Improvisation as an Evolutionary Force in Laptop Orchestra Culture

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Laptop orchestras are electroacoustic ensembles of digital instruments such as laptops, tablets, smartphones, and various controllers, often enriched by analog modular synthesizers, DIY circuitry, or other electric or electronic devices used to generate or process sound. These orchestras constitute a diverse global performance practice that relies on improvisation to evolve—both locally in each ensemble and globally as an art form. Laptop orchestras engage with varying artistic, social, and technological media that are *alocal* in nature—that do not necessarily manifest identifiable cultural traits associated with the ensembles' localities or their members' cultural origins. While a complex web of cultural, geographical, and social influences clearly affects the training, perceptual habits, and creative, improvisational practices of these orchestras, such influences are too varied and rapidly changing to be isolated or traced. While some argue that the history of laptop orchestra performance is rooted in Western traditions (see Jeff Albert, "Improvisation as Tool and Intention"), its perceptual alocality and technological bases are better understood as the product of global, social performance networks. From the untraceable, alocal multilocality of laptop orchestras a dynamic, evolving improvisatory musical culture has emerged.

Improvisation has always been at the heart of the laptop ensemble. Many performances include novel logistical settings and collaborative forms, technologies, and sonic structures. An emphasis on new instrument design and a shared drive to innovate has opened the way for many new modes of improvisation, including with DIY interfaces (Arduino open-source software, for instance), through processing—rather than generating—sound, and with loop-based material, among many others. Navigating these uncharted territories demands rapid, creative responses to emergent possibilities and challenges.

In this essay, I argue that laptop orchestra practices—due to their tradition-defying, multidimensional, hybridic nature at the cultural, stylistic, geographical, personal, social, and technological levels—should be approached as a culture of related behaviours and beliefs rather than as a genre. I focus on how non-idiomatic improvisation serves as a crucial local and global evolutionary force within laptop orchestra culture by breaking with old patterns to discover new expressive possibilities, by creating new *sui generis* patterns, and by developing skills that radically expand improvisatory strategies. Laptop ensembles transform their creative output, modes of interaction and perception, and technology by exploring new settings, problems, and solutions. I also provide a snapshot of current improvisatory practices that are unique or have special implications for laptop orchestras (based on extensive contact and wide-ranging email interviews with laptop orchestra directors and members across various geographical and cultural contexts). Additionally, I offer my own experiences as founder and director of the Concordia Laptop Orchestra (CLOrk).

Antecedents and Common Features

Collective improvised live electronic music emerged most prominently during the 1960s with ONCE Group from Ann Arbor, MI (1961) and *gruppo d'improvvisazione nuova consonanza* (1964) and *musica elettronica viva* (1966) from Rome (Dunn 36). Their improvisatory approaches ranged along a continuum from restrictive to very free. In *Symphony, In memoriam Crazy Horse* (1964) by ONCE's Robert Ashley, improvisers followed simple instructions on a graphical score—with timing guided by a conductor. They played sounds of certain densities, at certain times, "freed from the necessity to produce precisely prescribed sounds, or from the demand to exert their imagination to improvise ever-new patterns" (Kasemets, et al. 517). In contrast, *musica elettronica viva* developed a freer improvisatory style that "move[d] away from predetermined programs" and focused on "interpreting the moment, rather than constructing repeatable programs," and on "becoming involved with the process, the operation, and not with the result of it, or its effect on people" (Rzewski and Verken 93). Whether restrictive or free, such performances were generally detached from previously established idioms.

Before the 21st century, however, collective improvisation had not been a major force in electroacoustic music. The majority of music made before the mid-2000s was *acousmatic* in nature—composed in the studio and presented as "tape music" in several recurring formats: played as is, distributed ("diffused") live into a multichannel loudspeaker (sometimes with a live-electronics performer), or accompanied by instrumental performers (usually also performing a pre-composed part). Following the emergence of several small live electronic ensembles (up to about six members) in the early 2000s (including Philippe Chatelain's Laptop Orchestra in 2002, where the term "Laptop Orchestra" was first used), the Princeton Laptop Orchestra, or PLOrk, (established in 2005 by Perry Cook, Dan Trueman, Scott Smallwood, and Ge Wang) ushered in a new trend of larger laptop ensembles (typically twelve members or more). Beyond numerical size, the larger orchestras emphasized a collective identity where individuality became secondary.

