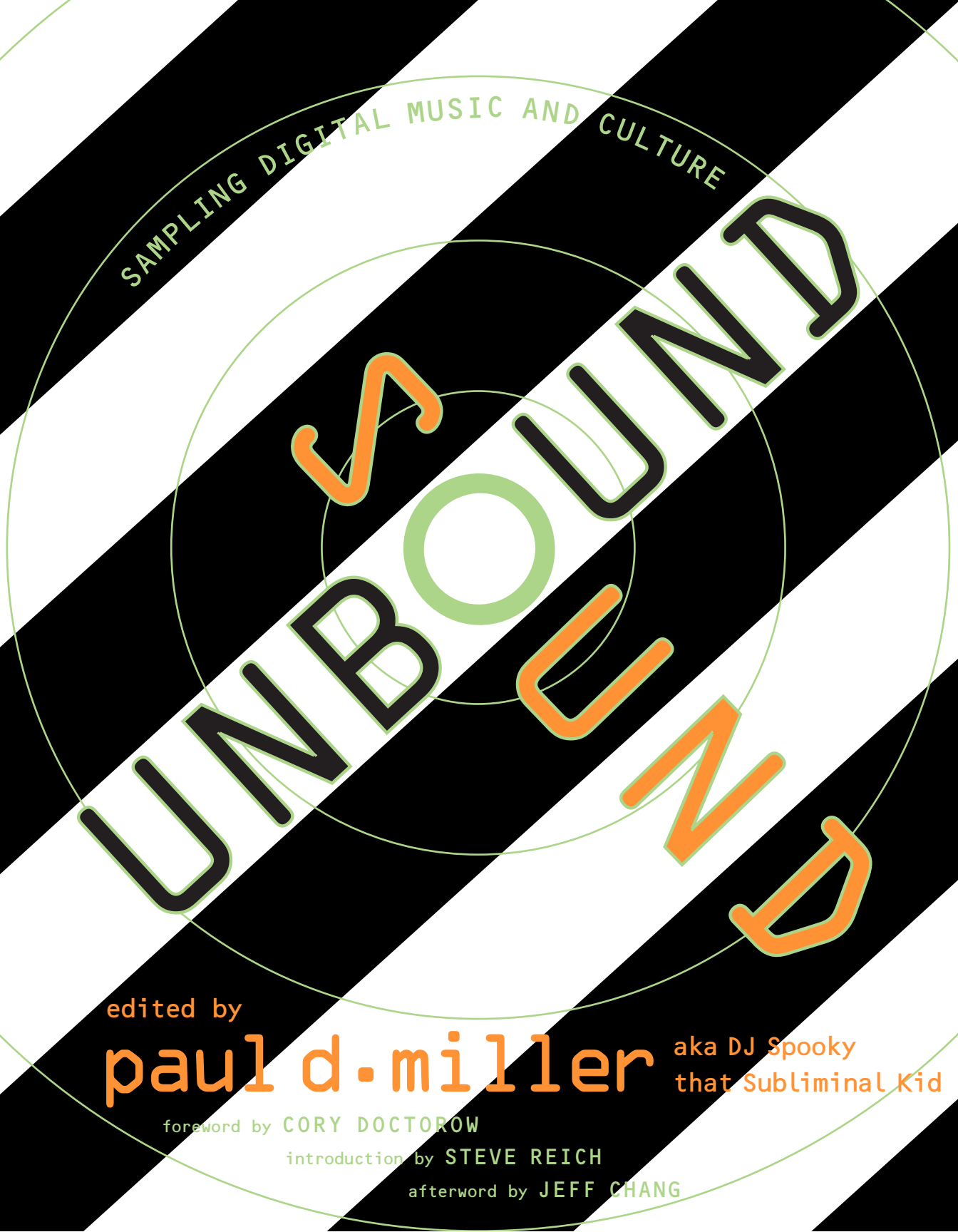
SAMPLING DIGITAL MUSIC AND CULTURE
UNBOUND
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Quantum Improvisation: The Cybernetic Presence

