment, on some occasions) to believe that an equipment purchase might shore up some deficiency in the recording or song when more practice might do just as well.

There is, of course, much more to be said about digital recording. Computers are now ubiquitous in professional and amateur studios, as are various kinds of hard-disc–based recording systems. While digital audio tape allows for numerical storage, which was one of its primary advantages over analog tape (along with cheapness), hard-disc recording allows for much easier access to the kinds of transcoding that people think of when they think of digital recording: cut-and-paste–style random-access editing, automatic pitch correction, wild transposition and filtering effects, and all manner of spatial and psychoacoustic processing. Does hard-disc recording better fit the impact story for digital recording than digital audio tape? Again, I would argue that its significance is primarily organological—as an instrument in music-making. And it is bound up with other phenomena.

Let's take perceived loudness of recordings, for instance. Put two different CDs into a stereo, leave all the other settings the same, play one and then the other and you may find that they are of a different overall volume. Or that the quiet parts are of a different volume but the loud parts are about the same. Dynamic range—the range of volumes between different beats, notes, and passages—is a central aspect of musical perception. But more recent recordings, especially in rock, pop, and hip hop have had less and less dynamic range. In other words, the quieter sounds are almost as loud as the louder sounds.

The explanation is a little technical, but please be patient with me. Before a recording is commercially released, it is "mastered." One thing a mastering engineer does is set the overall level of the recording. In digital audio, the highest possible level is 0db (db is short for decibel), with the lowest possible level being approximately–96db for a 16-bit recording (which is the CD standard). What this means in practice is that 0db is the loudest that your playback system will get at a certain volume. So, if your volume knob is set to "2," a sound at 0db would be as loud as your system could put out at "2." If you turn your stereo up to "3," a sound at 0db will sound louder, since 0db is now as loud as your system could put out at "3." So 0db—the upper limit of a CD's volume—is always relative to the maximum volume that your system will put out at a given setting. Historically, recorded music has had a fair amount of dynamic range. So if you listened

to an old recording on a record player, it might vary between 0db (at its very loudest passages) and, hypothetically,–12db at its very quietest passages. Modern, digitally mastered albums sometimes go very little below 0db for entire songs. This is because it is well known that all other things being equal, people tend to think something that is louder sounds better.

With digital mastering software and equipment, it has been possible to limit music to an unprecedented extent, but the reason for this "loudness" competition has very little to do with the fact that it's made possible by the technology. After all, it's also possible to have a 96db dynamic range with digital audio (assuming that the analog recording equipment and transducers are of high-enough quality to reproduce such a range), yet we don't get ever-quieter recordings. In fact, I don't know of a commercial recording that's used half that dynamic range.

Rather, there are two important forces at work. One is competition among songs on radio stations. The idea is that if a song playing on the radio is just a little louder than the song on the previous station, listeners will be more likely to tune in. The other force at work is competition among albums and songs. This was, in fact, possible to accomplish before digital mastering: most radio stations have very powerful limiters designed to "limit" dynamic range. In fact, some are set at such extreme levels that the "louder" parts of songs will actually sound quieter than the "quieter" parts of songs. You can hear this on many classic rock stations, for instance, when there is a song with a quieter electric or acoustic guitar on the verse and loud, distorted guitars on the chorus. This competitive mentality has now been extended to musicians and record executives, who don't want their CDs to be the quietest one on the CD changer.

But in radio stations' defense, it's not just a matter of competition for audience attention, it is also a matter of following FCC regulation. FCC regulations of signal strength and bandwidth are extremely stringent for radio stations, and so, in order to comply with the terms of their licenses, most stations *must* use some kind of limiting to insure that they broadcast a consistent signal out into the electromagnetic spectrum and on to our receivers. So, in the case of loudness, we have a broad cultural sensibility that is better enabled by digital technology, but that was fueled by the economic relationships between radio stations, their attention to habits of listening (listeners scanning the dial for a good song), a side effect of FCC regulation, and musicians' internalization of that aesthetic sensibility. And we haven't even discussed the degree to which the *sound* of compression and limiting has become an important part of 20th-century musical aesthetics. To offer but one example, compression has more or less defined the sound of recorded rock music (Zak 2001).

The Future of Digital Music Studies

In the examples above, it is impossible to tease out the precise "digital" dimensions of a musical practice, or even a technological system. To answer the question posed in my title: there's not much that's digital in digital music. Even in the *most* digital situations—where the music is completely composed and recorded on computers, reproduced electronically, and published on the Internet—most of the actual musical event still happens as sound in the nondigital parts of the social world. There may be a few select cases in the analysis of a digital technology that explains a practice, but in many more cases, the digital is one factor in a long line of other practical considerations.