This new ensemble format provided opportunities for performers of widely varying skills and backgrounds to improvise electronic music in participatory settings where they also served as composers, researchers, and technology designers (Trueman et al. 443). Practitioners generally have engaged in multiple compositional approaches that have fostered a wider aesthetic breadth in interaction with new technological possibilities (Smallwood et al. 9). In the following years, dozens of laptop ensembles were established in North America and Europe, plus a few in Australia, New Zealand, South America, China, Japan, and the Middle East. A substantial number of these ensembles (SLOrk, OLO, Electric Company, BLOrk, Sideband, West Chester University Laptop Orchestra, among others) focused on improvisatory practices, often in interdisciplinary settings, and followed to varying degrees PLOrk's model, philosophy, and technological approach.

Emergent common features in laptop ensembles include *meta-instruments* such as synthesizers and programming environments that are designed (patched or programmed) on other instruments (McCarty 107; De Laubier 25), DIY hardware instruments (circuit bending, Arduino-based designs, and others), gestural controllers, network applications, telematic music, live coding, and education research (Woollard and Tsbary). These features are influenced by and have implications for improvising and listening practices in the laptop orchestra: with new instruments, improvisers cannot rely on established techniques and theory, years of practice, or virtuosic motor skills. They are more likely to experiment with and embrace, as a foundation for experimentation, error and uncertainty. By pushing improvisatory expression towards the unknown, performers discover new sonic possibilities and boundaries, as well as technological problems that can be corrected, if necessary, sometimes even live during performances.

Unlike traditional instruments, digital meta-instruments can encompass a great variety of content, context, and configuration (Tanaka 238). Through improvised exploration, performers test, improve, and refine instrument design elements including input devices (such as gestural controllers), mapping algorithms (software that translates input data into musical parameters), sound synthesis engines (sound generators modulated by incoming data), compositional structures (sectional arrangements or large scale processes), and output systems (digital-to-analog conversions and output channels). Appropriate, effective mapping of input signals to performance parameters—making gestural control feel natural and expressive—facilitates greater technical mastery and opens more possibilities for creating new improvisational paradigms.

Live coding—"coding music on the fly" (Collins et al. 321) during performance—is another rapidly evolving practice unique to laptop performance wherein performers share real-time improvisation with listeners and fellow musicians via a textual interface projected on a screen (McLean et al. 1). Such shared platforms turn meta-instrument design into sophisticated interchanges that allow performers to share, copy, and modify each other's codes (Trueman 175). Cybernetic Orchestra (CO) director David Ogborn, a leading live-coding researcher, believes that live coding promotes "public reasoning" (Rohrhuber et al. par. 7), that "thinking is improvising, whether or not it happens in a musical way," and that "music is a particularly successful way of making thinking public" (Ogborn interview), a perspective shared by many practitioners.

It should be noted, however, that live coding also has performance limitations in that it involves far less physical movement than performing with acoustic instruments and can therefore seem overly cerebral and esoteric. Furthermore, many listeners perceive improvisation as activity that requires immediate response, but in live coding, performers assess and produce musical ideas through a typed code—a process that naturally takes time (normally 3-30 seconds). Therefore, to maintain the music's drive, live coders often perform metric, loop-based textures, allowing loops to keep playing until the next line of code is evaluated. This stylistic preference is most apparent in the emergent "algorave" movement,¹ in which improvised algorithmic dance music is performed in various clubs and venues.

Meta-instrument design and live coding are two representative examples of the constantly evolving, innovative nature of laptop orchestra practice. Due to this drive for innovation, performers typically operate under conditions of uncertainty in novel and unpredictable logistical, technological, and sonic environments that demand highly tuned improvisatory skills. In my experience directing the Concordia Laptop Orchestra (CLOrk), I have found that such unpredictability serves a collaborative, problem-centered, time-sensitive approach to creation—both at the individual and ensemble levels—and is essential preparation for performance success. We have named this approach *Whatever Works* (WheW), to favor time-sensitive functionality and forward motion over researched or "best" solutions (Tsbary and Woollard 54).

Cultural Localizability, Configuration, and Alocality

The great majority of laptop ensembles are located in the US, Canada, and the UK, but they may also be found in over 20 other countries, including China, Iran, Israel, Japan, Lebanon, Russia, and Turkey. Other ensembles,

focused on telematic, collaborative improvisation and online performance (Giaso, Global Net Orchestra, Avatar Orchestra, Shared Buffer, Ethernet Orchestra, etc.), are multilocal in nature (Woollard and Tsabary). As such, local and cultural markers in laptop orchestra music often stem as much from deliberate artistic intent as from geography, nationality, or individual origin.

