Interacting with Cage: Realising classic electronic works with contemporary technologies

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At a time when tape music, which obviated the need for performers by eliminating interpretation after composition, was becoming the dominant paradigm for electronic music, John Cage, motivated by his inchoate aesthetic of indeterminacy, radically reimagined electronic music that 'treats machines as things to perform with'. In the 1950s and 1960s, Cage employed electronic technologies in place of musical instruments in concert music, but also reframed the creation of tape music by following a score to be a performative act. Although Cage idealised a liberal approach to performance practice and maintained a modernist, utilitarian attitude towards technological progress, his actions and scores reflect allegiance to the 'work concept' (Goehr 1992). Twenty-first-century performers of Cage's electronic music are challenged to address the seemingly paradoxical imperatives of technological progressivism and creative interpretation with fidelity to a work embodied in a score. This article discusses efforts to reconcile these forces in contemporary realisations using the interactive technologies of three of Cage's classic electronic works. The development of interactive performance interfaces in response to musical requirements of a score is presented as an important but overlooked model for the development of new interfaces for musical expression.

1. CAGE, ELECTRONICS AND INDETERMINACY

Late in 1958, John Cage excitedly wrote to David Tudor that his composition *Fontana Mix*, nearing completion at the Studio di Fonologia Musicale in Milan, 'treats machines as things to perform with' (Cage 2013: 102). On its surface, Cage's assertion is perplexing, since, at least in its initial conception, *Fontana Mix* was a static piece for two tapes that would be played back over loudspeakers.[1] The implication that mechanical performativity is somehow novel is also striking, considering Cage had already employed electronic technologies in live performance – turntables in *Imaginary Landscape No. 1* (1939) and radios in three compositions beginning with *Imaginary Landscape No. 4* (1951) – and had composed two other tape pieces: *Williams Mix* and *Imaginary Landscape No. 5* (both 1952).[2]

The appropriation of electric technology was an important facet of Cage's compositional project throughout the 1950s and 1960s. Piekut (2012: 8) offers Cage's optimistic relationship with technology as evidence supporting a modernist reading of Cage's aesthetic position. Cage treated technology as a functional means of actualising musical progress, an outlook perhaps expressed most plainly in 'The Future of Music: Credo', a lecture delivered in 1940, but, significantly, subsequently chosen as the opening passage of *Silence* (Cage 1961: 3-6; Miller 2002). Cage's future music would be technological, predicated upon 'centers of experimental music' outfitted with 'new materials, oscillators, turntables, generators, means for amplifying small sounds, film phonographs, etc.' (6). Nicholls (2007: 23) highlights that Cage's 'Credo' is ideologically and stylistically reminiscent of Luigi Russolo's 1913 *Art of Noises: Futurist Manifesto* (1986); indeed, Joseph (2012: 159) refers to Cage as 'a futurist for the third machine age'. Like Russolo, Cage viewed technology as a means for extending the timbral repertoire of music to include noise-sounds. Yet whereas Russolo shoehorned noise into a familiar musical model, going so far as to propose ordered scales of noises (Russolo 1986: 67–80), Cage foresaw the exigencies of novel technologies dictating heretofore unimagined theories and contingent methods for composing: 'The present methods of writing music, principally those which employ harmony and its reference to particular steps in the field of sound, will be inadequate for the composer, who will be faced with the entire field of sound' (Cage 1961: 4; see also Van Nort 2006: 174). Absent these concomitant developments, Cage felt the opportunities

[1]Cage used the *Fontana Mix* score to create subsequent compositions, prompting some debate over whether the tape represents 'the piece' or 'a performance' (Lochhead 1994). Cage's conception most likely shifted over time from the former to the latter. His letter to Tudor makes no suggestion that Cage was then considering using the score for anything other than making a tape piece: '[The] composition […] indicates sources ABCDEFXY […] also indicates modes of splicing' (Cage 2013: 102).

[2]*Imaginary Landscape No. 1* was performed live at its premiere, but was broadcast to the venue by radio, where it was heard over loudspeakers. Later performances involved playback of a recording of this performance (Key 2002; Straebel 2012).

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afforded by new interfaces remained unrealised: 'When Theremin provided an instrument with genuinely new possibilities, Thereministes did their utmost to make the instrument sound like some old instrument, giving it a sickeningly sweet vibrato, and performing on it, with difficulty, masterpieces of the past' (Cage 1961: 4).

Although Cage insisted that technological advances should spawn radically novel compositional techniques, in practice the affordances of the electronics he employed were frequently subjugated by idealisations of their capabilities Cage inscribed in his scores. Cage's 'low-tech, improvised, and artisanal uses of electronics' (Piekut 2012: 8) even yielded compositions that were in some ways incompatible with the technologies they utilised. *Williams Mix*, for example, involved eight tracks of tape before the existence of eight-track tape recorders, or even a reliable means to precisely synchronise eight monophonic tape machines. In early performances, four performers manually started the eight playback machines, a remarkable compromise considering it took a team of people approximately nine months to assemble four minutes and fifteen seconds of sound from the 192-page score. 'Even though his score was realised with a high degree of accuracy on each of the tape tracks, there would always be a degree of variance from the score in actual performance with multiple tape machines' (Austin 2004: 200).

