"Batting Time Away"
Experiences of Time and Timelessness in Ensemble Electroacoustic Improvisation

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Abstract

This research project investigates the experiences of time and timelessness in musicians performing in freely improvised, electroacoustic music contexts over telematic connection. For this project, 7 trio ensembles were organized, recruiting free-improvisers with experience in electroacoustic performance, primarily from within the free-improvisation community in Toronto, Canada, as well as other international locations. Each ensemble was asked to convene through the online meeting portal Zoom to perform in 30-40 minute improvisation sets without any intervention. 4 ensembles were asked to perform in a semi-structured format of improvisation involving players initially taking turns performing solos/duets before completing the remainder of the set as a trio, while 3 ensembles were asked to perform in a more unstructured format together as a trio for the duration of the improvisation. After each performance, ensemble members participated in an open-discussion-style interview where each was asked to comment on their experiences of the flow of time, their sense of timelessness throughout performance, and what they believe to be the possible factors that influence these experiences.

The purpose of this research project is to outline certain trends found in the experience of the flow of time, or the sense of timelessness, in performers of ensemble electroacoustic improvisation (EAI), performing under certain structural constraints, and whether these trends are similar or fundamentally different than such experiences while listening to electroacoustic music recordings. The results will show that, although the act of deep listening played a crucial role in participants' performances, they were more or less consciously aware of other aspects of the live performance throughout the improvisation. These include points of awareness and attention, intentionality, engagement and emotional involvement, that contribute not only to sensations of time and timelessness in players, but also to players' abilities to improvise successfully as a collective. This project aims to contribute to the growing research on electroacoustic music, performance studies, and perceived experiences of time/timelessness in contemporary electroacoustic music practices.

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1. Introduction

I recall my very first independent public ensemble performance in Toronto outside the context of a school-related ensemble performance. The name of my group at the time was CHYPS (named quite literally after potato chips), an experimental jam band with close friends of mine that served as an early creative outlet for my emerging interest in experimental music, sound design and improvisation. The first public gig we played as a group featured myself on laptop effects and various briquetted percussion instruments (plastic water jugs, metal plates, etc.), three of my band mates on similar briquetted percussion, and one playing acoustic guitar. Apart from some ambient soundscapes I had prepared for the performance, as well as a rehearsed cover of Can's "Yoo Doo Right" from their debut album *Monster Movie* (1969), the nearly 50-minute set was almost completely improvised by our ensemble. After dismantling our setup post-set, we in the ensemble proceeded to do what most improvising ensembles do after a performance: we sat down and talked about what we had just experienced as performers, with the added bonus of involving the audience in the discussion. The topic of time, in this case the experience of the flow of time, was brought up early on, with one audience member mentioning that the performance went by quickly and that it seemed like we, as an ensemble, were really into it. In response to this comment, one my fellow ensemble members expressed a different perspective from their own experience as a performer, in which they felt that time didn't exist during the performance. They also mentioned that there was a planned break during performance that they were expecting to reach at a certain point, however their orientation of time had been so distorted that they couldn't tell if they were close to that break or not.

After performing improvised music on a regular basis in the subsequent years since this initial public performance, especially of the experimental variety, I have come to be familiar with this particular phenomenon of losing all sense of the passing of time during moments of intense focus and immersion in both my own playing and the contributions of fellow musicians, what Mihaly

Csikszentmihalyi might call a *flow state*, where there is joyous and creative "total involvement with life" (Csikszentmihalyi 1990). Depending on certain circumstances, durations of 5 minutes can feel like they are 10 minutes long for an improviser. In other instances, 30 minutes of performing can feel like 15 minutes. Stockhausen refers to this phenomenon as *experiential time*, the perception of the passing of time as either quick or slow compared to clock time. Stockhausen suggested that, on a structural level, processes of alteration in the sounds of the music are linked to listeners' experiences of the passage of time, which he claims is experienced in the intervals between sound alterations. He also suggests that when no alterations occur, listeners lose their orientation of time (Stockhausen 1955). Using Webern's String Quartet, Op. 28 as an example, Stockhausen shows how the parameters of musical structure, including the mode of attack, the number of notes in a chord, the registral spread and interval content of a chord, and levels of dynamics can be organized in ways that alter listeners' real-time experiences of perceived temporal flow. Stockhausen's *experiential time* relates more closely to theories of time perception based on the idea that perceived duration is dependent on the thresholds of human information processing (Fraisse 1963; Ornstein 1969; Michon 1972), as opposed to theories based on the idea of an internal time-keeping clock (Treisman 1963; Luce 1972; Kristofferson 1980). According to a study from Thomas and Cantor (1978), people interacting with a particular task can switch their attentions between the task and the passage of time; when one is task-oriented, the judgment of durations is primarily based on one's level of information processing and the less one pays attention to the task, the more duration judgments are based on clock time. More recent research into time perception has explored the idea of temporal illusions occurring during short-interval duration judgements, such as the "stopped clock" illusion, where the second hand on a clock appears to stop working momentarily before it moves forward to the next second (Eagelman 2008), while research into altered sensory environments, such as the immersive whole-body perceptual deprivation tank, showed participants reporting changes in temporal and spatial experience, including reports of *timelessness* (Glicksohn & Ben-Soussan 2020; Glicksohn et al. 2017).

The subjective experience of *timelessness* is of primary focus in this present research study. Mainemelis (2002) suggests that timelessness is a product of being in an experiential state in which one transcends a sense of self and temporal reality through immersion in a captivating present-moment activity or event. According to Mainemelis, in the context of practicing an act of creativity, when one enters such a state, one can potentially lose a sense of self-consciousness, including a sense of self, of desires and fears, and of a conception of cyclical or linear time during such moments (Hartocollis 1983; Whyte 1994). Mainemelis also states that the sensation of timelessness is a result of four concurrent experiences: a feeling of immersion, recognition of time distortion, a sense of mastery, and a sense of transcendence (Mainemelis 2001). Phenomenologically, according to Berkovich-Ohana et al., an altered sense of time and space is related to an altered sense of body, characterized by "a disrupted sense of spatial unity between self and body, where the self is not experienced as being confined within the boundaries of the body" (Berkovich-Ohana et al. 2013). In this perspective, one's perception of self can transcend the perceptual limitations of the human body leading toward experiencing a sense of timelessness during a particular moment of perception. Looking back at my first improvised public performance from 2014, particularly at my fellow performer's comments about time not existing for them during the performance, Mainemelis' four sensations of timelessness during acts of creativity, as well as Berkovich-Ohana et al.'s notion of the altered sense of body, provide an interesting context for understanding the temporal experiences my band-mates and I had while performing improvised music as well as possibly other ensemble improvisation settings.