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Pauline Oliveros

Dedicated to the memory of Robert Erickson, who encouraged us all to improvise

According to Ray Kurzweil in his book, *The Age of Spiritual Machines: When Computers Exceed Human Intelligence*:

> In a hundred years there may be no clear distinction between humans and computers. There will be enormous augmentation of human perceptual and cognitive abilities through neural implant technology.
>
> Humans who do not use such implants are unable to participate in meaningful dialogue with those who do—knowledge is understood instantaneously through assimilated knowledge protocols. The goal of education and intelligent beings is discovering new knowledge to learn.

The speculations for the future in the Kurzweil book and others concerning self-aware machines with the ability to reproduce into future generations with patterns of matter and energy that can perpetuate themselves and survive set me wondering. It's already evident that computers and human intelligence are merging. What would I want on a musician chip if I were to receive the benefit of neural implant technology? What kind of a twenty-first-century musician could I be? Humans, with the aid of technology, already see and hear

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far beyond the capability of the unaided senses. It's not long according to Kurzweil when such aids will be available at the personal level as implants like personal computers or digital assistants. All of us improvisers could have new input from this and new challenges. I'll return to the question of my musician chip after looking back a hundred years for some reminders and highlights:

The first magnetic recording came in 1899. One hundred years ago—sound is recorded magnetically on wire and a thin metal strip. By 1900 the Gramophone Company advertised a choice of 5,000 recordings.

The human desire to record—to replicate and preserve—resulted in 52,000 CD titles produced in 1998!

Early Jazz improvisation emerged after the civil war and emancipation. Improvisation developed in parallel with radio broadcast and recording technology. It is not surprising that all styles and forms of improvisation from historical to free have been empowered by recording. Recording is the memory and documentation of improvisation and testifies to an enormous creative effort by innumerable musicians. Musicianship for written forms of music has been empowered by recording as well.

The African aesthetic imposed on American and European dance music leads to the decade of the birth of the blues and blues-influenced jazz—1920–30. Ma Rainey and Bessie Smith mothered this music and rose to short-lived stardom as blues queens during the migrations from the South to Northern metropolitan centers. Horn players of innumerable bands followed the lead of Ma Rainey, Bessie Smith, and other singers in a tremendous era of creativity and enterprise by people of African descent.

By 1930, 60 percent of all American households have radios. Improvised music spreads out from recordings and radio broadcasts. Music by Americans of African descent is heard throughout the land and influences all of American music. This enormous creativity is recognized and appropriated by the white entertainment establishment. The black–white exchange and interaction continues throughout the century and grows into the billion-dollar music industry which exists today.

In 1953 the first consumer-model tape recorders are available. This means that musicians can record themselves at home or in their studios—a sound mirror is available to use anytime. Musicianship escalates with the aid of tech-

nology. Today's musicians are phenomenal in their performance skills in all styles of music improvised and written.

Currently another wave of creativity originating from 1970s hip-hop sweeps youth culture—influencing the whole world. All recordings are sources for improvisation. Rather than frozen historical objects, recordings become live material through DJ scratching and remixing.

Classical music as taught in American establishment institutions and conservatories regards improvisation as a kind of craft, subordinate to the more prestigious art of composition. It's well known that Mozart as well as Beethoven improvised on their tours. Improvisation as a lost art was excluded from the curriculum and all but disappeared in America except for church organists and occasional cadenzas in concertos. The denial of the validity of improvisation has a racist tinge and origin. In America in the first half of this century improvisation grew mostly from jazz and blues—heart music of Americans of African descent—the disenfranchised. After 1950 improvisation appears in white avant-garde music through the influence of marginalized indeterminate or aleatoric procedures, exposure to jazz and blues and to recordings and live imports of non-Western music—also disenfranchised music.