Cage was continually forced to reconcile the vision for a future music actualised by electronic technologies with the practical realities of their constraints, and appeared to consistently favour functionality and pragmatism over fetishising their idiosyncrasies. Cage was, for example, satisfied to abandon coin flips for a computer simulation of the *I Ching* to generate random numbers (Cage 2003: 98). In his 1960 televised performance of *Water Walk*, Cage agreed to strike radios with his hand when a union dispute prevented him from operating them electrically. Cage would proclaim that 'technology essentially is a way of getting more done with less effort. And it's a good thing rather than a bad thing' (Cage 2003: 161). Retrospectively, Cage assessed the months-long effort of assembling *Williams Mix* as 'a highly questionable process', considering 'it might be that the kinds of variation in *Williams Mix* that did result from splicing could happen with computer programming' (168). Erbe's (2012) computer realisation of *Williams Mix* does exactly so, facilitating the creation of new performances by simply supplying digital recordings according to Cage's specified characteristics – getting more done with less effort.

Cage's interest in sound reproduction was principally as a means to incorporate conventionally non-musical sounds; he was ambivalent towards magnetic tape as an object or its particular qualities as a medium. Cage's early compositions with electronics therefore lacked the orthodox medium-specificity of contemporaneous musique concrète, nor were they self-consciously *about* the technologies they employed, as post-digital music tends to be. Musique concrète exploited the possibility with tape to precisely compose sonic objects, and, by virtue of being disseminated on tape, eliminated or severely diminished the role of the performer. Although sympathetic with Cage's modernist desire to expand the timbral repertoire, musique concrète enshrines the elevated status of the composer in the musical ecosystem, arguably representing the inevitable apex of European art music's trajectory through the nineteenth and early twentieth centuries. Cage's failure to embrace tape's foremost quality – its concreteness – should therefore not be surprising, for Cage's aesthetic radicalism inhered precisely in undermining the intention and authority of the composer, destabilising the conventional relationship between composer and performer. Cage (along with Wolff, Tudor, Feldman and Brown) 'can be credited with radically reconstructing Eurological composition', largely through the reintroduction of 'real-time musical discourse, often approaching an explicitly improvisative sensibility' (Lewis 1996: 96–7).

Cage was conscious of his aesthetic rift with musique concrète. *Fontana Mix*, he wrote from Milan, 'is like no other tape music on this side of ocean' (Cage 2013: 102). Cage had rejected an invitation to work with Schaeffer in 1949, later attributing his disinterest to a 'shift from [considering] music as structure to music as process' (Cage 2003: 167), referring to his budding aesthetic of indeterminacy, which underscores all his music after 1957 but began to take root earlier. According to Pritchett, '"Indeterminacy" … refers to the ability of a piece to be performed in substantially different ways – that is, the work exists in such a form that the performer is given a variety of unique ways to play it' (Pritchett 1993: 108). By contrast, 'chance operations' encompass methods such as coin flips that generate random variations with no recourse to the composer's intention, however, the ensuing music could still be conventionally notated in a score for a prescriptive performance (Cage 1961: 35). Indeterminacy is a far more radical proposition in that it diminishes the composer's own role in the sound-making process, providing performers (and, as I shall argue, instrument-makers) with a limitless possibility space within which to make creative decisions. To achieve indeterminacy in electronic music, Cage deliberately relinquishes control over the sonic surface; his technological compositions are disseminated as scores that outline processes for their realisation but only abstractly represent the sounds to be employed. In stark contrast to musique concrète, any number of realisations of nearly all of Cage's technological pieces could be created, each sounding dramatically different. In the earlier compositions (e.g. *Williams Mix* and *Imaginary Landscape No. 5*), the processes are more akin to 'recipes' generated through chance operations. The *Williams Mix* score is 'like a dressmaker's pattern'

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(Cage 2003: 169), which provides a literal template for splicing and assembling fragments of tape, but only offers abstract descriptions of the sonic qualities of each fragment; 'someone else then could follow that recipe, so to speak, with other sources than I had to make another mix' (169–70).

Henri Pousseur's *Scambi*, created in 1957 at the same Milan studio where Cage composed *Fontana Mix* the following year, offers almost total freedom to structure the presentation of Pousseur's recordings of electronically processed noise. Eco's (1989) seminal essay on the 'open work' derives its central premise from a quotation of Pousseur's that appears to resonate with Cage's idea of indeterminacy: '*Scambi* is not so much a musical composition as a field of possibilities, an explicit invitation to exercise choice' (quoted in Eco 1989: 1). Yet *Scambi* retains allegiances to musique concrète in its lack of a score, and in its use of a fixed repertoire of recorded sounds – Pousseur (1959: 54) depicts a hypothetical realisation in terms of assembling musical 'materials'. *Scambi* is in this sense the antithesis of Cage's vision of indeterminacy: a collection of sound material – of objects – that only implicitly suggests a process. Cage was agnostic to material, interested in pieces that 'are not objects, but processes' (Cage 1967: 134).