Therefore, this research paper concerns itself with temporal experiences, both of time and timelessness, within the context of *ensemble electroacoustic improvised music performance*. When I say *improvised music*, I'm referring specifically to freely improvised music performance as opposed to improvisation that may be found within jazz, classical or other musical idioms. According to Bailey (1992), rather than being reliant on idioms of a style, the characteristics of free improvisation are established by the individual improviser's sonic-musical identity, therefore making

free improvisation conceptually non-idiomatic overall. Though free improvisation has historical ties to developments with free jazz in the late 1950s and 1960s (Smith 1973), non-idiomatic improvisation styles will be of particular focus in this paper, though it is worth noting the influence that jazz improvisation styles have on a number of free-improvisers' performance styles. When I say *electroacoustic music,* I'm referring to the composition/performance of electronically processed input signals from acoustic/electric musical instruments, synthesized sounds or recorded sound materials through analog effects-chains, computer-based systems, software applications or digital interfaces (or a combination of these) to convey musical meaning. Electroacoustic music is typically characterized by the organization of sound timbres and textures through transformation by means of electronic processes, which serve as musical objects for composition and performance. These musical objects can often be organized in ways that are near impossible for humans to conceive in terms of what is coined as *embodied cognition*, where cognitive processing is dependent on features of the physical body of an agent (Wilson & Foglia 2011). Noble et al. (2020) outline some of the "superhuman" musical characteristics made achievable through electronic sound production techniques:

> …producing sound events of durations so vastly protracted or contracted, achieving tempos so unattainably fast or slow, exhibiting degrees of almost unimaginable rhythmic complexity with such microscopic precision, executing groupings and superpositions of layers in proportions so far outside our capacity for perceptual differentiation, that they confront us with the limits of our ability to process information or embody musical sound, and point (potentially very far) beyond them. (Noble et al. 2020)

In the context of reception and perception of electroacoustic music, this paper considers *embodied cognition* as a key point of study in understanding the subjective musical listening experience. Wilson and Foglia et al. (2011) define embodied cognition as a form of cognitive processing that deeply depends on characteristics of the agent's physical body and their surrounding natural/social environment. Through the physical motion of parts of the human body, or the perception of other people's physical motions, the processing of relaying/receiving new information becomes more streamlined as it is tied to our embodied experiences; one example of

a phenomenon that motivates embodied cognitive science is the use of physical gestures in conversation with another person, which helps one to facilitate communication and language processing (McNeill 1992). With regards to embodied music cognition, Leman (2008) posits that our cognitive processing of music is fundamentally linked to the embodied experiences that afford us the understanding of how we, for instance, sing songs or bow a violin. Through *entrainment*, where one participates gesturally in the music being perceived (tapping the rhythm with their feet, dancing to certain rhythms, performing "air instruments", etc.), humans perceive motion in the music while having the ability to move with the music in a physical manner as well as through *aural imagination* (London 2009). Our mental images of sound-producing actions, or *motor programs*, are related to what Godoy calls *motor-mimetic* music cognition (2003), where we mentally imitate the production of sounds in attentive music listening or actively trace the contours of the music's shape in our imaginations in order to parse and make sense of such sounds as perceived units. Motor-mimesis in music can also be viewed as a translation of musical sounds, singular or complex in musical phrasing and texture, into visual mental images in the listener.

Now with regards to the cognitive processing of temporality in musical listening, Noble relates this to the concept of *human time* (2018), referring to the perception of temporal scales that aligns with the boundaries of optimal human auditory information processing and embodiment. These boundaries of auditory information processing are defined by the time zones of human biorhythms, such as natural walking pace, breathing pace, chewing, the variations of speeds in syllables of speech, and other frames of human bodily processes (see Section 2 for a more detailed view on temporal boundaries outlining *human time*). Therefore, music that is composed within the temporal boundaries of human auditory information processing can be more susceptible to entrainment in music listeners. Arnie Cox (2016) has said that "the history of Western music, classical and vernacular, has been dominated by music that is either easily singable, or easily danceable, or both…easily danceable music has a regular beat, with relatively simple and regular rhythms, at a tempo that affords efficient whole-body mimetic movements." This not only applies to the

processing of music through physical actions in listeners, which Cox refers to as *mimetic motor action* (2016), but also to mental images of such physical actions as processing of music, which Cox refers to as *mimetic motor imagery* (2016), similar to Godoy's theory of motor mimesis music cognition mentioned earlier. However, given the above, what happens in music cognition when temporal organizations of music surpass the boundaries of auditory information processing? How is the listener affected when musical entrainment is not easily achieved? How does the listener process music that is not easily singable or danceable? What mental images are perceived in this case? Furthermore, how does the listener experience time through music with temporal organization that is not aligned with human time? These are just some questions that may be explored, and possibly answered, through analysis of experiences in listening to electroacoustic music with temporal organizations of sound that surpass the boundaries of human time into what is referred to as *non-human time*, affording listeners the potential experience of *timelessness* (Noble 2018).

While considering the investigations above, the question arises of how time and/or timelessness is experienced by performers of *electroacoustic improvisation* (EAI), a form of free-improvisational music performance that utilizes the various forms of electroacoustic processing of musical sound materials as instrumentation. These forms of processed sound input or synthetic sound generation during performance may include, but are not limited to, analog effects chains, modular/granular synthesis techniques, sound-processing software applications/interfaces, etc. The work of Noble et al. (2020) in analyzing the experiences of participants listening to excerpts of electroacoustic and other contemporary music recordings served as a particular inspiration to this research paper's investigation of the experience of time/timelessness in EAI. Noble et al. focused exclusively on the *listener's* experience, using quantitative data-gathering methods to link listener's experiences of timelessness to certain musical moments that feature sounds whose temporal organizations surpassed the cognitive boundaries of human time, whereas this research study focuses primarily on the experiences of time/timelessness in *performers* of EAI during performance

(particularly in an ensemble setting) and the ways in which performers process their experiences through conversation directly after performance. Some important research questions emerge from this comparison:

- ***Are the experiences of time/timelessness in listening to electroacoustic music the same as those experienced by performers of ensemble electroacoustic improvisation (EAI)? Or are they inherently different?***
- ***If the experiences are different, how do they manifest in improvisers during performance?***
- ***What are the aspects of performing EAI that specifically contribute to players' experiences of time/timelessness?***

One who is familiar with the electroacoustic music listening experience, freely improvised music performance, and performing EAI music may presume the experiences in each context (listening and/or active performance) would be similar considering that both contexts require deep and intent listening from their respective participants. However, by presenting an analysis of 21 players' responses to questions regarding their experiences of time and timelessness during improvised performance, this research suggests that the above hypothesis is not absolute and, in the case of many of the participants of this study, the sensation of timelessness, in particular, may be caused by more than just spectral phenomena in the sounds being listened to.