In this paper, I have tried to focus on situations where people have argued for the clear

and compelling impact of digital technology on music-making. But as we move away from those examples, it becomes even more difficult to conceive of digital technology as having an impact all its own. To take a diminutive example, consider the new phenomenon of the mobile, hard-disc–based mp3 player (Creative Labs' Rio and Apple's iPod are the two best-known examples). Here is a digital device that is, functionally speaking, not very different from any other kind of portable, personal stereo (e.g., a Sony Walkman). And as Michael Bull (2000) has shown, understanding the personal stereo is really a matter of understanding listening and experience in urban life. Does it make a difference that people are listening to mp3s instead of tapes or CDs? The one obvious difference is the storage capacity of mp3 players; it is now possible to carry a whole music collection around with oneself, instead of just a few selections. But does this really change anything? That is, ultimately, an ethnographic question, and it would have to be posed in the context of the intertwined histories of portable music listening and the maintenance and transportation of music collections. If that weren't enough, we might well have to move outside the specific realm of musical practice to the larger culture of data storage and movement, and the burgeoning cult of consumer electronics as one of the new frontiers of consumerism.

The question of digital music itself poses further difficulties for media scholars because, strictly speaking, digital music isn't a medium. Music isn't a medium, but rather a phenomenon that occurs in many media. I've said little about television and film, for instance, much less video games, advertisements, telephones and radios. There's certainly a musical and a digital dimension to all those media, and the stories of how those vectors intersect have yet to be written. And even they will be plagued by the difficulty of defining "the digital." As Tim Taylor, Trevor Pinch, and Frank Trocco all point out, orchestras have largely been replaced by synthesizers on TV program and advertisement soundtracks (Pinch and Trocco 2002; Taylor 2001). But those were analog synthesizers. The role of the shift to digital music-making in the sound and feel of contemporary television and film is an essay or a book that has yet to be written.

Like the transducer before it, the fact of analog-to-digital-to-analog conversion of sound has a history, and carries with it a truckload of cultural baggage, but that "digital baggage" truck must be understood in the much larger traffic of culture and practice. This might sound like a grim or slim view of digital technology. But I think scholars of digital music should rejoice at this state of affairs. It means that we have the opportunity, once again, to ask some fundamental questions about creativity and culture, technology and humanity, power, effect, and meaning. By eschewing an exceptionalist stance, where we treat the digital as a revolutionary or prima facie determining factor, and instead consider it in the vast traffic of practices, we will be able to better understand the role and meaning of digital technologies. This is because we will be able to see them as they really are: bound up with countless other technologies, people, natural forces, and institutions in vast networks, to borrow a term from Bruno Latour (1993).

But if I am going to end with the French, I'd prefer Pierre Bourdieu and his collaborators (Bourdieu, Chamboredon, and Passeron 1991; Bourdieu and Wacquant 1993; see also Sterne 2003b), who say that the most important moment in social research is the "construction of the object," the moment when the researcher decides which questions he or she is going to ask. Our challenge as scholars of digital technology is ultimately to reformulate our questions to approach digital technology from its many exteriors. In this essay, I have offered some possible avenues for doing that, but the point is not to follow

my lead. Rather it is to use your own imagination. Leave aside the advertising hype, the "new amazing products" and the black boxes that are supposed to change our lives. Scholars, ask not what digital technology can do for you! Instead, approach it anew each time, and ask after the world of which it is and must be a part.

NOTES

1. The author would like to thank Carrie Rentschler for her reading of an earlier draft of this essay.
2. On the history and significance of transducers, see Sterne 2003a, 31–85.
3. Observers familiar with the workings of recently manufactured synthesizers will note that most synthesizers are, at this point, essentially samplers because they build sounds from sampled waveforms. But the distinction between synthesis and sampling still has heuristic value because it indexes different sets of musical practices, so I will live with it for now.
4. The most basic elements of sound reproduction technologies have a long history over the 18th and 19th centuries in a wide range of sonic and social practices. And by understanding those earlier histories (I do not think they are "prehistories," even though recording was not officially invented until 1877), we can better understand the genesis, roots, and meanings of practices that appear to "belong" to sound recording and its cousins when they finally are "invented" (in the narrow sense of the term). Sound—and sound reproduction—have a history that cannot be contained in a single lineage of devices.
5. Though in my own casual listening, I think the significance of the "sound" of ADATs and Mackies is overstated in the industry. Much more important is quality of the music recorded and the talent of the engineer.
6. In new sales only. ADATs are still in use all over the world.
7. There is a vexed gender component here as well, since domesticity has traditionally been coded as feminine, while office work (apart from secretarial activity) and audio recording have, in many cases, appeared as stereotypically more "male" pursuits. As Crawford (2003) points out, the e-topian fantasy of the wired home is often a specifically male fantasy. But at the realm of changing practice, and given the number of women in the workforce, I think it also speaks to the changing gender dynamics of the professional world.

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