Ensembles are undoubtedly affected by their localities, but in ways that are largely procedural—not stylistic or idiomatic—and artistic outcomes are typically detached from cultural contexts. For example, co-director Mohammad Pazhutan lists John Coltrane, Miles Davis, King Crimson, John Cage, Karlheinz Stockhausen, and Halim El-Dabh, among other composers, as the main influences on the improvisatory practice of the Iranian ensemble MP | vH+, demonstrating a fundamental stylistic interest in the global electroacoustic and improvised music communities. The effects of these global influences may, however, be very idiosyncratic, not necessarily producing a sense of belonging and community, especially in countries where laptop orchestras are rare. Working in Tehran and without any university affiliation, MP | vH+ is isolated from the worldwide community of laptop ensembles; therefore, the ensemble's co-directors Mohammad and Honey Pazhutan cannot gauge with confidence the relevance of their improvisatory practice in the global reality of laptop performance. As M. Pazhutan explains, "besides searching the web, there is no other way for us to know if somebody else works like us or not." Geographic detachment undoubtedly limits MP | vH+'s collective sense of confidence, but is this likely to produce an identifiably Iranian sound? I think not.

Contrarily, in Montreal, "a city that is very friendly for experimental musicians" according to student member Mariana Czapski, CLOrk can operate with more confidence through a sense of belonging to local and international art communities. CO likewise "enjoys good relationships with a whole series of arts organizations" in downtown Hamilton, which "is a source of confidence for the orchestra" (Ogborn). While these logistical and cultural conditions affect confidence and sense of belonging, do they localize the ensembles' improvisatory style? Again, I think not.

Local identity is further complicated by the rapidly evolving style and technology of laptop orchestras. It is therefore difficult to answer these questions with certainty, although a tentative response suggests the need for attention to procedural inflection rather than local, idiomatic reflection. Jeff Albert sees laptop orchestras as developing from situations "rooted in the Western European classical tradition and its experimental fringe" (par. 1), but none of the ensemble members interviewed for this study agreed. I therefore propose that laptop orchestral practices develop from cultural roots that are more complex, multilayered, and hybridized. As Samson Young, founder of Hong Kong-based Electric Company (EC), avers,

The great thing about laptop instruments is the fact that there is no common practice and the history is relatively short. I mostly do not think that New Interfaces of Musical Expression (NIMEs) are, say, Western. One can speak of the violin being "Western" I think, but perhaps not the laptop?

A similar sentiment is expressed by M. Pazhutan:

When I compose music, for a computer-based ensemble, or any other form of ensemble, I do not regard myself as somebody from a specific country, with specific beliefs and biases; instead, I let my imagination be free and flowing. I always looked at music as math and science. There is no nationality in science and math.

Young's position that NIMEs are not Western (or non-Western) is easy to accept given their birth in an era of high-tech development and worldwide Internet usage greatly dominated by Asian markets.² Pazhutan's argument that his musical practice is non-national may be more debatable, but it can be supported by MP | vH+'s list of improvisatory influences. Though these influences are mostly from the West, they may not be idiomatically Western because jazz is culturally hybridic (Porter xvii) and its artists often engage with non-Western interests and influences. John Coltrane's spiritual interests in Sufism and Jewish mysticism influenced his thought and music (Mohajer 5), King Crimson's improvisatory style of the early 1980s was influenced by Javanese Gamelan music (Bohling 29), John Cage's Japanese Zen influences and interest in East Asian studies played a central role in his aesthetics (Pritchett 1), and so forth. Influenced by Western music with Eastern influences, MP | vH+'s improvisatory style evolved in a second-generation (or intensified), culturally-hybridic manner. BSLOrk director Eufrazio Prates cites similar, multilayered, hybridic patterns in noting Derek Bailey, whose practice grew from the study of many world musics including Indian (Bailey 14) and Flamenco (17), as "one of our most important references" for improvisatory style.