Section 2 of this research project will explore the historical and contemporary scholarly research on perception of experiential time and timelessness and how these topics intersect with musical improvisation and electroacoustic music production, the literature of which will also be presented. Design of the overall experiment and the methodology of gathering the data will be explored in Section 3, outlining the intentions behind the structure of the performance sessions and the process of analyzing transcripts gathered from participant discussion. As a result of the circumstance of conducting this study remotely through Zoom during the COVID-19 pandemic, some of the challenges of telematic performance (in which players connect with one another over networked connections to perform music together) will also be covered in Section 3. An examination of the responses gathered from players in each group discussion will be presented in

Section 4 of this paper, followed by an analysis of the collected data and discussion of the results in Section 5. Here, the paper will summarize the emergent trends discovered in the data dealing with how ensemble-EAI performers from this particular study treat the perception of the passing of time and the experience of timelessness during performance. These trends offer a starting point toward better understanding the phenomenon of experiencing timelessness in EAI performance from a player's perspective while simultaneously contributing to the understanding of the nuances of successful and effective EAI performance in ensemble contexts.

2. Literature Review

This section of the paper will present a collected gathering of related works and scholarly literature in the following areas: cultural conceptions of time and temporality, the perception of timelessness in music, electroacoustic music composition and performance, free improvisation, and listening. These categories of study intersect with one another in this research project, as it examines the phenomenon of temporal perception in music performance and recording, the performative nuances informing improvisers' creative decisions during performance, and how electroacoustic processing of musical instrumentation impacts these.

2.1. Conceptions of time

To begin, it's important to consider the different ways in which time/temporality is conceptualized and the ways in which these conceptions are culturally informed. Various dictionary entries have provided variations of similar generalized definitions of the concept of time: the *Oxford English Dictionary* defines time as "the indefinite continued progress of existence and events in the past, present and future regarded as a whole," the *Merriam-Webster Dictionary* defines time as "the measured or measurable quantity in which events occur in a sequence proceeding from the past though the present to the future," and the *Science Dictionary* posits time as "a continuous,

measurable quantity in which events occur in a sequence proceeding from the past through the present to the future." All three of these definitions of time feature a common element: the view of time as a linear trajectory, starting from the past (what occurred before), moving through the present (what is currently happening) and reaching to the future (what will happen later). Another common feature in the definition of time, found in two of the three definitions listed here, is the view of time as a measure of change, related to *chronometry*, which the *Oxford English Dictionary* defines as "the science of accurate time measurement." In contrast with chronometry, *chronology* is also defined by the *Oxford English Dictionary* as "the arrangement of events or dates in the order of their occurrence." Chronometry is used for timekeeping (the use of a clock to measure the passing of time throughout the day or a calendar for measuring periods of time longer than a day), whereas chronology is applied to the study of history and the timelines of historical events throughout history. The imagery of chronometry is similar to the analogy of *time's cycle*, in which events and other periodic aspects of time are defined by their recurrence in a repeating cycle (Davies 1995; Coveney & Highfield 1991; Gould 1987). Units of time measurement like seconds, minutes, hours, days, weeks, etc., are characterized by their ongoing recurrence and their organizations into larger units of measurement. The cycles of seconds, minutes and hours keep track of the days passing by, the cycles of which keep track of the weeks and months of each passing year, and so on (of course these time-keeping cycles were designed to measure the Earth's revolution around the sun while spinning around on its internal axis). While chronometry, or cyclical time, represents time as recurrence lacking direction, chronology is more related to the analogy of *time's arrow*, which emphasizes forward direction, beginnings, temporary points of arrival, and irreversible flow (Mainemelis 2002). Inspired by Heraclitus' concept of the ever-flowing river, time's arrow represents time as a sequence of irreversible events occupying their own distinct position in a temporal series, with each event linked together to tell a story moving in a singular direction (Gould 1987). The view of time's arrow can be compared to the chain of events in a person's lifetime from birth to death, the story told in a film through the linear organization of scenes from opening to end

credits, or the recollection of moments in history from the start of one decade to the start of the next one.

The definitions and analogies of time presented above show only a fraction of the different facets of time, many of which are formulated from Western conceptions. For instance, Richard Lewis (2006) writes that the American concept of time prioritizes opportunities for action found in the present in order to benefit the immediate future while ignoring what occurred in the past. In a country built around 'the American Dream' and capitalism, time becomes a precious commodity; people may organize their daily or weekly schedules around activities/events that feel like a good use of time instead of those that would be considered *a waste of time*. This sanctification of timekeeping and the metaphorization of time as currency reflect what Lewis suggests is a distinctly Western-capitalist view of time (represented by the familiar adage *time is money*), one that is framed by a linear vision of time (2006). This is a view of time that, according to Lewis, is shared by many Westernized countries like Britain, Germany and Switzerland, though is quite opposite to the more cyclical view of time held by countries in the East. Cyclical time in Buddhist cultures (e.g. Thailand, Tibet) is viewed in relation to the repeating cycles of events: the rising and setting of the sun and moon each day, the periodic succession of governmental rulers, the recurrence of weather phenomena and natural disasters, etc. (Lewis 2006). Through the knowledge that events will recur throughout a person's life, there is less anxiety towards planning for the future as time is not viewed as a precious commodity that could possibly be wasted.