Cage's embrace of music as process marks a concomitant evolution in his understanding of the role of electronics. Whereas the score of *Williams Mix* describes a procedure for generating a tape using only qualitatively defined sound sources, the score of *Fontana Mix* – curvilinear drawings above which transparent sheets of dots and a grid are to be overlaid – describes a process for generating events in time with no specific bearing on tape music. *Fontana Mix* therefore came to be viewed as a 'tool' as much as a composition itself (Nicholls 2007: 75). By describing 'machines as things to perform with' in the context of *Fontana Mix* (Cage 2013: 102), Cage conceives of the production of music on magnetic tape as *performance*. For his tape version, Cage interpreted *Fontana Mix* in terms of similar sound categories and operations as he did in *Williams Mix* (Pritchett 1993: 130), thus *Fontana Mix* does not represent a pragmatic development in his electronic composition practice, but rather an aesthetic one. Cage steps decisively beyond considering electronic technology as a tool for creating a *work*; the machine becomes a coequal force in the creation of a *performance*. Significantly, *Fontana Mix*'s instrumentation is undefined, leaving its technological interpretation completely open.

Fontana Mix would usher in an intense, roughly ten-year period in which Cage almost exclusively explored the possibilities and implications of performance with electronics. *Fontana Mix* initially prompted Cage to consider ways of performing with technologies beyond radio and tape, initially household machines in *Water Walk* and *Sounds of Venice*, both derived from the *Fontana Mix* score in 1959. Paralleling the destabilisation of the relationship between score and sound, Cage began to explicitly decouple his works from the technologies involved in their performance. A logical extension of indeterminate performance with machines is *WBAI: Material for Making a Mechanical Program* (1960). Itself a product of *Fontana Mix*, the *WBAI* score 'may be used in whole or part by an operator of machines'; Cage provides examples of current technologies, but leaves open the possibility of performance of future music using electronic technologies not yet invented.

Technological invention is the direction Cage would pursue next, incorporating motion-controlled synthesisers (by Robert Moog), a mixing and sound projection system (by Max Mathews), photocells for triggering playback of recorded sounds on tape (by Billy Klüver), and distorted television images (by Nam June Paik), into a number of theatrical performances that can be loosely grouped under the umbrella of 'Happenings', culminating in *Variations V–VII* (1965–6) (Pritchett 1993; Fetterman 1996; Nicholls 2002;). Far beyond 'open instrumentation', these works extend indeterminacy to the domain of musical instruments, radically recasting the instrument from a physically and culturally constrained prior artefact to a field of possibility to be sculpted creatively and responsively to both the score and the local exigencies of a performance.

2. THE PARADOX OF PERFORMING CAGE

Although Cage's radical experiments with electronics and indeterminacy create the possibility of limitless variation, 'indeterminacy is not synonymous with an absence of boundaries' nor of intention (Miller 2009: 62), as is evident in Cage's reactions to perceived abuses of his openness: Cage chastised 'foolish and unprofessional' musicians performing his *Concert for Piano and Orchestra* in both New York and Cologne in 1958 (Cage 1967: 136), lambasted the New York Philharmonic after musicians removed contact microphones from their instruments during *Atlas Eclipticalis* (Cage 2003: 126), and denounced 'inept' engineers involved in a 1967 performance of *Variations VI* (Fetterman 1996: 135). For Cage, accepting unknowable outcomes did not absolve performers of a responsibility to approach his compositions honestly and 'professionally'. In spite of the radical notion that his works do not suggest a sonic ideal, Cage's works remain 'works' that, in his view, demand disciplined adherence to the dictates of the score. Goehr (1992) claims that Cage did not abandon or undermine the 'work-concept' – a broadly held view that emerged after 1800 which regards the musical work as an intangible ideal object, created by the composer, to which performers should aspire. The score is an imperfect and incomplete embodiment of the work,

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but provides a firm circumscription of fidelity. Writing about Cage's 'silent piece', Goehr argues:

> Despite the apparent absence of pre-determination in the composition, despite the experimental nature of performances … Cage has not obviously succeeded with *4′33″*, and other such 'works', in undermining the force of the work-concept *within* the musical institution. First, he has maintained control (however minimal) over the music. It is because of his specification that people gather together, usually in a concert hall, to listen to the sounds of the hall for the allotted time period … The performer is applauded and the composer granted recognition for the 'work'. Whatever changes have come about in our material understanding of musical sound, the formal constraints of the work-concept have ironically been maintained. (Goehr 1992: 164)