While artistic creation does not occur in a vacuum and improvisers' styles are arguably products of rich, multifaceted cultural and personal experiences, localizability—perceiving a style as belonging to a localized culture—depends on additional factors, most prominently intention. For example, director Roger Mills indicated to me that the Ethernet

Orchestra (EO) was created specifically “to collaborate with musicians of different cultures with different instrumental timbres” and that their improvisatory practice is “influenced by all the idioms that are coming together at any one time . . . depending on the locations and cultures of musicians engaging in any one session.” Interculturality—interaction among identifiable cultural features—is approached here through idiomatic dialogue that includes the use of culturally identifiable instruments (in contrast to the culturally-neutral laptop, itself a debatable construct).³ Although individual elements in EO’s performances are localizable, their mixing of remote cultural elements in telematic performances blurs any overall sense of locality.⁴ Laptop ensembles evolve alocally—affected by a complex network of cultural influences that are becoming increasingly undefined and unrestricted geographically. The combination of a large variety of timbres, textures, processes, and instruments with the rapid evolution of approaches, technologies, and sounds masks location and origin (Beck and Branton 27). As Czapski has noted to me, “although there were people from different nationalities and cultures in the [CLOrk] ensemble, I don’t think there are any evident characteristics of transcultural exchange.”

Global laptop ensembles are too rich and unpredictable to be considered idiomatic; nevertheless, their many shared interests and practices (new interface design, networked music, live coding, etc.) could constitute a culture of shared behaviors and beliefs. The geographical and cultural diversity of ensemble members drives this innovation, leading to new hybrid improvisatory practices. In other words, the absence of uniform, localizable idioms does not weaken their sense of identity, but is rather a defining feature of laptop orchestras.

Innovation

Laptop orchestra culture thrives on innovation, as is evident from many of my interviewees’ responses: BSBLOrk’s mission, for example, “is to emphasize new paradigmatic notions in order to provoke self-questioning on what is music” (Prates); Mills explains that “intercultural tele-improvisation . . . by its nature requires an empathy and dialogical exchange to create the conditions in which innovation can occur”; Pazhutan emphasizes the role of new technologies in innovation, as they allow the ensemble to “improvise with parameters that without contemporary technologies were impossible”; and CLOrk student member Peter Van Haaften states that “technologies such as Pure Data and Max/MSP [are] essential to the improvisatory practice of CLOrk, and I think that they will open many more doors for the ensemble in the future.”

I am often asked about the value of having multiple laptop performers, given that a single laptop can generate an equivalent sonic richness and complexity. My primary answer is that learning and innovation benefit from collaborative music making and depend on what Christopher Small defines as “musicking”—treating music as a process of social interaction rather than a product to be disseminated, as “an encounter between human beings . . . [where] all are contributing to its nature through the relationships they establish with one another.” (2). As Hill et al. explain, “innovations most often arise from the interplay of ideas that occur during the interactions of people with diverse expertise, experience, or points of view” (17). Innovation is “a problem solving process [and] a process of trial and error, often to embarrassing degrees” (18), where “the most innovative solutions [are produced by] making integrative choices, which often combine ideas that once seemed in opposition” (19). When conflicts emerge, therefore, the most innovative solutions are found not through compromise among people or by selecting the dominant approach, but rather by devising creative strategies to integrate opposing ideas.

These solutions often happen both asynchronously when “improvising” working solutions to emerging performance needs and synchronously during group improvisation. Laptop performers are often faced with new and unpredictable timbres, gestures, textures, and processes improvised by their partners, and they must respond to these sounds and ideas with an integrative approach that, to paraphrase Tina Fey’s rules of (comedic) improvisation, must agree with their partners’ contributions and add something to them (83). This collaborative attitude also informs CLOrk’s WheW approach in which critical reflection and trial solutions to emerging synchronous and asynchronous problems take place in a democratic educational setting where all orchestra members function as creators and researchers (Tsabary and Woollard 68).

Diversity in ensembles can have many bases: culture, gender, skill, discipline, background, or simply personal interest. As posited by Hill et al., greater diversity tends to prompt innovative and collaborative problem solving (140), and my experience through CLOrk with interdisciplinary, multilocal performances supports this assessment. In rehearsing *Dancing with Laptops*, for instance, I assumed that eighteen mostly first-time laptop improvisers could not create a meaningful performance with three dancers in only two rehearsals. I initially planned to use Soundpainting⁵ to guide their interaction, but this setup resulted in poor flow between the musicians and dancers, overly dense sonic textures, and a limited expressive range that the lead dancer found “extremely tiring” (Tsabary and Woollard 69). Through open discussion, the group decided to experiment with an improvised setup in which the dancers became *de facto* conductors. Observe in the following video how their improvised movements convey rhythm and dramatic

intensity, driving the laptop musicians' responses. Thus the problems posed by conflicting performance media led to a new, integrative improvisatory model.