What's the purpose of creating music in performance without reference to memory or written form—improvisation? The purpose varies according to the function of the music. One purpose is to enter into direct dialogue through sound with oneself and others. If the improvisation is creative then new mental and physical patterns could be born such as happened with Ornette Coleman and Cecil Taylor breaking away from jazz traditions in the '50s, and later Musica Electronica Viva, San Francisco Tape Music Center, and AMN breaking away from classical music restrictions with improvisation. If the improvisation is historical, such as replicating Charlie Parker, John Coltrane, or the legacies of other great improvisers without introducing new elements, then the purpose is to affirm a tradition.

The improvising musician has to let go of each moment and also simultaneously understand the implications of any moment of the music in progress as it emerges into being. In historical improvisation the course is charted or set by the conventions and codifications of the style—the classicism of the music; in so-called free improvisation nothing is known about the music before it happens—this edge is the challenge for human and for machine

intelligence. Unless the styles of the musicians improvising were already absorbed by the machine then what information would there be to calculate a response? If the outcome is known in advance it is not free improvisation, it is historical improvisation.

What in fact does happen when a creative musician makes new music? How can it be new or free? What is it free of? What could be new about it? What is happening with a solo improvising musician? a group? The soloist gives herself feedback and enters a dialogue with herself and musical space —the group stretches the possibilities for dialogue and new relationships come about creating a myriad of new possibilities even though the course of the music—new as it may be—will flow with ineluctable inevitability. The recorded legacies of innumerable musicians are waiting to answer these questions.

What happens when a new musician chip is implanted in a human or a machine? All ranges are increased. Processing is possible beyond known present human capabilities. What could be heard? Could a new musical paradigm include a new spatial domain? Moments of local sound—moments of moving sound with the ability to detect locations from light years away—defining new interdimensional spatiality? What would a spatial melody sound like—a pitch beginning on Saturn moving to Aldeberon to Sirius to Earth? Space-related frequency and amplitude—multidimensional melody—color/space/sound melody. Who would be playing this tune? Who would be listening and where? Melody across space stretched out and also happening everywhere simultaneously. Space is the place—I hear you Sun Ra!

According to the article "Is Space Finite?" by Luminet, Starkman, and Weeks:

> The universe may look infinitely large, but that could be an illusion. If space folds back on itself like the braids of a pretzel, it might be boundless, and light could spool around the cosmos endlessly. The usual assumption is that the universe is, like a plane, simply connected, which means there is only one direct path for light to travel from a source to an observer. A simply connected Euclidean or hyperbolic universe would indeed be infinite. But the universe might instead be multiply connected, like a torus, in which case there are many different such paths. An observer would see multiple images of each galaxy and could easily misinterpret them as distinct galaxies in an endless space, much as a visitor to a mirrored room has the illusion of seeing a huge crowd.

What if we could sound out, hear, and perceive the shape of the universe by bouncing sound around the torus? We don't have to be limited to the physical

definitions of our perceptual ranges. What about imagination? Here is the challenge of the machine—the promise of hybrid human–machine forms through implants. The challenge of new beings with formidable powers of perception, memory, reasoning, and interpretation. Non-carbon-based beings created by humans to eventually replace humans. Are we creating new beings to replace humans, or are we expanding our minds—making a quantum leap into the neocortex to develop our own potential power?

Back to the highlights:

In 1948, Norbert Wiener coins the word "cybernetics" meaning the science of control and communication in the animal and machine. The cybernetic presence is definitely with us. Kurzweil says in his time line: "10 years from now (2009) human musicians routinely jam with cybernetic musicians." This is a shallow statement because there is no revelation concerning style, complexity, or form. In fact many musicians are already improvising with machines programmed to respond to improvised input. Will Kurzweil's cybernetic musicians be self-determining in ten years?

In 1977 the first desktop computers from Apple become available. Musicians and hobbyists continue to work out programs to make and play music now in their own studios away from Bell Labs, Princeton, Stanford, and other institutions for computer music research.