High-profile performances around the 2012 Cage centenary (BBC 2012; Tommasini 2012) have helped cement his place in the canon, but also bring into relief challenges of performing Cage in the twenty-first century. Cage's ambivalence towards technological fetishism and emphasis on indeterminate outcomes are at odds with the prevailing trend towards authentic performance that is a consequence of the work-concept. It is doubtful that Cage would in 2015 desire to see a piece composed in the 1950s performed with 1950s technologies, but as 'works', his compositions still demand honest (though potentially critical) consideration of their original concept. Writing about the *Variations*, Miller (2009) implicitly invokes the paradox between Cage's open scores and adherence to the work-concept: the 'scores – Cage's formal statements about these works – should be taken as points of departure and of periodic return in the course of developing realisations. They are the documents that express, however enigmatically at times, the works' potentials and particularities' (64). Part of changing 'the responsibility of the composer from making to accepting' inheres in embracing the fact that changing circumstances will dramatically alter a piece's sonic impression (Cage 1961: 129). This variability is not a consequence, rather an integral feature of indeterminate compositions, manifested from performance to performance, but also over time: 'Indeterminacy is responsive to changing technological, art-historical, or sociological conditions. It is in the scores themselves that the works' responsiveness resides. Other sources of information provide a context for understanding what the works have meant, but not necessarily for what they may come to mean' (Miller 2009: 64). The exigencies of indeterminacy demand performance practices that evolve – culturally, musically, and technologically.

Such a reading suggests significant opportunity for performances of Cage's electronic music that incorporate contemporary technologies. Over the last three years, the author has led a group of musicians in performing Cage's electronic music in this spirit, focusing on works that originally utilised now-antiquated media. Paralleling Cage's evolving approach to technology through the 1960s, incorporating interactive systems into these pieces enables more spontaneous performances. Our practice of reconsidering instrumentation prompts a valid concern over a potential loss of some essential qualities of the works that inhere in the specific media involved in Cage's own realisations. Yet Cage's aesthetic is non-essentialist – a crucial aspect of his particular flavour of radicalism. Although Cage preserves the 'formal constraints' of the work-concept (Goehr 1992: 164), he nevertheless critically undermines the notions that the work embodies a singular ideal against which individual performances may be measured, and that the role of performance is the revelation of meaning embedded in the work by the composer. For Cage, the work was a field of possibility whose meaning was remade with every performance. 'The notion of "field" … implies a revised vision of the classic relationship posited between cause and effect as a rigid, one-directional system: now a complex interplay of motive forces is envisaged, a configuration of possible events, a complete dynamism of structure' (Eco 1989: 14). Cage's shift away from individual taste and towards 'accepting' was initially conceived in terms of sound, but it would come to extend to the entire domain of performance. In employing twentieth-century media – records, tape and radio – in interactive settings, we critically foreground the anachronism of performing Cage's works in the twenty-first century, probing the essentialism of these media within the field of meanings surrounding these works.

3. ROZART MIX

Cage's score for *Rozart Mix* consists of a series of correspondences with Alvin Lucier, in which the two devised a performance that ultimately took place on 10 May 1965 at the Rose Art Museum at Brandeis University. The performance they describe involves at least 12 open-reel tape machines and a supply of at least 88 tape loops. Loops are to be played simultaneously on every machine until they break, get tangled or become otherwise unplayable, with four or more attendants replacing broken loops. The performance continues indefinitely, until all the loops are broken beyond repair or the audience leaves the venue.

Rozart Mix is an important step in Cage's expanding notion of mechanical performativity, which should be considered as an antecedent to a vast body of loop-based live electronic music performance. The performance history of *Rozart Mix* suggests it was conceived as an ambient work – an environment rather than a concert piece in the traditional sense. It was composed at the height of Cage's interest in Happenings (Kostelanetz 1968: 53–4) or 'circuses' (Pritchett 1993: 157) – open-ended, theatrical multimedia productions often featuring a party-like atmosphere. Cage's performances

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in this era strove to provide freedom for audiences to explore and make their own meanings. Performances were frequently presented with a multisensory 'overload' that allowed for individualised experiences depending on where one's attention drew them. *Rozart Mix* fosters the potential for auditory exploration according to a method analogous to one the Minimalist composers were beginning to use: through regular repetition of sound sustained over long durations.

An environmental reading of *Rozart Mix* is further supported by its designation as one of the optional accompaniments to the *Solos for Voice 3-92* (1970), commonly known as the *Song Books*. After the Rose Art Museum, *Rozart Mix* was performed at the *Song Books* premiere in Paris, and again, directed by Lucier, at a 1989 benefit for the Cunningham Dance Foundation, in which the vocalists and tape machines surrounded an audience seated at dining tables. A similar 'dinner theatre' performance of *Rozart Mix* alone, sometimes known as *Newport Mix*, was staged at a restaurant in 1967 while Cage visited the University of Cincinnati (Fetterman 1996). This impulse was present from the premiere in 1965. According to Cage, 'When only twelve people were left, we had arranged to serve refreshments; all those people had a party' (quoted in Kostelanetz 1968: 61).