Click image above to watch video, "Dancing With Laptops: Concordia Laptop Orchestra (CLOrk) and Collab'Art de Stéphan B (Montreal 2014)."

Hybridity

Integrative solutions often cannot be segregated into distinct components because the ideas are quickly used by others as containers, platforms, and inspiration, leading to hybrid, co-created, and co-owned (or unowned) performances. Such solutions produce sophisticated mixtures of subjectivities, cultural influences, backgrounds, interests, and talents that are difficult to trace. This hybridity not only influences the sonic outcome of a performance, but can also transform the practitioners themselves. As Ogborn explains, "I think the sound, the timbre, the character of everyone you collaborate with shifts your own character ever so slightly in one direction or another (in a highly multidimensional space, to say the least)."

In addition to musical interaction, performance ideas can be communicated via texting—a very accessible laptop tool that provides a real-time score and allows for operational communication behind (or in) the scenes, supplementing with precision and sophistication aural and visual communication. As Freeman and Van Troyer explain,

Text-based performance interfaces . . . are a fascinating fusion of composition and improvisation. Textual performance interfaces can offer a precise and concise means to define, manipulate, and transform motives, gestures, and processes in real time and at multiple hierarchical layers. They can also render musical thinking visible to the audience by projecting the text as it is written (8).

Improvised hybrid creation also demands that performers share creative and intellectual ownership of the sonic material generated, as players rarely have an opportunity to shine individually in such settings—and indeed often cannot be identified within the mix due to the versatile, unfamiliar sounds and patterns of laptop instruments and the general lack of visible, correlated gestures characteristic of performers on acoustic instruments.

Blurring ownership further is the fact that performers can manipulate—rather than generate—signals created by others or by the entire collective. A laptop musician may improvise with musical parameters such as the orchestra's tempo, pitch structures, and dynamics; signal processing parameters such as cutoff frequency, reverb duration, delay feedback, and grain size distribution; or other combinations of parameters. This type of interaction—unique to

electroacoustic performance—compartmentalizes sound generation and transformation to produce one rich, integrated voice. For example, in one improvised live coding game by CO, all the laptops produced patterns from the SuperCollider pattern library on an individually designed instrument with various shared parameters. Every performer was assigned control over a single parameter for the entire group, “such that one performer decides the rhythm for all, another decides the pitch, another decides some or other spectral parameter, etc.” (Ogborn).

CLOrk also often uses a shared network-based metronome wherein a single computer drives the sequencers of all the laptops.⁶ Ogborn explains that such automated looping has the advantage of freeing performers from keeping the meter to focus on other parameter controls, such as shuffle, triplets, double-time, pattern on/off, and live signal processing (57). For example, during a 2014 performance of composer Pouya Hamidi’s *Sparks*,⁷ CLOrk automated their sound generation and metronome through a conductor patch, and performers improvised with only those parameters stipulated by Hamidi: delay, flanger, EQ, degrade, reverberation, and a flexible Max/MSP host called “sound tap.” Compartmentalizing improvisatory parameters individually in this way creates an overall sound mass from which audiences cannot distinguish the constituent parts and actors.

Out with the Old and/or in with the New

Albert divides improvisation into two domains: (a) *improvisation as intent*, aimed at discovering “new or compelling expressions and modes of interaction” (par. 7), and (b) *improvisation as a tool* for investigating new instruments, operational modes, and compositional strategies. Improvisation as intent is unrestrictive, exploratory, and an effective entry into collaborative creation: “when you are at the point of really wanting to explore what is possible in complex and changing configurations of code, well, you have to improvise” (Ogborn). Similarly, in the intercultural context of EO, “for musicians meeting each other online, possibly for the first time, improvisation is a good way to begin an interaction” (Mills).

Beyond an entry strategy, improvisation as intent is also useful for breaking with tradition, moving away from known comfort zones into new potentialities that are putatively free, non-judgmental, and without obligation to conventions or standardized interaction formats. BSBLOrk’s improvisatory aesthetic, for instance, is based on the belief that contemporary music “should be unpredictable, fresh, provocative, dynamic . . . interactive . . . non-linear, non-periodic, chaotic” (Prates). According to M. Pazhutan, in MP | vH+ improvisation is used to “free the music . . . and promote development and change.” H. Pazhutan similarly posits that improvisation leads to performance “not influenced by the past . . . we do not restrict anything and are more interested in exploring the possibilities.” Improvisation as intent is therefore akin to embarking on an expedition into uncharted wilderness. Discovering new forms of collective creation requires a release from the known and an embrace of the unknown: irregular, novel approaches to technology; new sound creation and transformation techniques; experimental interaction modes; risky, destabilizing musical gestures; and errors.