What I intend to illustrate above is that not all cultures around the world share the same attitude towards time/temporality and that these conceptions are each culturally informed. Research into the impact of language on perceiving the world shows that perspectives on the passing of time can be entirely dependent on the cultural language one knows, extending from Whorf's studies in linguistic determinism – the idea that distinguishing characteristics of each language inform the ways in which one perceives the world and acts in it (Whorf 1956). Boroditsky (2001) states that the non-permanent aspects of conceptual time, such as the experience of being in only one place

at one time, experiencing each moment happening only once and not being able to go back (aspects that are extractable from world experience), are universal across languages and cultures, though the spatial aspects of time may differ between different cultures. According to Boroditsky, English speakers typically use horizontal spatial terms to talk about the ordering of events in time (planning *ahead* for the future, thinking *back* to last week, moving meetings *forward*, pushing deadlines *back*, etc.), aligning with a more linear view of time. However, although they also occasionally speak of time in horizontal metaphors, Mandarin speakers systematically use vertical metaphors for the order of events in time (Scott 1989). For example: *māo <u>shàng</u> shù* is Mandarin for *cats <u>climb</u> trees* in English. Compare this with <u>*shàng*</u> *ge yuè* in Mandarin, which translates to <u>*last*</u> *month* in English. Here, the word *shàng* works as a vertical spatial term (climb) as well as a temporal function (last) referring to the previous event in time (example from Scott 1989). Boroditsky's experiment with English speakers and Mandarin speakers, which involved the verification of true-or-false time-based statements ("March comes *before* April" or "March comes *earlier* than April) after viewing a series of horizontal and vertical spatial primes ("X is *ahead* of/*behind* Y" or "X is *above*/*below* Y" with corresponding images), found that native English speakers were quicker to verify the temporal statements after viewing horizontal primes than vertical primes, while native Mandarin speakers were quicker to verify temporal statements after viewing vertical primes than horizontal primes. This experiment found that native English and native Mandarin speakers each thought differently about time (Boroditsky 2001); one can conclude from this finding that perspectives on the organization of time can be totally dependent on the language one uses to understand time itself. Despite the differences in spatial terms, it's also important to note that the use of spatial terms in general to understand the way time flows, as well as metaphors of motion, remains a common element in both languages, mirroring Cox's point that "…most of our temporal concepts […] are borrowed from literal spatiotemporal experience" (Cox 2016).

2.2. Time perception & music

According to Mountain and Dahan (2020), all music is temporal by nature. Any piece of organized musical sound exists in a temporary time-space, a landscape in which sounds evolve and change over the course of the piece until it is eventually over. Raymond Monelle (2000) has stated that music is structured within time and also has the ability to *signify* time, causing listeners to distinguish between the temporality of what is being signified and the temporality of the signifier. Christopher Hasty (1986) suggests that, because humans tend to identify time with the process of change, listeners may perceive the changes in temporal scales and structures in music as changes to time itself. Composer Gérard Grisey offers three different forms of what is known as *musical time* through metaphoric comparison to the composition of the human body (1987): *the skeleton of time*, referring to the chronometric temporal divisions used by composers to organize rhythms and durations of sounds; *the flesh of time*, referring to the expansion or contraction of time through organizations of perceptually similar/opposite sounds in sequence and points of suspension that afford listeners space for perception of the sound; and *the skin of time*, referring to the communication between musical time and the listener's immediate memory of time. Noble (2018) suggests that, through temporal organization, music can create *temporal fictions*, worlds of timelessness or altered states of time defined by the deployment of sounds in time, with temporal proportions of these sounds acting as markers for such temporalities in the music. So how do certain types of music use temporal organization of sounds' properties in order to formulate temporal fictions that influence the listener's subjective experience of time during the music? Taking inspiration from Boroditsky's findings on the influence that language has on shaping people's thoughts on time, it is worthwhile to consider the ways in which different forms of music may express different forms of temporality. Though it may be problematic to conflate expression through music and communication through language, different styles of music, similar to different languages, may be composed through different sets of organizational rules and may also be culturally informed,

meaning that the temporal fictions within certain styles of Western music, for instance, may yield wildly different experiences of temporality to non-Western musical styles.

As previously mentioned in this paper, Noble (2018), among other scholars, claims that the many examples of pre-20th century Western art music have been composed and temporally organized around the time zones of human biorhythms and the limitations of what humans are physically capable of playing on their respective musical instruments, which he refers to as *human time*. Typical Western art music pieces feature rhythmic pulses and grooves that are commonly aligned within a perceptual range in which listeners can more easily entrain (Janata et al. 2012), while note durations tend to fall within optimal perceptual units and are grouped within easily digestible phrases of melodies and harmonies. However, Noble (2018) states that when the limits of performability in the music are pushed to the point of challenging listeners' abilities to imagine themselves performing the music, the listeners' grounding in human time becomes distorted and pushed toward a superhuman form of time experience. London (2009) states that, on the opposite end of the spectrum, the use of droning resonances in non-Western music practices, such as gongs in Javanese gamelan music or the shō (or mouth organ) in Japanese gagaku music, can bring the listener into a state of being *out of time*. Apart from these styles mentioned by London, other styles of global music that utilize elements of drone, including Indian tanpura music, and more contemporary forms of music such as electronic trance, pure-intonation minimalism, or ambient music, could potentially yield similar experiences of time disorientation for the listener. Noble outlines the perceptual thresholds of four sonic properties that align with human-perceived time scales: *segmentation* (the duration of a sound event), *sequence* (the durations of inter-onset intervals (IOIs) between the beginnings of successive sound events), *periodicity/pulse* (the ability to perceive beats in the music), and *meter* (durations of metrical patterns in the music). The table below outlines Noble's perceptual boundaries of each sonic characteristic (the minimum and maximum values) that contain optimal human perception. It is Noble's claim (2018) that perceptual sonic characteristics that *exceed* their maximum values or *subvert* their minimum values not only

Table 1. Ranges and thresholds of *human time* (Noble 2018).