The audience in Cage's circus pieces is further liberated through an avoidance of choices that may reflect personal taste. In *Rozart Mix*, Cage insisted the material on the tape loops should not be assembled deliberately. Cage instructed Lucier: 'Record just anything (lots of speech, some music, not much in the way of continuous noises) then cut quite small (not longer than 4 or 5 inches, down to fragments– tiny) then splice together ignorantly' (Cage 1965; see also Kostelanetz 1968: 61). Lucier notes Cage's desire for the performance to lack a distinct beginning or ending (quoted in Fetterman 1996: 131), but evidence suggests performances deviated from this ideal. In the 1989 performance, the loops and equipment were apparently so robust that the loops did not break of their own accord; Lucier instructed the performers to replace the loops 'after a while' (quoted in Fetterman 1996: 131). No documented performance seems to have lasted until one of the two designated ending conditions: the entire audience leaving or no functional tape loops remaining. In cases for which accounts exist, the performances were stopped when a small number of audience members remained.

3.1. Rozart Mixtape

In performing *Rozart Mix*, we sought to resurrect a composition whose original technologies are effectively obsolete, in doing so reconciling the concerns outlined above: producing a critically informed reading of Cage's understanding of his work, while simultaneously incorporating contemporary technologies to avoid ossification of performance practice. A performance involving increasingly scarce technologies and having an open-ended, potentially hours-long duration would be all but impossible to mount today, therefore it was imperative to consider – as Cage himself was frequently forced to do – how to respect the score while maintaining feasibility. The tangible, analogue materiality of magnetic tape and involvement of human performers were deemed critical to making a meaningful performance, but we needed to create a system that is inexpensive, portable and adaptable to different environments (the realisation has since been performed five times, on three continents).

A contemporary realisation can also address potential inadequacies of the score in documenting what we suppose Cage's vision for the performance entailed. As Lucier noted, tape loops are much hardier than Cage seems to have anticipated, requiring the compromise of introducing human intention in order to effect progress through the piece. We sought a 'non-intentional' means for reliably but unpredictably enforcing loop-changes, while avoiding the need to end piece at an arbitrarily chosen time. Practically, it was impossible to have the piece programmed without providing at least a range of possible durations and a guarantee that it would eventually come to an end. The goal became a realisation where adhering to the process would yield a natural ending within a predictable range of time, but whose precise duration would be indeterminate. Historical performances of *Rozart Mix* have been described as cacophonous; according to Lucier, 'more often than not, the mix of sounds in the Museum was overwhelming' (quoted in Fetterman 1996: 131). Although cacophony may be desirable in some contexts, we opted for a smaller number of playback devices in order to create more sonic space (especially in a reverberant museum) for planned simultaneous performances of other Cage pieces such as the *Song Books* or *Radio Music*. Our version is, however, easily scalable up to 12 sources.

The new realisation employs four to eight modified battery-powered cassette players and 88 loops on 44 double-sided cassette tapes. Cassette players and tapes address nearly all the instructions of the score while maintaining the tangibility and sonic qualities of analogue tape, but are far easier to procure than open-reel tape machines. A performer stationed at each cassette player changes tapes, and two additional attendants distribute the pool of 44 tapes among the performers as needed. The performance addresses the score's implied theatricality, wherein the recorded media are visually presented – exhibited, almost – by stationing the attendants at the centre of the room, with the cassette loops arrayed on a table. The attendants must traverse the space to deliver the loops to performers stationed around the perimeter.

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The performers create cassette tape loops in advance according to a procedure analogous to the one devised by Cage and Lucier. A computer program concatenates randomly selected segments (with a random envelope and intervening period of silence) from a pool of audio files into a digital collage of found sounds. This collage is recorded onto a cassette tape, which is then cut naively to make physical tape loops. The loops are inserted into disassembled cassette housings, and can be played on modified cassette players. Several different lengths of loops can be achieved by feeding the tape through different paths inside the housings, although the available variety is less than what can be achieved with open-reel tape.

As Cage and Lucier experienced, most loops played essentially indefinitely. A control device, adaptable to any battery-powered cassette player, was developed using a programmable microcontroller to impose a tractable duration on the performance. Two copper strips separated by a thin, non-conductive shim are inserted between the batteries of the cassette player. The copper strips are normally electrically connected, but the controller uses a relay to break the connection at random intervals, cutting the power to the cassette player and stopping loop playback. The minimum and maximum interval between interruptions is programmable, providing a bounded estimate of the overall duration. An indicator light on the separate control circuit box turns from green to red when the power is cut, cuing the performer to change the cassette loop. After changing the cassette, the performer presses a button on the box that restores power to the player and restarts the internal timer for the next power cut interval. The performer plays both sides of each cassette, after which they raise their hand to signal to the attendant to deliver a new cassette. The piece ends when both sides of all cassettes have been played.

4. RADIO MUSIC

Cage first composed for radios in 1951, the same year as his first important chance composition, *Music of Changes*. But whereas the chance operations in *Music of Changes* occurred at the time of composition, only to be subsequently enshrined in a score, *Imaginary Landscape No. 4* generates an ephemeral soundscape that is unknowable until the instant of performance. Like the subsequent *Imaginary Landscape No. 5*, a tape collage of phonograph records, *No. 4* superimposes a temporal-dynamic structure on top of the existing inherent dynamics and structure of the arbitrarily selected source material, which may be silent at any given moment. To a greater degree than Cage's first two tape pieces, the particular sounds present in a given performance are not contingent on the choices of performers. In the pre-computer era, radio marked the most reliable and sonically diverse method for achieving this unpredictability.

