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Duration in Composition

The sound of a phonograph record's playback is as iconic as it is widespread. The recording is omnipresent. Its presence implies repetition. With the recording's ubiquity has come not just the ubiquitous repetition of those recordings, but the realization of repeated sound as the universal constituent of musical composition. The recording precipitated a paradigm shift in the concept of repetition. Understood as a motive underlying musical production since long before the captured sound, repetition is a response to a frustration with music's durational nature and an acknowledgement of its limited sonic constitution.

Repetition and Mutation

All sound involves some element of repetition. Our ears perceive the repetitive propagation of molecules in a transmission medium. In representations of sound, there is necessarily a structural pattern that is generative of this propagation.

Sound transmission must involve some element of mutation as well: radio transmission, recording and reproduction, amplification, spatial reverberation, and even projection through the air are mutations that occur universally to sound in its normal course of movement and distribution. Electronic filtering is one esoteric example of mutation. The more fundamental mutations are those physical manipulations that give rise to varying pitch in classical instrumentation and to the vocal variation that constitutes our speech. A mutation is any change in the structure of a wave or its recorded representation between two of its instances in space and time.

Mutations require recognition, but they are recognizable only in contrast. We perceive two sounds as separate precisely when we can tell the difference between them. Our ears superficially perceive a continuous stream of vibrations and translate them directly to neural signals. In breaking this river of 'sound' into discrete 'sounds', the brain engages in two types of separation: delineation of sounds that can be separated in time, and distinguishing of sounds that are concurrent in time. If neither of these separations are possible between two sets of stimuli, they will be conflated and considered as a single sound.

In composition, construction of a narrative requires the production of sounds that are perceived as distinct by the audience. This process of separation, accomplished by the mutation of a repeated form, and is thus a superstructure to the process of repetition. The construction of multiple concurrent narratives requires the ability to distinguish the concurrent sounds and their assignment to different voices or sources. Both of these processes of sound recognition occur within the listener.

The perception of a distinct sound event is this process of identifying it relative to other sounds. In the presence of visual stimulation we easily associate the sound with a more general event that we assign as its source. Here repetition is discernible through both the sound and other stimulation caused by its event. In the absence of other sense input, a given aural stimuli has some aspect of repetition only if it is recognized as similar to a prior sound. To perceive a sound is to compare it with one's memory of prior sounds, determining its character in reference to the listener's existing ontological categories.

When we hear the sound of a violin string, we discount the mutations incurred in its transmission, and subsume what we consider internal mutations: the shortening of the string, the variation in body and bow from earlier violin sounds, and the slight movement on the fingerboard causing minute variations in pitch between notes. These internal mutations become the 'note'. Together with the repetition of the violin, we recognize a 'sound'.

Composition and Repetition

Any instrument has an expectation of repeatability, of similar parametric transformations and manipulations producing a repeatable sound as output. The representation of music has long assumed this repeatability of timbre: in the score, we are given only a pitch and a system used to generate that pitch. The control information embedded in a score is all that which is not involved in the mechanical or generation of the sound. It is understood that we can provide the signified timbre by properly preparing and playing a given instrument. The repeat symbol or higher-order repetition directives are incidental: fundamentally music is repeating a physical transformation that generates a sound prescribed by a given score.

Repetition is thus at the heart of musical composition: whether from the primitive analog synthesis of a Roland TR-808 drum machine, from the demure output of the 2A03 sound chip in a Nintendo game console, or from the massive piano. Even in the absence of mutations, we can generate musical rhythm through repetition. Mutation simply allows more complex composition through modification of the repeated sounds.

The classical composition begins with an instrument and directives for controlling the instrument. A composition consists of a selection of instruments along with the arrangement of their physical parameter settings in time. The experience of the piece of music, however, is not entirely described by the compositional arrangement of mutations in time. It is also strongly determined by the underlying set of sonic material: timbres, assumed by the composer, that are fundamentally repetitions. Beyond the material repetitions of sound units, there are larger structures of sound that are repeated, such as motives or phrases in classical music (Brandt). Performances of scores are themselves repetitions of a prescribed composition. Live improvisations demand and invite high level mutations, but the mechanics of their generation are still fundamentally repetitive. The performer's formation of expectation about the sound they can produce is dependent on the repeatability of its function.