At this time, improvisation is also developing and merging with new forms of interaction made possible by machine intelligence. Computers expand the reach of solo as well as group improvisers. Laurie Spiegel, David Behrman, Warren Burt, Joel Chadabe, George Lewis, Elliott Sharp, Jim Tenny, Deep Listening Band, Chris Brown, the Hub, and many others come to mind.

By 1990 computer hard disc recording and editing is available. A powerful and revolutionary combination—the merging of recording and computing. What a wonderful tool for the creative musician.

From Kurzweil, again: "In twenty years virtual musicians with their own reputations are emerging." We need to know what constitutes a musician. How will humans with or without implants compete or collaborate with the cybernetic presence? I don't feel comfortable with the notion of surgical implants. I hope that some noninvasive reversible form may be available.

"Thirty years from now direct neural pathways for high bandwidth connections to the human brain perfected. There will be a range of neural implants

to enhance auditory and visual perception and interpretation, memory and reasoning.'' What would be enhanced? What and how would such powers be measured and valued and by whom? What about imagination? What kind of improvisation could and inevitably will result?

Music and especially improvised music is not a game of chess—improvisation, especially free improvisation, could definitely represent another challenge to machine intelligence. It won't be the silicon linearity of intensive calculation that makes improvisation wonderful. It is the nonlinear carbon chaos, the unpredictable turns of chance permutation, the meatiness, the warmth, the simple, profound humanity of beings that brings presence and wonder to music.

We have looked one hundred years before and one hundred years ahead of the 1999 conference Improvisation Across Borders. Now for what I would want on my musician chip—what skills should the twenty-first-century musician have? What could she know?

In 1937, the Church–Turing thesis stated that ''All problems that humans can solve can be reduced to a set of algorithms, supporting the idea that machine intelligence and human intelligence are essentially equivalent.''

Returning to the future Star Date 2336, we find a machine intelligence—minus human emotions that evidently don't reduce to a set of algorithms until lately—at work on the *Starship Enterprise*. *Star Trek*'s android Lieutenant Commander Data is an imagining of the future predicted by the Church–Turing theory. Data solves problems and is a sentient life form with the same rights as other life forms. His ultimate storage capacity is 800 quadrillion bits and his total linear computation speed is 60 trillion operations per second. Data can remember every fact he is exposed to and can imitate voices so perfectly that he can even fool the computer of the *Enterprise* into thinking he is someone else. *Star Trek*'s Data has performed as a classical musician on several episodes. His classical musician chip allows him to perform any music superbly, having absorbed all known styles and all available recorded interpretations of written music. The musician who learns to perform classic forms and idioms is a conservative who affirms and preserves tradition. All of known music could be listened to, absorbed, analyzed, and interpreted by machine intelligence and be contained on a chip.

The composer is an organizer who designs and formalizes music prior to performance through notation. Computers already aid a variety of composer's

design calculations. Computers can engage in rule-based composition, and can calculate and realize musical forms. *Experiments in Musical Intelligence* by David Cope describes the basic principles of analysis, pattern matching, object orientation, and natural language processing. This system makes it possible to generate new compositions in the styles of various composers, from Bach and Mozart to Prokofiev and Scott Joplin. The program SARA (Simple Analytic Recombinant Algorithm) produces new compositions in the style of the music in its database. Already audiences are hard put to tell what music is composed by a human and what is composed by a machine. All known styles of composition could be contained on the composer chip.

Data could certainly handle all known styles of composition and historical improvisation. Improvisor is a computer program that creates original music, written by Paul Hodgson, a British jazz saxophone player. Improvisor can emulate styles ranging from Bach to jazz greats Louis Armstrong and Charlie Parker—historical improvisation. What about the improvising musician as an evolutionary? What would an improviser chip have to include for Data as a machine intelligence to engage in free improvisation? To boldly go where no musician has gone before, sounding through dimensions of space—of time? Finding new sounds and new sound relationships?