Perceptual category	Minimum threshold	Maximum threshold
Segmentation	100 ms (Repp 2005)	5-7 seconds (3-5 seconds is average short-term memory time limit) (Snyder 2000)
Sequence	~100 ms IOI (London 2009)	~1800ms IOI (Repp 2005)
Pulse "The Beat Zone" (London 2004)	~200 ms IOI (~300 BPM) (London 2004)	~2000ms IOI (~30 BPM) (London 2004)
Meter	Binary grouping of the shortest rhythmic unit (2 x 100ms = 200ms) (Noble 2018)	Compound grouping of the longest possible pulse (3 x 2s = 6s) (Noble 2018)

fall outside of optimal auditory information processing, but also lead to experiences of *non-human time*, or *timelessness* (see **Table 1).**

The use of non-normative temporal organizations to convey specific musical meaning is common amongst certain 20th and 21st century composers who desire to evoke specific images or concepts within their compositions. Olivier Messiaen's use of extended meter in his *Quartet for the End of Time* (1941), particularly from sections D to G of the second movement "Vocalise for the Angel who announces the end of time" (see **Figure 1**), evokes a feeling of endlessness in the music, which Diane Luchese refers to as an "evocative ambiance, which may be interpreted as a

Figure 1. Section D from Movement II "Vocalise" from Messiaen's *Quatuor pour la fin du temps* (1941)

sonic metaphor for eternity" (2010). In this movement, the ambiance is created from the contrasting metrical structures of the piano, playing a repeating pattern of complex chords in descending motion that evoke a dream-like quality, and the strings (violin and cello) playing in an intentionally disorienting meter composed of a mixture of 8th notes, dotted-8th notes, 16th notes and ¼ notes. Though the piece is composed in 3/4 time, neither the strings nor the piano parts align with the start of each measure. The piano pattern repeats every 2 beats, yet begins on the second 16th note of the measure, while the strings don't follow a consistent pattern of motion at all, leaving the listener intentionally confused on where the music will go. Gyorgy Ligeti's *Atmospheres* (1961), in contrast with Messiaen's approach to temporal organization, uses a compositional technique that features no melodic, harmonic or rhythmic development and instead places significant emphasis on texture as the focus of the piece. In the introductory section, the instrumentalists are all playing sustained notes, with the score suggesting that players choose any note from D2 to C#7. The result is a cluster of sustained pitches of indeterminate pitch in the introduction that invites the listener to pay attention to the overall texture of the sound field. Noble (2018) includes the use of sustained tones in *Atmospheres* as an example of music that exceeds the maximum threshold of human-scale perception of segmentation (tones with durations longer than 7 seconds), resulting in the experience of *timelessness* in the listener.

We can link the development of non-normative temporal organizations in music to the history of the development of musical instruments in the 20th century, instruments that could produce music that surpassed human performance ability. Even long before the 20th century, we can surely consider the organ in this discussion, with its ability to sustain tones for however long the player depresses keys with their fingers. Noble et al. refer to the organ as an example of a musical instrument capable of achieving "superhuman" production abilities (2020), creating droning pitches with sonic segmentations far longer than what is normally perceptible to human performability. In an extreme example, John Cage's *Organ2/ASLSP*, an organ rendition of his piano work *As SLow aS Possible*, began as an organ concert on September 5th, 2001, organized by the John Cage

Organ Project, and is scheduled to continue for a total duration of 639 years, ending in the year 2640 (Helman 2020). The development of the player piano, which utilizes a pneumatic mechanism to self-perform pre-programmed piano pieces on perforated paper, afforded composer Conlon Nancarrow the ability to write extremely complex piano studies that featured note sequences that are physically impossible for human hands to perform. The 20th century also saw the advent of electronic instrument development, starting with Thaddeus Cahill's *Telharmonium* in 1896, an electromechanical musical instrument that used the combination of sine waves, or additive synthesis, to generate electronic tones similar to an organ (Weidenaar 1995). This was followed by the establishment of electronic music studios, further developments in electronic synthesizers for public consumption and the use of tape recorders for the capturing and recontextualization of recorded sounds, leading up to what Roads considers "[t]he most precise and flexible electronic music instrument ever conceived": the digital computer (Roads 2001). These technologies have historically afforded the electronic production and processing of sound materials to create a new language of musical communication commonly referred to as *electroacoustic music.*

2.3. Electroacoustic music

2.3.1. Overview of electroacoustic music

As mentioned previously, electroacoustic music is derived from the use of electronic processing of sound materials to unlock new sonic timbres, gestures and textures that may be far removed from any association with the original sound. This form of music stems from a number of historical relations, including John Cage's thoughts on experimental music (Cage 1957), Karlheinz Stockhausen's contributions to the development of electronic music and theories on musical time (Stockhausen 1957), though I won't delve too deep into these due to the scope of this paper. I will, however, explore more of the development of what was initially referred to as *musique concrète*, pioneered by Pierre Schaeffer in post-WWII France using tape recorders to re-contextualize sounds removed from their original context, known as *sound objects* (Schaeffer 1966), and

disseminated through loudspeaker technology. However, the term musique concrète, or concrete music, has become a somewhat antiquated term in the latter half of the 20th century; Chion (1993) notes that the term may be perceived by some as representing a restricted sense of the music as simply a form made from concrete sounds, or sounds originating from acoustic sources. Many prefer to use the term *acousmatic music*, referring to a style of presenting music in which the origins of sounds being perceived, typically through loudspeaker systems, are imperceptible to the listener. Though the term *acousmatic* dates back to the days of Pythagoras, whose followers would listen to his lectures as he gave them from behind a veil (Schaeffer 1966), its use to define the listening experience of musique concrete originated from Schaeffer and novelist Jérôme Peignot in 1955 (Peignot 1960). Electroacoustic composer Trevor Wishart defines the contemporary usage of the word as referring to the aural processing of a sound without the context of its original source (Wishart 1986), relating closely to Schaeffer's concept of the *sound object*, referring to a sound whose origin is potentially unidentifiable due to the removal of the sound from its source via recording, leaving the sound independent of causal reference and rendering it as its own object of focus (Schaeffer 1966). Godoy (2006) refers to sound objects as raw fragments of sound, typically in the durational range of a few seconds or less, that are deemed suitable for use in composition as musical objects. When one listens to a sound object, the listener has no frame of reference to contextualize the sound being processed, leaving the object of study to be the sound itself rather than its source context. Expanding on the concept of the sound object, Schaeffer coined the term *reduced listening*, referring to the process of listening to a particular sound as a sound object removed from the context of its source. In his book *Treatise on Musical Objects* (1966), Schaeffer gives the example of the sound of a creaking door. When the listener is practicing reduced listening, the object they are targeting while listening is not the door creaking, but the creaking sound alone, removed from the context of the door. In this mode of listening, the listener begins to focus their attention away from the image of the door and instead towards the timbral qualities that characterize the creaking sounds. With regards to music, sounds produced by certain musical

instruments or specific sound processing techniques may hold a contextual place within the minds of those that hear them based on identifiable sonic characteristics and their uses in various styles of music. For instance: seasoned guitarists may be able to identify the difference between the sound of a Telecaster vs. that of a Stratocaster based on having experience playing either model, or a music producer may be able to identify the sound of a phaser effect based on the experience of having used it before. Such experiences may inform listeners' perceptions of musical objects as they are heard from familiar sound sources and could make it difficult for reduced listening to occur