Radio Music (1956) is scored for one to eight performers, each with a portable AM radio. Cage described the piece as a response to critics of the markedly quiet premiere of *Imaginary Landscape No. 4* (Fetterman 1996: 18–19; Cage 2003: 167). *Radio Music* was composed through similar chance operations, but instructs performers to set their radios to maximum volume level. *Radio Music* also appears to be part of a concerted effort by Cage to produce indeterminacy more economically: whereas *Imaginary Landscape No. 4* requires a conventionally-notated 36-page conductor's score and twelve parts, the eight parts for *Radio Music* are each one or two pages long, containing simply lists of AM frequencies to which the radios should be tuned. Interspersed among the tuning frequencies are horizontal lines indicating silence. The timing of tuning adjustments and silences over the piece's six-minute duration is at the discretion of each performer. Each part is divided into four sections, 'to be programmed by the player with or without silence between sections'. Cage composed *Radio Music* in part to fulfil a desire to 'involve the machine in some way' in a concert for which he was unable to convince the Ampex Corporation to provide tape machines to play *Williams Mix* and Earle Brown's *Octet* (Revill 1992: 177). Performances after the 30 May 1956 premiere appear to be rare.

4.1. Radio Music Remix

We have performed two 'remix' versions of *Radio Music* (Figure 1). In both, eight performers with portable radios play the score as written, although 'transposing' the AM frequencies to FM by reading the AM section of the radio's analogue tuning display with the radio's band selector set to FM. This transposition serves two purposes. First, we found that with little broadcasted content reaching portable AM radios in performance venues, the switch to FM made for a much louder and denser performance, as Cage envisioned. Using FM radios also allows us to receive sound that we broadcast from eight homemade, low-power FM transmitters. The transmitters are tuned to frequencies interspersed between active radio stations, effectively 'spiking' the FM spectrum with audio played back from a computer. Our signals are audible at frequencies between those of regular radio stations, thus the effect is ultimately a subtle intervention, one of hiding signals among the noise.

In the first version, the remix is of Cage: the broadcasted signals are from eight different recordings of *Sonatas and Interludes* (1948) for prepared piano. This approach is partly a response to *Radio Music*'s hasty conception as a replacement for *Williams Mix*. We introduce a different kind of mix – a remix, an artefact

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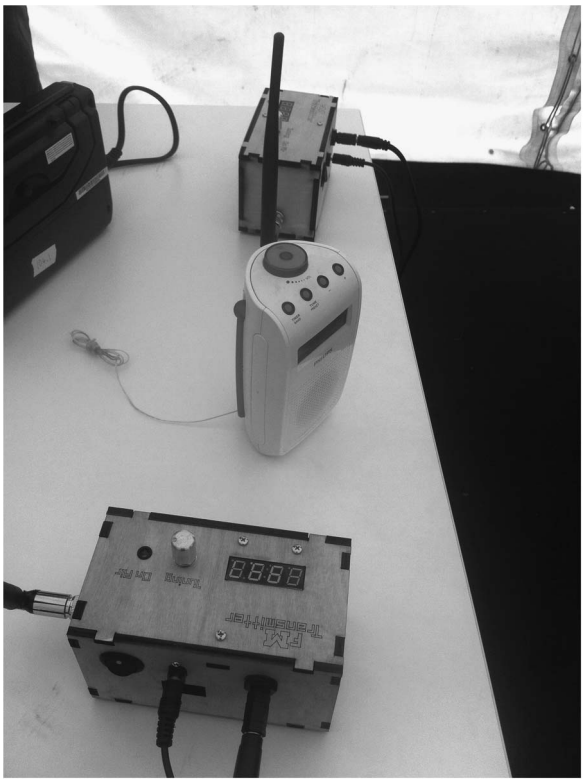


Figure 1. FM transmitter and radios used in *Radio Music Remix*.

of the computer age. Whereas Cage mediated the radio by 'sampling' it at arbitrary times and frequencies, we now have the ability to mediate at a different stage of the broadcast chain, inserting whatever we choose into the radioscape with portable transmitters. *Sonatas and Interludes* was selected for its timbral qualities – their surprising and unpredictable nature seemed apt for the disembodied, otherworldly nature of the radio soundscape – and for the high degree of variability in timbre across different performances due to the piano preparation. Multiple, simultaneous versions provide a compromise between uniformity and variability that reflects the tentativeness of Cage's early experimentation with indeterminacy.