Data could probably analyze all known instruments for instrument makers, all performance abilities for performers, and all known musical forms for composers. The edge, though, is the unknown of imagination for performers, improvisers, composers, and instrument makers, and the unification of all these roles.

On my musician chip I would like the following features:

The ability to recognize and identify instantaneously any frequency or combination of frequencies in any tuning, timbre, in any tempo or rhythm, in any style of music or sound in any space.

The ability to produce any frequency or sound in any tuning, timing, timbre, dynamic, and articulation, within the limits of the selected instruments or voices used. Maybe I would also like to morph from any instrument to any other instrument or voice, at will.

The ability to recognize, identify, and remember any piece of music—its parts as well as the whole, no matter the complexity.

The ability to perceive and comprehend interdimensional spatiality.

The ability to understand the relational wisdom that comprehends the nature of musical energy—its form, parts, and underlying spirituality—as the music develops in performance.

The ability to perceive and comprehend the spiritual connection and interdependence of all beings and all creation as the basis and privilege of music making.

The ability to create community and healing through music making.

The ability to sound and perceive the far reaches of the universe much as whales sound and perceive the vastness of the oceans. This could set the stage for interdimensional galactic improvisations with yet unknown beings.

I suppose it would be great to be able to print it all out as well in 3-D color.

Are improvisers conscious? Do they have self-perception, self-awareness, the ability to feel? What is conscious improvisation? For that matter, what is unconscious improvisation? The body knows what to do even if the small mind does not comprehend. The body "dances" the music—the nerves fire and the mind notices slightly after it happens. Conscious improvisation involves strategy—responding strategically even if the outcome is unknown. A strategy of conscious improvisation might be: play only if you are listening—or, trust the body to respond. This melds of course the notion of conscious–unconscious improvisation.

The capability of the human mind is unplumbed. We have far more capacity than we currently use in the neocortex waiting for evolutionary expansion. Computers may actually instruct us in this process, as we continue to merge with the machine intelligence that we are creating and as we continue to develop improvisation interaction. We must decide, though, what a fifty-year-old structure of silicon is going to tell a five-billion-year-old structure of carbon before making irreversible physical changes.

Quantum computing is a revolutionary method of computing based on quantum physics that uses the abilities of particles such as electrons to exist in more than one state at the same time. Quantum computation can operate simultaneously on a combination of seemingly incompatible inputs.

By analogy or metaphor, quantum improvisation could mean a leap into new and ambiguous consciousness opening a new variety of choices. Ambiguous consciousness would mean the ability to perform in more than one

mental state simultaneously in order to reach or bridge past and future as an expanding present. There could be new sound combinations anchored by increasing order, even though choices might seem incompatible. Such a quantum leap could mean the utilization of more of the neocortex, the seat of creativity and problem solving. The newest part of the brain is waiting to evolve in association with the limbic system—the amygdala—the "old brain" and seat of the emotions. Quantum improvisation could find new ways to express and understand the relationships between mind and matter.

Ordinarily we use only a relatively small percentage of the neocortex—this reflects the style of most content-oriented education in institutions, which limits or suppresses rather than encourages creative problem solving. After enormous growth spurts in the brain by age sixteen, many people are no longer interested in creativity. Education—content-oriented education particularly—does not necessarily access the neocortex. Rather there is the classic learning of forms—cortical learning—recognizable forms with no encouragement or support for innovation, which requires creative problem solving. This situation is particularly true of music. Performance of traditional music is rewarded and encouraged rather than acts of creation. Performance and creativity both could be rewarded and encouraged.

What is needed now is a complete program—an Improvatory of Music for pre-K through post-doc in aural music, including all forms of improvisation and aural traditions, to complement conservatories. As soon as possible young children could be encouraged to improvise and create their own music. They could be introduced to sound gathering and listening strategies. This program would not replace traditional music learning but would complement, enhance, and make it possible for all people to participate in creative music making. An Improvatory would necessarily be interdisciplinary and include all the arts and technology.