Reduced listening, acousmatic listening and the sound object contextually inform the practice of electroacoustic music creation, where electronic transformations of sound material can create spectral content that differs immensely from sounds that have associations with physical objects, natural human gestures or human conceptions of time. Sound objects, and their spectral/gestural/temporal transformations over time, serve as the basic units of musical structure and development in electroacoustic composition. With regards to time scales, musical units in electroacoustic music can be as large as a few seconds long or as small as a fraction of a second. The time scales of the sound object can be broken down even further into *microsounds*, which extend down to the thresholds of human auditory perception (measured in thousandths of a second), and even further down into *samples*, the atomic level of digital audio systems measured in millionths of a second (Roads 2001), though sound events lasting a few samples in length would not typically comprise a sound object. Roads also refers to *microsounds* as *grains of sound*, brief microacoustic events with durations nearing the minimum value for human auditory perception, developed from Denis Gabor (1947) and Iannis Xenakis' (1971) early models of *granular synthesis*, the process of organizing sound grains into larger structures of complex sounds (Roads 2012). Gabor and composers Jacques Poullin and Xenakis were among the first to devise sound granulation experiments and studies, with Gabor using electronic parts from film projectors and Poullin and Xenakis utilizing magnetic tape. Roads was then one of the earliest composers to implement digital granular synthesis techniques in musical composition with his early works *Klang-*

1 (1974) and *Prototype* (1975). These innovations would go on to be further developed by future computer-music composers, including Canadian composer Barry Truax, whose 1986 work *Riverrun* implements real-time granular synthesis with a digital signal processor to generate oscillator tones through additive synthesis, frequency modulation and sampled sounds, arguably the first musical piece to do so (Truax 1988). Through the breaking down of sound objects into micro-level time scales using tools like digital processing and granular synthesis, composers of electronic music are afforded the ability to create works with not only unique timbral phenomena but also micro-level temporal organizations that can push beyond the thresholds of human-level time perception in musical sound through artistic intention. For example: Stockhausen initially wrote about the relationship between *rhythm* and *pitch* as it relates to the perception of durational intervals in his Temporal Theory (Stockhausen 1957), claiming that the two are in fact one and the same phenomenon while differing only in their respective time scales. Depending on the speed of the durational intervals of rhythmic beats, one may perceive either a distinct rhythm at slower speeds or a distinct pitch at higher speeds. Roads continues:

> Taking this argument deeper into the microtemporal domain, the *tone color* or steady-state spectrum of a note can also be seen as a manifestation of microrhythm over a fundamental frequency. This point of view can also be applied in the macrotemporal domain. Thus, an entire composition can be viewed as one time spectrum of a fundamental duration. (Roads 2001)

2.3.2. Brief analysis of Barry Truax's *Rivverrun*

For this section, I'd like to briefly step away from a literature review in order to look at two specific moments in Barry Truax's *Riverrun* that demonstrate sonic material with temporal organizations that surpass human perceptual thresholds through the use of granular synthesis techniques. We will first examine the introduction, which features a variety of repeating sequential patterns of sounds of different textures. To start, we hear the sounds of rough textures of an irregular periodicity, in very short duration, that almost resembles the sound of an object floating over water (in relation to the title of the piece, *Riverrun*), with the water's small ripples and waves rocking the