As per Miller (2009), we treat the score 'as [a] point of departure and of periodic return', actively probing what the work 'may come to mean' (64). A strictly historical reading would suggest that our intervention deviates from Cage's aesthetic of revealing a latent, otherwise imperceptible soundscape, but we do so with careful consideration. With *Radio Music*, Cage sought to address the uncritical consumption of culture imposed by broadcast media: 'People must decide whether their homes are going to be those of curators or the homes of artists, hangers-on-to-what-has-happened, or makers-of-what-is-and-is-becoming' (quoted in Kostelanetz 1970: 117). Some 60 years later, we are ironically faced with a similar question with respect to performing Cage's own works with technology. In this regard, the performance responds to Cage's technological progressivism: we avoid simply 'curating' his work, and instead use the piece to make what-is-to-be. With what is now a cheap technological intervention (that would have been unimaginable in 1956) we undermine the unidirectional broadcast's authority to define or 'disseminate' culture, as Cage feared; as a centenary tribute, and to thumb our noses in solidarity, we do so with the unmistakeably Cagean soundscape of *Sonatas and Interludes.* Yet, doing so simultaneously questions whether Cage has come to be part of the culture that is foisted on us.

The second *Radio Music Remix* introduced a more performative way to subvert the silence between stations: interactively remediating the radio by looping and rebroadcasting real-time radio signals in place of recordings. Two additional musicians perform this remixing. One has a portable radio receiver whose signal is split to a pair of headphones for monitoring and to a computer audio input. This performer tunes the radio to find moments to sample, mostly speech. The second performer uses the computer with a hardware controller to sample and loop snippets of these radio broadcasts. These loops are then sent to eight independent FM radio transmitters and rebroadcast as in the previous version. The effect is a real-time mediation or remixing of live radio broadcasts – intercepting the radio, modifying and relaying it. As a listener, it is intriguing and somewhat disorienting when the radio receivers land on these looped radio broadcasts; the content is distinctly that of a radio broadcast, but with the effect of being frozen in time. The live radio remix version of *Radio Music* was devised for simultaneous performance with *Rozart Mix*, as a way of occasionally and fleetingly bridging the sound worlds of the two compositions. Like the first, this realisation elaborates on Cage's aesthetic in response to twenty-first-century technology. Writing *Radio Music*, Cage wrote in 1956, 'enabled me to accept … the television, radio, and Muzak [sounds]. Formerly, for me, they were a source of irritation. Now, they are just as lively as ever' (quoted in Kostelanetz 1970: 118). We play with Cage's conception of 'silence' not as the absence of sound, but as the ambient sonic background of the environment (Nicholls 2007: 59; Cox 2009), by surreptitiously and subtly infiltrating that background: perhaps, in this media-saturated century, the background needs to be amplified, the potential irritant augmented, to even be perceptible.

5. IMAGINARY LANDSCAPE NO. 5

Cage's first tape composition, the last of his *Imaginary Landscapes*, is a block-graph score composed in 1952, intended to be a template for constructing a tape piece using 'any 42 phonograph records' as source material.

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Against a square grid background with a time scale of 1/5 second per square, each page contains two systems of up to eight tracks. Each of the six pages corresponds to thirty seconds – a total of three minutes. On each track, an outline around a block of squares indicates the duration that a fragment of the track's current record should be played. Unlike *Williams Mix*, which achieves variations of attack and decay through varying splice patterns, loudness envelopes are specified according to numerals (1–8) below the rectangular fragment outlines. A dot above the track line indicates the moment that a new record should be selected. The eight simultaneous tracks are to be mixed to mono or stereo tape. Cage realised the first tape version for performance with Jean Erdman's dance *Portrait of a Lady* using exclusively jazz records found in Erdman's studio (Fetterman 1996: 19).

Cage selected jazz records to deliberately challenge his own distaste for jazz, a kind of immersion therapy to force himself to accept the consequences of allowing all sounds into his music in spite of his preferences; the score was generated by chance operations using the *I Ching* (Cage 1961: 31; Revill 1992: 133). In spite of being his first tape composition, Cage did not attach much significance to *Imaginary Landscape No. 5*, describing it as 'an inconsequential work... done in 18 hrs. because it was needed for a dance program' (Cage 1993: 130). *Imaginary Landscape No. 5* was the piece that instigated his collaboration with Louis and Bebe Barron, which in turn led to the Project for Music for Magnetic Tape under the patronage of Paul Williams. The project facilitated the creation of tape pieces by Feldman, Brown and Wolff, as well as *Williams Mix* (Pritchett 1993: 90). Given that Cage did not see *Imaginary Landscape No. 5* as a major work, he rarely presented it after the premiere. Like *Williams Mix* and *Fontana Mix*, Cage is only known to have made one version, although the score explicitly allows the possibility of future realisations.

5.1. Imaginary Landscape No. 5 (DJ version)

Cage's early tape pieces establish precedents for his live electronic compositions. As in *Imaginary Landscape No. 4*, in *No. 5* Cage designates only a temporal and dynamic structure, but not the particular sonic content, which again possesses its own temporal and dynamic structure. This profound similarity between *Imaginary Landscape No. 4* and *No. 5* suggests a performative reading of *No. 5*; the creators of a tape according to the score's parameters should be considered performers (Fetterman 1996: 20; Straebel 2012). Considering *Imaginary Landscape No. 5* as a performance work prompts an enticing experiment: could such a performance be executed 'live', where instead of recording the fragments to tape, they are extracted and mixed in real time? Had Cage conceived that his score could be performed in this manner, he may have considered the work to be far more consequential.