In any of these repetitions, mutations emerge. Performers are human: pitches are not exactly as prescribed. Timing is inexact in larger phrases. Atmospheric conditions affect performances from day to day and hour to hour. All these mutations put tremendous pressure on a paradigm

of composition that trusted a minute number of sounds. Composition became a rigorous mathematical activity, clearly discernible from its surroundings by its score. Its performance, as Paul Hindemith notes "depends on the closest physical and mental proximity of not more than a few hundred listeners." (Schwartz 84)

From this teeming mass of mutation emerged the recording. Recording is the pinnacle of repetition, the purist of scores, and the enabler of the most prescriptive compositions. Human eccentricity in performance is supplanted by the occult (but ostensibly reliable) intricacies of mechanical and electronic reproduction. The recording affected music composition in two ways: it replaced the score as the most specific means of communicating a composition, and it dramatically expanded the set of source timbres available to the composer.

Infinite Sound

"The phonographic composer may first listen to the sound he wishes to combine, choosing what he wants from numberless possibilities at his disposal." -- composer Carol-Bérard, 1929 (Katz 109)

New sounds challenge our perception. Challenges to perception beget composition. But as composition requires repetition through mutation, the recorded sound becomes less challenging and more constituent. The human brain re-associates the sound with its recent context, namely, the composition. So at least for the duration of the composition, the sound becomes a platform for manipulation.

The range of possible manipulations to the sound are described by the mechanical instrument that circumscribes its recording and reproduction. The devices, which are thus of critical importance to the composition, prescribe baseline transmission mutations as well as active interventions.

Early works that relied on mutative interventions in gramophone recordings were those of Paul Hindemith and Ernst Toch at the Neue Musik Berlin festival in 1930. Both regarded their recordings for the festival as an unpublishable diversion from their normal composition. They were regarded as a joke by much of the contemporaneous commentary: Toch himself called it "perhaps a musical joke". His critics thought of the records as "burlesque... practical joking". (Katz 111)

Their compositions expose only a small segment of the devices' repertoire, mutating the sound using the ability to collect multiple performances into coincident layers (and therefore conflate previously disparate sounds) and the ability to vary the playback speed (and therefore change the pitch and duration). Even in their limited experiments, though, they begin to realize the theorized power of the sound reproduction device as an element rather than a document or fragment of a composition. Critically, the reproduction devices are able to repeat their recorded sounds under transformations.

The produced sound had been experimented with before, with Luigi Russolo's *Intonarumori* noise machines and the electronic instruments designed by Léon Theremin. But these barely accepted works marked the point of transformation of composition based on the instrument to

that based on the reproduced sound. In hindsight they seem to predict the kind of active listening John Oswald would espouse 50 years later. Their classification as joke reflected the anxiety listeners felt in their new found freedom.

As devices gave listeners the freedom to choose what music to listen to, so too it gave them responsibility. It seems that the public discourse was not yet ready to recognize that power for what it was: the ability to compose their own sonic environment, from compositional elements much more complex than ever before available.

Responsibility

In the decades that followed, few musicians would compose with recorded sound, for lack of apparent interest. John Cage's "Imaginary Landscape" in 1939 marked the usage of a multiplicity of recorded sound sources in a greater composition. This was a distillation of the techniques used by Hindemith and Toch: Cage attended their concert in Berlin. (Katz 113) His work, in contrast, focused almost entirely on mutation; the source material is intended to be non-repetitive. Pierre Schaeffer again rediscovered the techniques in his "Concert of Noises" broadcast in 1948. He expanded the instrumentation of the turntable, through "variation of recording and reproduction speeds, sampling and editing by manipulation of the pickup, looping of recorded grooves, backwards playing of disks, loudness modulations, and fade-in and fade-out." (Sitsky 433)

Schaeffer's work briefly preceded the introduction of widespread tape recording, and precipitated a worldwide explosion in the theory and practice of sound music composition, with the works of Edgar Varèse, Karlheinz Stockhausen, and Hugh Le Caine. Varèse characterizes the new concept of the composer as "a worker in rhythms, frequencies, and intensities," and asserts that he, "like all artists, is an organizer of disparate elements." (Schwartz 207)

In 1952, Stockhausen began work in the style of Schaeffer's musique concrete, working a tremendous variety of recorded sounds into what was to become a strongly anti-repetitive narrative style. We recognize here the voice of the machine in all its glorious ability to reproduce. Hugh Le Caine's 1955 "Dripsody" explores an alternate extreme of repetition under strict limitations. The systematic restriction he uses projects the mutations into a single dimensional sound space. We recognize in his piece the voice of the drop alone.