object back and forth as it floats gently over the water's surface, a natural metrical pattern that evokes a particular image, one of stillness and calm. After roughly 30 seconds, the spaces between sounds begin to close in until there is no semblance of empty space between sounds, creating a perpetual texture. At approximately 70 seconds into the piece, very short tones emerge in a similar sequential pattern to the previous sounds, a sequence of sounds that are themselves too short for sequential resolution with inter-onset intervals (IOI) too short for the perception of ordered sequence. These two perceived sound phenomena are copied and layered over one another, creating a densely textured landscape of sound that no longer resembles the initial peaceful image posited at the start. What remains heading into the 2'30" mark is an unrecognizable sonic environment that features a great deal of internal spectral activity yet still implies a sense of stillness, a feeling that is further emphasized by the introduction of a steadily rising high-frequency texture as a declining high-frequency texture is simultaneously heard. There is motion and there is also implied stillness in this moment, as the segmentations of the sounds are so short that it is impossible to perceive them individually and ordered sequence is next to impossible to determine. The next moment of interest starts at approximately the 5'40" point, where a recurring percussive sound, heard over a low rumbling drone, introduces a steady beat of roughly 60 BPM, or 1 second IOI; this falls within the human temporal thresholds of perceived pulse, between 200ms and 2s IOI (London 2004), so this is a clearly perceived pulse in this moment. As each percussive sound is repeated, the listener begins to hear its grains separate more and more until the pulse is eliminated. **Figure 2** shows a spectrogram of the percussive sounds as their grains begin to separate, while **Figure 3** shows the shift from these percussive pulses to a large texture of granular activity, where
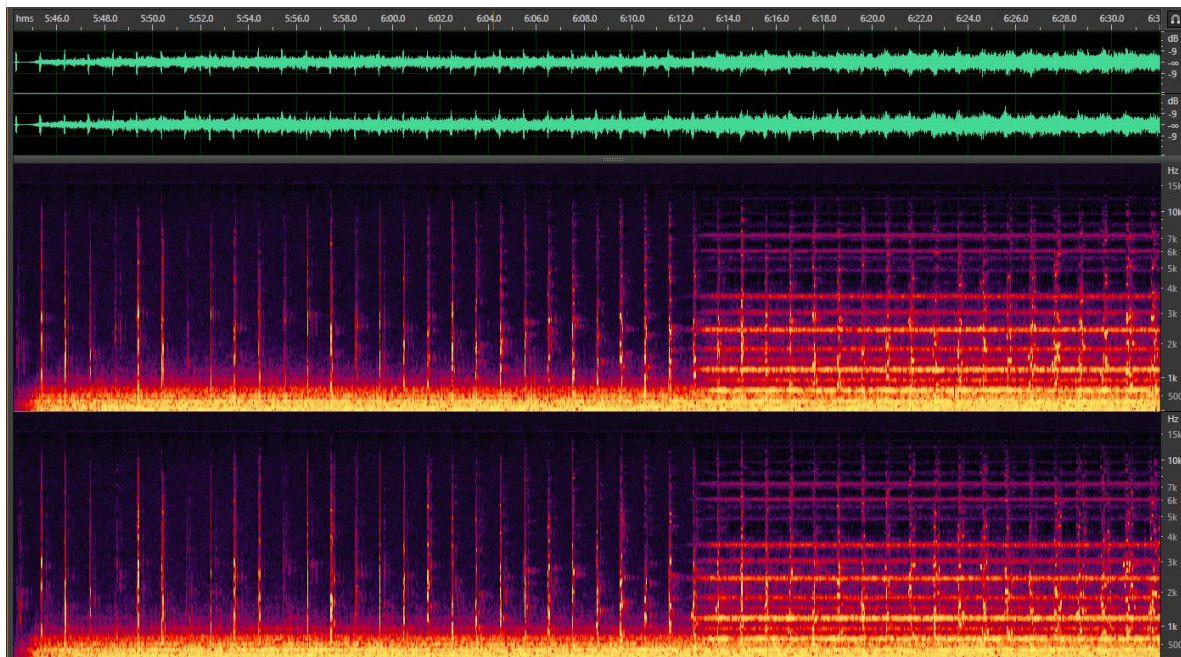
Figure 2. Spectrogram of *Riverrun* (1986) from 5:44 to 6:32. The grains are organized into a steady, distinguishable pulse.
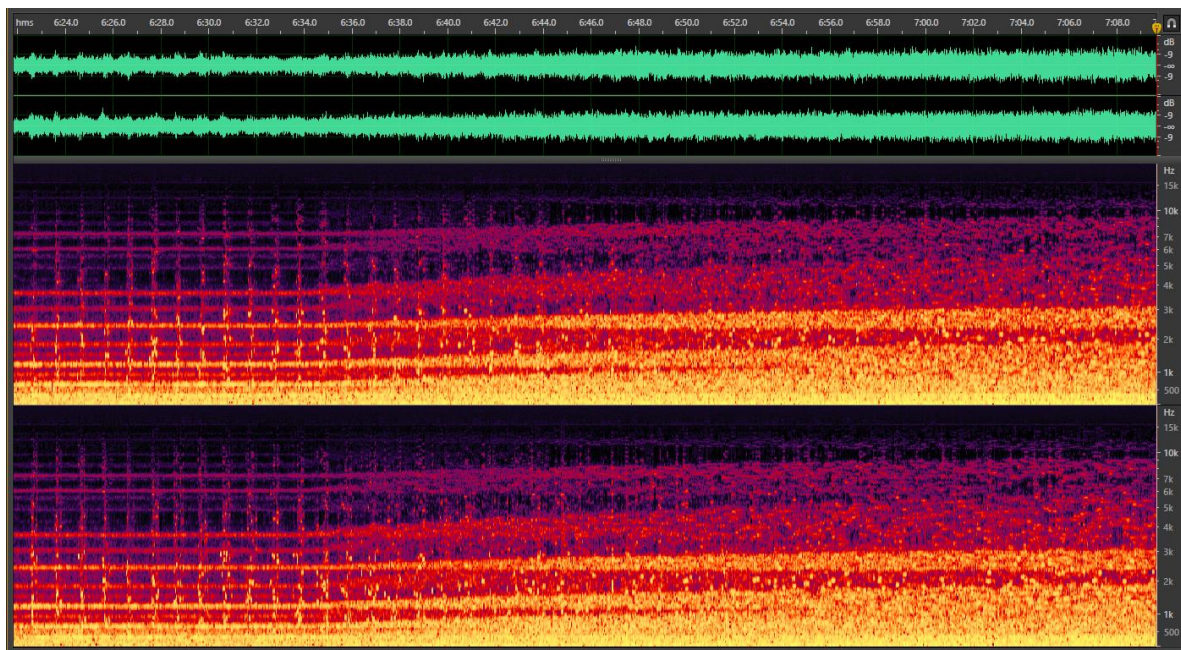

Figure 3. Spectrogram of *Riverrun* (1986) from 6:22 to 7:10. The grains that comprised the initial pulse start to break apart, generating a new texture that results in the elimination of pulse.

steady pulse is no longer distinguishable. It is Noble's claim (2018) that these two moments in *Riverrun* point to perceptions of timelessness in the listener because of the use of micro-level segmentations and pulses that exist beyond the human-level boundaries of perception.

2.3.3. Performing live EA music

Developments in signal processing hardware and software programs have not only afforded new sonic augmentation capabilities for composers of electroacoustic music, but also new instrument systems for performers of real-time EA music creation. An early example of this type of system is Pauline Oliveros' Expanded Instrument System (EIS) (Oliveros 2008), a personal live-electronics system for processed solo instrumental performance, typically in the form of Oliveros' accordion playing. Originally designed around the analog delay effect achieved through the use of reel-to-reel tape recorders, with the later addition of feedback effects and even a second tape machine (and later digital delay in 1983), Oliveros was afforded the ability to manipulate amplitudes and make changes, or electroacoustic transformations, to her sound qualities during improvised performance, adding a further dimension of creative improvisatory control over her instrumentation (Oliveros 1979). The intention behind the EIS was not only to have a player-controlled instrument expansion that augmented the player's sonic palette, unlocking new spectral content in the instrument that could not be reached by acoustic means alone, but also for Oliveros to translate her studio compositional techniques into live performance. Some modular synthesizers like the EMS VCS 3, and later the Eurorack modular synthesizer, also have the ability to process sound input from acoustic or electric instruments, the latter of which has seen a growth in popularity in recent years[1]. Today, modular synthesis or hardware signal-processing systems can be recreated through purely digital means on modern computers, with granular synthesis programs also available through various programs. For instance, visual programming audio software programs like Max/MSP or

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[1] Exploring the contemporary resurgence of modular synthesizers may surpass the scope of this paper, but I would strongly recommend exploring the documentary film *I Dream of Wires* (Fattinatto 2014) for more details on the subject.