Our realisation introduces real-time performance by translating the sequence of cues and loudness envelopes from the score into software. The program applies the cues and envelopes to eight live audio streams, each representing one track of the score. The live streams are from eight record players, each attended by a performer. Each performer's role is quite literally that of a disc jockey: they must stop, start and change the records at precise times specified by the score. Since some of the record-changes in the score are instantaneous, the distribution of fragments among the eight tracks was reworked in order to preserve the exact timing. In the score, several tracks are silent for extended periods of time, allowing material to be allocated to silent tracks in order to achieve the same effect as an instantaneous splice. Since the eight tracks are mixed to stereo, the cumulative result is indistinguishable.

As implied by recent digital realisations of *Williams Mix* (Austin 2004; Erbe 2012), we approach *Imaginary Landscape No. 5* not as a 'tape composition' that is to be forever bound to that particular medium, but as a field of compositional potentialities revealed by magnetic tape. In our case, software still allows us to 'get more done with less effort' – any number of new versions of the piece can be created live simply by selecting a new set of records – but tangible, analogue media, such as phonograph records, represent a point of continuity with the era of the piece's inception. Our approach attempts to reflect Cage's contemporaneous interest in mechanical performativity, while simultaneously accounting for the fact that record players have taken on dramatically new cultural meanings since 1952; perhaps more than anyone, DJs 'treat machines as things to perform with'. This cultural recontextualisation of the record player provides an opportunity to set Cage's fraught relationship with jazz embodied in *Imaginary Landscape No. 5* against broader questions of the relationship between the avant-garde and African American musical practices (see, e.g., Lewis 1996).

6. DISCUSSION

The aforementioned performances were conceived partly as a response to the author's experiences in the 'New Interfaces for Musical Expression' (NIME) community and its attendant techniques, yet differs significantly in that our interfaces are not stereotypical 'NIMEs' or 'Digital Musical Instruments' – they are not gestural controllers for real-time DSP which otherwise take the role of a musical instrument (e.g. Miranda and Wanderley 2006). Rather, the interfaces were devised creatively in response to the exigencies of the score, the performance environment,

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and the desire to produce new instantiations of music that is in some cases technologically obsolete.

One feature of NIME is that the creators of new interfaces for musical expression are almost always the performers. Even in the notable cases in which they are not, the reach of new interfaces is often constrained to a relatively minuscule community. Commercial controllers (e.g. Monome, Push), while widely available, are typically so general purpose that they are not indicated in scores. While these phenomena are not aesthetically or practically problematic in themselves, one consequence is the absence of a robust and widely available NIME repertoire. A repertoire is more than a series of compositions available for performance; it is a body upon which future composers may build, or against which they may react. Performances with new interfaces are frequently documented in video or audio, but these do not provide a sufficient basis for interpretation, re-realisation or elaboration.

NIME, however, does have a historical repertoire, extending at least as far back as Cage's seminal early works for electronics, which should serve as a point of departure – aesthetically, technologically and philosophically – for contemporary live electronic music practice. If interpreted dogmatically, the technological specifications of these early works can be impediments to their contemporary realisation and contrary to the spirit in which they were composed. These compositions are at risk of being lost to recordings or history books if they do not remain vital, relevant and realisable.[3] We present our contemporary realisations as suggestions for how we may begin to incorporate new interfaces for musical expression into the repertoire of electronic music in ways that are pragmatic and innovative, but also critically responsive to works embodied in scores. Of course, this is but one of many paths forward, but NIME could benefit from a repertoire and the sense of continuity with history that it brings.

A repertoire-driven approach explicitly allows musical considerations to dictate the development of new interfaces. Broadening the scope of aesthetic input in the realisation of a performance beyond that of the composer was the hallmark of Cage's radicalism. To do so with tape was initially vexing for Cage, but his work with Moog, Mathews, Klüver and others demonstrate that electronic system designers should be included alongside Cunningham, Tudor and Rauschenberg as artistic collaborators. In the contemporary context, new interfaces developed in response to Cage's scores are not as technologically revolutionary as they may have been in the 1960s, but they serve significant aesthetic roles. This approach follows Cook's (2001) NIME principle 'make a piece, not an instrument or controller', a prescient critique of the now-frequent practice of building a device and subsequently needing to find a musical application for it.

A critical examination of the relationship between Cage's scores, historical performance practice, and our contemporary realisations suggests ways that composers can create compositions that facilitate the development of new interfaces for musical expression, whereas the process too frequently happens the other way around. Cage can serve as a model for post-digital musicians to overcome technological fetishism; his scores express fields of possibility initially revealed by a technology, but should not enshrine those technologies indelibly and eternally into the works. Rather, Cage's scores can be catalysts or provocations for invention, even 50 years later. Our interactions with Cage suggest that composition and interface design activities may be distributed in time, space and personnel while still leaving substantial room for creativity and aesthetic input.

[3]This statement touches upon a long-standing point of debate in musicology beyond the scope of this article (but see, e.g., Taruskin 1995; Butt 2002).

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