Edgar Varèse asserts "Our new medium has brought to composers almost endless possibilities of expression, and opened up for them the whole mysterious world of sound... Composers are now able, as never before, to satisfy the dictates of that inner ear of the imagination. They are also lucky so far in not being hampered by esthetic codification -- at least not yet!" (Schwartz 208). All of these artists are attempting to compose with variations that emerge from the turntable and tape recorder. They are emerging from a radical depressurization of the compositional landscape, brought on by the appearance of an instrument capable of reproducing sounds in an almost boundless sample space.

The pressured use of given instruments here began to crumble, and in its place came great confusion regarding the proper repetitive basis of composition. If mutation could be infinite, what might the concept of instrument mean? If Toch & Hindemith's works indicated the

responsibility of the listener in the age of recorded sound, then their followers exposed the responsibility of the composer.

Finite Composition

The devices involved in the reproduction of sound from physical objects are as physical as the recordings themselves and the human participants in the compositional and performative process. The system is bounded by physical laws and the construction of the devices themselves. The recordings, likewise, are bounded by the shape and size of their physical media.

The availability of sound from a mechanical recording is dependent on a sufficient mechanical infrastructure for its reproduction. The score requires human musical interpretation, passed on in a tradition of transmitting the knowledge required to interpret, perform, and write compositions. The recording is much less robust: its infrastructure is more fragile. But it is nevertheless more accessible in the short term, since its performance requires no local time investment. It is engineered out of the mind and into the physical world.

The first playback mechanisms were the Thomas Edison's phonographs. These played helical grooves embedded within wax cylindrical media. Recording began with human initiated contact between the stylus and the wax cylinder. Recording continued as long as the cylinder was continually rotated against the stylus, and stopped when this rotation stopped, the needle was lifted, or the cylinder hit the stopper at the end of the device. (Bottone) The end of the recording, with this first device, was abrupt. Since the turning motion required was that same motion which drove the lateral motion of the needle relative to the cylinder, the end of this motion resulted in an unknown. If the playback continued past the end of the recorded region, the sound output would translate the imperfections in the unrecorded part of the medium into sound.

But while the rotation of the device was motorized by Charles Edgar Fritts as early as 1880 (Fritts 1916), the ability to stop it automatically remained frustrating until the gramophone. The radial rotation of the recording medium was no longer strictly correlated with the progression of the recorded sound. Detached from the rigidity of the rotating screw, the new process allowed for a more graceful recording endpoint, in which the tone arm sits in a rotating circular groove until the user intervenes. It requires, however, another degree of freedom, that of the motion of the tonearm rather than just the rotation of the physical medium.

Very quickly that intervention became automatic: the gramophone devices themselves were often constructed to detect this circular groove and return the tone arm to its resting position, using a timing mechanism driven by lateral motion of the tonearm, thus re-associating the progression of the recorded sound with the functioning of the device. (Spengler) In the automatic-reset turntable, the lateral progression of the tonearm provides a mechanical monitor of the sound's output. The turntable detached the listener from the endpoint of the music in that the runout groove made it no longer dangerous. The automatic-reset turntable makes the listener downright redundant at the end of the recording, as if their purpose had

been fulfilled. The listener initiates the beginning of the musical reproduction, but the duration and cessation of the act are determined.

It is a rare instrument for which the musician must both begin and end the production of sound. The phonograph as built by Edison required a great deal of attention to operate: one had to attend to it completely and continuously. The evolution of recording devices has provided a progressive reduction in the amount of attention required. Automation of the medium's rotation and then of the cessation of its rotation provided the ability to subconsciously listen to a prescribed set of sounds. Listeners began to compose, to score their own lives with the instrument of the turntable. The wax media were never constructed to the specifications of music production: they evolved mainly in response to demands of listeners. They thus failed, largely, to advance composition even given the tremendous power they could theoretically offer composers. They failed to provide what magnetic tape would begin in the 1950's.