These seeds must be nourished, however, by delving into new musical possibilities and developing them further for performance. Ensembles use structured, restricted improvisation as tools for developing new practices, skills, modes of interaction, and technologies into defined, reusable tools for collective performance. In EC, for example, “we experiment and improvise within the bounds of a loose set of instructions, and then after a couple of rehearsals like this, we would finalize our notation” (Young). In some of CLOrk’s performances, improvisation is based on the gesture vocabulary of Thompson’s Soundpainting system,⁸ while other performances are compositionally and technologically free, so long as room is given for emerging dialogue and individual expression.⁹ In BSBLOrk, all members perform with hand gestures on a Holofractal Transducer of Music and Image (HTMI), an instrument designed by Prates that “is able to convert images captured by the webcam into real time synthesized and granularized sounds.”¹⁰ He told me that playing this instrument with hand gestures, “as if each one of us was the conductor of our notebooks,” has been the most distinguishing feature of BSBLOrk, and that using it allows members “with very mixed background[s] in music . . . to produce complex sounds and patterns in very simple ways.”

The dichotomy of breaking with tradition and establishing new possibilities is not binary, and ensembles usually practice both improvisatory functions simultaneously at different musical and organizational levels. For example, while BSBLOrk expands its aesthetic palette with unpredictable and chaotic improvisatory intent, its members are also limited by the restricted possibilities of the HTMI. CO’s exploratory live coding improvisation is similarly restricted by its programming language and interface. The choice in any setting is therefore not *whether* to practice one domain or the other, but what weight to give each and where and how to apply it.

Improvisation as an Evolutionary Force

When asked whether their ensembles and their members' improvisatory styles evolved perceptibly, interviewees gave mixed responses. Prates observed no such evolution "because we are so young and also because we change everything all the time." Mills "hesitate[d] to say there [was] an evolution in style because with EO there [is] not one definable style but many," and added that "perhaps the evolution is in approaches to dealing with constant uncertainty." CLOrk members felt that "the ensemble changed a lot" in the course of one semester (Czapski), "experiment[ed] with a wider palette of sounds as the semester progressed, . . . [and] began to employ higher levels of processing and gesture control" (Van Haaften). M. Pazhutan posited that evolution "always happens even in short-lived ensembles . . . and also observed the cultural change in some of the members, parallel to their knowledge progress and the shift in their perception."

While change is observable in all ensembles, most interviewees felt uncertain whether it was evolutionary, possibly because the term "evolution" is often associated with progress. According to Mary McDonald Pavelka, "natural selection produces only local adaptation and not change in the direction of some overarching plan or design for the way things are intended to be . . . [It] is not heading anywhere. There is no plan in it." (s41). Hodgson and Knudsen also argue that "there is no requirement that outcomes of a selection process are necessarily optimal or improvements on their precursors" (57). Similarly, while the orchestras mentioned above all witnessed change, which by nature indicates elements of variation and selection, they were not able to identify more than localized adaptations. Also, while the interviewees are creatively involved with their ensembles on a daily basis, they may lack a wider perspective of their ensembles' identities and of global laptop ensemble practices. Hence the request to assess the evolution of their ensembles through improvisation may be unfair, and the lack of a standardized language, sonic lexicons, and evaluation parameters makes this task even more difficult.

Still, analyzing ensemble practices, formats, activities, and skillsets as part of an evolutionary process can provide broader perspective on the multilayered relationships between improvisation, emerging technologies, and new artistic practices. I have found it useful to apply the terms *variation*, *inheritance*, and *selection*—three foundational Darwinian principles—to the contextual mechanisms of laptop orchestra evolution: we must explain "how variety occurs and how it is replenished," similar to genetic recombination and mutation; we must identify the mechanism—equivalent to DNA inheritance—for retaining and sharing "solutions to particular adaptive problems"; and we must define the element of selection whereby some entities survive longer and produce more copies of themselves (Hodgson and Knudsen 56).