There exist now 100 years of recordings of the complete range of improvisation from historical to free. This is ample documentation that could yield many fruitful studies for advanced degrees. Improvisational strategies could be introduced early and advance through graduate levels. Here is one example of an improvisational strategy: "Only sound what has not been sounded before."

Once an improvisation has happened, is recorded, and studied, it becomes historical. Too much replication can be destructive of creativity. Replication

guarantees survival and perpetuation of form but it would be critical to hold the space for creative problem solving—proposing an advanced problem to solve would be how to do this. Music teachers could encourage playing by ear as well as reading and writing music. The use of recording and computing could accelerate the learning of reading and writing music through intelligent courseware.

What would one learn at an Improvatory of Music? Basic listening skills, including the listening effect. Music only happens with conscious listening. Maybe one would learn quantum listening—listening in more than one state simultaneously. If you are not listening the music is not happening. A conscious observer is necessary. Conscious observation affects sound. One could also learn ways of sounding and listening—strategies; starting from scratch—making music by any means possible (e.g., bottle caps, found objects).

Other areas of study at the Improvatory:

Sound ecology—what happens in the environment?
Sound gathering through recording.
Sound sensitivity.
Sound provision with live feeds from sonically stimulating environments such as ponds, oceans, natural soundscapes, the weather, and many other sources including industrial and urban sites.
Sound as intelligence.
Relational techniques or relationality.
Relational organization.
Informality.
Egalitarian ethics.
Political structures.
Evolving open form processes.
Computing—computers may push us or teach us about the mind and facilitate a quantum leap into unity of consciousness.
Technology—especially tools for expanding the mind through listening.
Instrumental research and development.
Acoustics.
Psychoacoustics.
Organizational strategy.

An Improvatory requires an architecture that is supportive of the process—ideally. Chaos is a key resource in pushing evolution. Meeting places might

provide an appropriately chaotic environment with reconfigurable levels, color, textures, sonorous objects, acoustics, recording opportunities, and open spaces. There could be many choices to make.

The Improvising Across Borders conference has brought a new dignity to a creative activity, which has been marginalized by the Western, established musical order. It is time now for an inclusive curriculum where improvised music is no longer ignored or denigrated. Borders should not only be crossed, but should dissolve. Degrees in both aural and written musics should be available equally. Aural music informs written music and vice versa. Improvisation is a key process for creative problem solving and the expansion of mind that is needed to meet the challenge of the machine intelligence that we are creating. Improvisation is creative problem solving and is a portal to quantum thinking—thinking in more than one state simultaneously.

What exactly is free improvisation?—nothing is known in advance of making the music. What's the algorithm for that condition? It may or may not be free of historical patterns, or it may use historical patterns in new ways. Theoretically free improvisation is utterly spontaneous, like the big bang of creation. Maybe the big bang was the first and only genuine free improvisation. Algorithms anyone? How about holding the possibility of the first unknown sound to begin an improvisation at an unknown time in a group of players who are all new to one another? Imagine then a crowd of creative people improvising together.

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References

Cope, David (1996). *Experiments in Musical Intelligence.* A-R Editions.

Floyd, Jr., Samuel A. (1995). *The Power of Black Music: Interpreting Its History From Africa to the United States.* Oxford University Press.

Gershenfeld, Neil, and Isaac L. Chuang (1998). "Quantum Computing with Molecules." *Scientific American* (June 1998). Available at http://www.media.mit.edu/physics/publications/papers/98.06.sciam/0698gershenfeld.html/.

Kurzweil, Ray (1999). *The Age of Spiritual Machines: When Computers Exceed Human Intelligence.* Viking.

Luminet, Jean-Pierre, Glenn D. Starkman, and Jeffrey R. Weeks (1999). "Is Space Finite?" *Scientific American* (April).

Prevost, Edwin (1995). *No Sound Is Innocent: AMM and the Practice of Self–Invention.* Copula.