Magnetic tape promised to remove the eccentricities of recording and reduce it to a transparent representation of the recorded sound. The tape loop asserted the possibility to repeat any sound endlessly. At the same time, it removed the possibility for such sounds to be heard accidentally. A tape cannot skip in the way that a disk record can.

The major distinction between tape loops and their disk parallels were the tapes' flexibility in time: they have no real upper bound on duration, and the "usual problem is devising loops that are short enough to give quick repetitions when desired." (Dwyer 31) The repetition only had a conceptual upper bound, in that "sound events with a period longer than five or ten seconds begin to be perceived less as repetitions by listeners." (Keane 60)

The tape loop had a curious relation to meaning: "repetition allows us to examine and re-examine the sounds in a way not possible when the sounds are heard only once... many sounds quickly become annoying when they are repeated literally (witness a scratched record which causes the needle to jump back repeatedly to the same place)." (Keane 59) Steve Reich would later insist of his 1965 piece, "It's Gonna Rain" that "the incessant repetition intensified [the words'] meaning and their melody at one and the same time." (Reich p19)

This is hard to believe. If this is the track's goal, to amplify sounds' signified meaning and their formal characteristics at the same time, then it fails. Tape is still an intermediary, an external device. The amplification of sounds' formal characteristics in our attention is necessarily at the expense of consciousness of their significance. Once we understand the sound as a constituent, we turn our attention to the composition it is a part of, to the broader organization. Our subconscious perception assumes responsibility for the repetition aspects of the sound and it becomes background. This can be seen at all levels of perception: from the conflation of sounds repeated less than 30ms apart to the ubiquity of contemporary personal audio devices and the importance of recognition in appreciation of popular music.

Steve Reich recognizes the challenge, "my problem was then to find some new way of working with repetition as a musical technique." (Reich 19) His response was a minimalist constraint to composition within "limited initial and the limited transformational techniques." (Mertens 12) Following Le Caine's "Dripsody," Reich's Minimalism collapses the last dimension from the

sound. Any variation that a listener perceives is a drift in his own conscious determination of sound. The repetition is free of mutation until it reaches our ears.

Reich uses a tape loop played in contrast with itself at a different speed to construct "It's Gonna Rain". In this piece, we hear a gradual phase shift effect, where the slight variations in the speed of the repetitions create contrast between their speeds without perceptible difference in pitch (or timbre). We focus, then, on the offsets between these repetitions. Ultimately, we do not perceive those samples themselves that are repeated, but instead are conscious of their spacing and some temporal analog to the chord that emerges across time in the work.

Alvin Lucier's 1969 piece, "I am sitting in a room" is a reminder of Reich's naive idealism. Lucier brings the entire physical context of the recording act into the composition itself, reminding us of the inability to isolate a musical work from the mutations that occur in its transport. By allowing a single large sound to propagate far further than usual through his recording space and apparatus, he distills the inherent process of mutation to an audible level.

The repeated phrases of these compositions, in focusing on the repetitions themselves, have the desire to fill eternity and continue indefinitely. In emerging from the pressure of signified musical notation, music compositions find a new pressure in the confines of the physical medium. It is the constraint of its duration within the physical medium within space which limits their length. The very fact that they are now destined or doomed to be elements in the larger compositions of human lives reduces them from music to sounds.

Imagination

Sound & music are fundamentally durational. We as humans perceive ourselves to be more immediately spatial than temporal, and thus to compose is to challenge oneself to disperse sounds into an arrangement in time.

Every composition exists under the assumption of repeatability, and the composer's challenge is to decide what mutations to apply to these possible repetitions. Allowing more mutation minimizes the perception of repetition and maximizes the ability to distinguish sounds and voices toward a narrative ideal. In cases of maximal compositional pressure, the listening apparatus is put in the spotlight: what duration is mandated? What transformations are allowed? But ultimately the composition and combination of the sounds, as well as even their recognition, is left to the imagination of the listener.

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