Variation is possibly the most dominant element because laptop ensembles involve artists of extremely varied backgrounds and widely differing creative approaches. As Andrew Barry, Georgina Born, and Gisa Weszkalnys explain, "the evolution of disciplines has often come about through the eruption of interdisciplinary challenges" (23). A culture that does not abide by any standardized rules or aesthetic values provides an abundance of "errors"—unpredictable new sounds, textures, processes, interactions, and technologies—somewhat analogous to the high mutation rate of RNA viruses that evolve about one million times faster than DNA organisms (Gojobori, et al. 10015).

The mechanism for inheritance—"how useful information, concerning solutions to particular adaptive problems, is retained and passed on" (Hodgson and Knudsen 56)—exists at multiple levels of musical operability. At the ensemble level, group discussion and critical reflection lead to democratic, integrative solutions (Tsabary 659; Mudd 34), while on a global scale new problems, solutions, practices, and technologies are communicated through specialized journals,¹¹ conferences,¹² online forums, social networks, and telematic collaborations. Laptop performers' inherent skill with digital technology enhances this dissemination.

Selection "bring[s] about the survival of some variations rather than others, and often reduces variety" (Hodgson and Knudsen 56). At the ensemble level, this principle applies to practices crucial, at least for the moment, to a group's artistic identity. For example, EC typically performs with mobile instruments where gear is "integrated into a wearable contraption, including the speakers . . . [and members] play / write pieces that showcase / take advantage of this mobility" (Young). With CO, "Live coding quickly became a defining characteristic of the group . . . The group's performances are often beat oriented, both by predilection of the members and as a use of the EspGrid synchronization software" (Ogborn). CLOrk's identity is primarily educational, utilizing a curriculum "built around highly participatory planning, production, and realization of innovative interdisciplinary and networked laptop orchestra performances" (Tsabary 657). In its first three years, CLOrk's improvisatory practice was primarily guided by Soundpainting conduction, but since 2014, it has primarily performed unconduted, free, interdisciplinary improvisations (Tsabary and Woollard 56).

Improvisation plays a central role in all three of these fundamental evolutionary principles. Breaking away from tradition promotes variation, while the development of new patterns is driven by evolutionary selection. As Hodgson

and Knudsen explain, “innovation is about the creation of new variations; selection is about how they are tested in the real world” (56). Inheritance occurs when performers observe and imitate improvised modes and techniques. Selection is then also evident in trends (meta-instruments, DIY hardware, live coding, telematic collaborations) that get traction and spread among laptop ensembles around the world, giving birth to online communities, research partnerships, specialized journals, shared tools, and shared aesthetics.

Conclusion

Two types of improvisatory intention drive the rapid evolution of laptop orchestra culture: free improvisatory practices break with tradition and lead the way to new sounds, textures, and processes; while restrictive, focused forms of improvisation develop new, tangible performance skills. These two intentions also have complementary evolutionary functions—free improvisation promotes variation, while restrictive improvisation promotes inheritance driven by selection.

Perhaps what stands out most in laptop orchestra practices is a multi-dimensional, hybridic nature—geographically, culturally, improvisationally, technologically, and socially. The traditional distinction between composer, performer, and instrument designer is ambiguous, as these roles often rotate or completely merge in some settings (Gurevich and Treviño 108; Collins 77). The rich, sonic palettes created by laptop orchestras are, due to the laptop’s sonic versatility and lack of performance conventions, coproduced without distinguishable individual voices. Network technology and shared-buffer live coding practices turn multiple laptops into a single instrument that can be played by several performers at once.

Presently, most laptop orchestras are Euro-American, but there are a growing number of ensembles forming in other regions, and some ensembles (like EO) are multi-local in nature with a geographically distributed membership. Whether multilocal or unilocal, laptop performances are typically alocal, and while there are many cultural, geographical, and human influences on performers, these influences too are varied, rapidly changing, and difficult to isolate or trace. These influences are further hidden by a determination to discover new possibilities, sounds, and technologies—to be “influenced by the future . . . not by the past” (Pazhutan, H.).

The Ethernet Orchestra’s multilocal, multi-idiomatic performances are unique among the ensembles in this study because they build on diverse interactions between culturally identifiable instruments and improvisatory practices and culturally unidentifiable laptops. Despite localizable components, however, EO’s overall performance practices are as alocal as those of most laptop orchestras, though with a different “flavour” of alocality. These unlikely cultural mixtures are characteristic only of EO’s performance intentions and are not localizable as Australian, where director Roger Mills lives, or as belonging to any other country.

Global laptop orchestra practice is rich in “flavours” of innovation, creation, improvisation, interaction, technology, education, social setting, and purpose—too many to be packaged as an idiom. This wide disparity is, counterintuitively, a unifying trait of laptop orchestra culture: the celebration of difference. I propose treating this global practice as a culture of related behaviours and beliefs rather than as a genre. Human-Computer-Interface researcher Alan Blackwell and live coding pioneer Nick Collins support this view: “Laptop music is not a genre, but a characteristic of contemporary performance practice in electronic music” (122). As this culture evolves with new ensembles and an ever-accumulating body of research, we may witness new manifestations of its larger patterns and characteristics: alocality, disparity, hybridity, innovation, collaborative creation, and the evolutionary force of improvisation.

Notes

¹ Coined in 2011 by Nick Collins and Alex McLean, the algorave portmanteau (algorithmic rave) can be interpreted in diverse manners, but “algorithms, music and dancing should be involved” (355). Through live-coded improvisation of dance music in club settings, algorave events bring the work of computer music researchers to mainstream clubbers. The algorave movement has been growing in the past five years in Europe, Asia, and North America, with an increasing frequency of performances, as evident on the algorave website: www.algorave.com. See also Tom Cheshire. “Hacking Meets Clubbing with the ‘Algorave’.” *Wired*, September 2013, www.wired.co.uk/article/algorave.

² www.statista.com/statistics/249562/number-of-worldwide-internet-users-by-region/

³ For example, listen to the Ethernet Orchestra's "Distant Presences" (youtu.be/iKL3kzPaSXM). Notice how the distinct sounds and images of the Turkish Oud and Mongolian horse fiddle at the beginning and the Behir and throat singing at 1:40 stand out as localizable, idiomatic elements due to their familiar timbral and expressive features.

⁴ According to EO's director Roger Mills, perhaps the most substantial challenge of telematic improvisation is interaction without "corporeal significance" among distributed musicians. He told me, however, that such lack of corporeality is not really problematic because significance is achieved primarily through aural interchange, and "apart from occasional glances, improvisers often don't look at each other in co-located improvisation." Furthermore, corporeal interaction is a relatively new concept in electroacoustic music that has for decades evolved primarily in studios and through acousmatic presentations in dark concert halls. Laptop musicians are much less dependent than instrumental musicians on gestures and visual cues from their collaborating improvisers, because unlike acoustic instruments, the laptop demands visual focus and is often less immediately responsive.

⁵ Soundpainting is a live composing sign language developed by composer Walter Thompson for communicating specific instructions about content, process, and interaction to an ensemble during structured collective improvisations.

⁶ Orchestras have used various tools (typically proprietary) for syncing laptop clocks over a network. Examples include Ge Wang's *Non-Specific Groove Interface*; David Ogborn's *espBeat* and *espGrid*; and my own *OSC/MIDI Step Sequencer and Metronome*, or OMSSAM (youtu.be/liqOkAEEUL0).

⁷ youtu.be/mRaxFWEA0Qc.

⁸ For examples of improvisation guided (restricted) by Soundpainting conduction, see CLOrk and CO's *Concerto for T-Stick and Two Laptop Orchestras* (youtu.be/zlheWtLA_-4) and CLOrk & Orchestre Symphonique de l'Isle's *Creation* for laptop and symphonic orchestras (youtu.be/qQb4uWWZ34w).

⁹ For examples of interdisciplinary, free improvisation, see CLOrk and Collab'Art de Stéph B's *Dancing with Laptops* (youtu.be/IOIzk6Rr14k) and *Blind Date*, performed by CLOrk with Dan Toren and Sharon Hochma (youtu.be/ESDPX4TuAzo).

¹⁰ See, for example, BSBLOrk's *Holofractal impromptu #19 part I: Pinheirinho* (youtu.be/qAoBlty-q0o).

¹¹ Prominent journals include *Organised Sound*, *Computer Music Journal*, and the *Journal of Music, Technology & Education*.

¹² Knowledge relevant to laptop orchestra research and electroacoustic studies is shared worldwide in diverse symposia and conferences. Notable recurring events include (1) The International Computer Music Conference (ICMC); (2) The International Conference on New Interfaces for Musical Expression (NIME); (3) the national conference of the Society for Electro-Acoustic Music in the United States (SEAMUS); (4) The Toronto International Electroacoustic Symposium (TIES); (5) the Electroacoustic Music Studies Conference (EMS), a European parallel to SEAMUS and TIES; and (6) The International Conference on Live Coding (ICLC), a relatively new annual gathering of live coders.

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