Pure Data feature robust in-house signal processing devices that have the capabilities to recreate a performance system like EIS, as composer Doug Van Nort has done with his software system GREIS (Granular-feedback, Expanded Instrument System), developed in Max/MSP. One major difference between Oliveros' EIS and Van Nort's GREIS is the latter's implementation of a sort of bi-manual style of interaction, through the use of a Wacom tablet and various controllers, to focus more towards "building sound structures rather than purely on machine partnering, and thus includes shorter time delays (e.g. from milliseconds to a few seconds) that influence the timbral and textural quality of the immediate sound output as well as longer-term musical structures" (Van Nort et al. 2013), as opposed to EIS' capability of propelling sound input through time and space after durations of 20-60 seconds. One very important aspect to note here is an increased accessibility of technologies today such as software programs and digital interfaces by means of modern laptop computers. Composers/performers of EA music are able to download programs like Max/MSP and PureData (the latter of which is open source and free to access), or any other type of signal-processing software application that may be found online, that run on a powerful laptop computer for both composition and live performance, along with digital interfaces such as USB MIDI controllers or third-party FX programs. These types of systems can also be used to process acoustic or electric instruments through microphone pick-up or direct line-in signal into an audio interface connected to the computer or electronic sounds generated by virtual synthesis devices. With the use of laptop computers (as well as considering the portability of certain digital controllers or analog devices), performers can take their instrument rigs on the go for public performance over loudspeaker configurations. Considering the large spectrum of options that musicians have for performing with electroacoustics, the possibilities are seemingly endless for the electroacoustic musician.

2.4. Free improvisation & listening

The type of musical improvisation at the center of focus in this paper is free improvisation, which Derek Bailey (1992) refers to as a form of *non-idiomatic improvisation*, where sonic characteristics of the musical performance are not based on the form of the genre but rather the style of performance brought forward by the performer who improvises free from stylistic constraints. This is unlike jazz improvisation, where improvised solos are structured in real-time based on the harmonic/melodic structures implemented by the tune being performed, or any other form of improvisation expressing a particular musical idiom like baroque or flamenco music. Ornette Coleman's work in *free jazz* for instance, among other prominent musicians such as Albert Ayler and Cecil Taylor, established new techniques in improvisation in the late 1950s - early 1960s where the conventions of jazz performance ceased to be absolute and players could freely improvise around such traditional rules (a breakdown of such rules in jazz performance is beyond the scope of this paper). Underpinning Coleman's performance style in particular was his personal/philosophical theory of *harmolodics*, an individualistic perspective which he defines as "the use of the physical and mental of one's own logic made into an expression of sound to bring about the musical sensation of unison executed by a single person or with a group" (Coleman 1983). Coleman uses the word unison to refer to the sound of a musician's own individual voice of expression during performance. Coleman also says that a player's unison and generation of ideas results in "harmony, melody, speed, rhythm, time and [phrase] all [having] equal position" in the music (Coleman 1983), meaning that, according to Pitsiokos (2019), the different musical parameters all share an equal significance in the music and should be considered as a singular unit in unison. Rather than having a basis in a particular musical idiom and adhering to said idiom's stylistic attributes, free-improvisation rejected stylistic conformity in favour of exploring the totality of sound, which gave audiences a tendency to classify later free-improvisation as "experimental music". According to free improviser Cornelius Cardew:

> An open-ness to the totality of sounds implies a tendency away from traditional musical structures towards informality […] Informal 'sound' has a power over our emotional responses that formal 'music' does not, in that it acts subliminally […] We are *searching* for sounds and for responses that attach to them, rather than thinking them up, preparing them and producing them. The search is conducted in the medium of sound and the musician himself is at the heart of the experiment. (Cardew 1971)

Michael Bullock (2010) refers to the style as *self-idiomatic improvisation*, where the improviser supplies their own individual style or idiom of improvisation, one that manifests through the assemblage of a unique system of sound-making objects that comprises the performer's instrument setup. There is no one way for improvisers to perform, thus the performer contributes their own idiom of performance from their own personal compositional practice. The same certainly applies to electroacoustic improvisation, where there are countless possibilities for invention in instrumentation or intervention of existing instrumentation (Van Nort 2016), resulting in totally unique and personal styles of sound production and navigation within improvised performance. As far as structure is concerned, Van Nort (2016) notes two different modes of group improvisation: *laminal*, a form pioneered by English free improvisation music group AMM (of which Cornelius Cardew was a member) where the focus of performance and musical meaning lies in layers of overlapping textures co-existing and co-evolving, and *atomic*, where improvisation is based on turn-taking and the sequential presentation of brief sonic ideas from each performer. Through either laminal or atomic improvisation, Van Nort also notes that authorship is distributed equally amongst all the players and that composition through self-idiomatic improvisation is also distributed by nature, meaning that compositional choices in improvised performance, particularly electroacoustic improvisation, are a result of each group member's contributions, influenced by players' abilities to "locate themselves within the sound field through listening for relationships that manifest across players, mediated by systems of technological and performative engagement," or *distributed listening* (Van Nort 2016). The act of listening is critical to ensemble free improvisation, even more so with EAI where electroacoustic processing can drastically manipulate each player's sound output, affecting the sonic environment shared between all performers. This is connected to Pauline

Oliveros' practice of *deep listening*, in which, in the context of improvised music, performers are actively and attentively listening to their sonic environments and then reacting to what is perceived through conscious awareness and presence in the moment (Oliveros 2005). Performers' listening practices are based on their levels of attention/focus, their levels of awareness of the environment they inhabit in the moment and the ways in which attention and awareness influence each other while listening:

> While one's attention is focused to a point on something specific, it is possible to remain aware of one's surroundings, one's body, movement of all kinds, and one's mental activity (in other words remain aware of inner and outer reality simultaneously). Attention is narrow, pointed and selective. Awareness is broad, diffuse and inclusive. Both have a tunable range: attention can be honed to a finer and finer point. Awareness can be expanded until it seems all-inclusive. Attention can intensify awareness. Awareness can support attention. There is attention to awareness; there is awareness of attention. (Oliveros 1973, in Oliveros 1984)

Oliveros' intention with deep listening as a form of meditation is "to heighten and expand the consciousness of sound in as many dimensions of awareness and attentional dynamics as humanly possible," (Oliveros 2005) so naturally deep listening serves as a beneficial practice and almost necessary function of successful EAI performance, where the collective sonic environment is vast in scale and contributions from other players are made based on what sounds are perceived in the sonic space/time continuum.

Since this paper focuses largely on the experience of group improvised music performance, it's of particular importance to touch upon the ways in which collective real-time musical creations emerge from the *distributed creativity* found within group improvisation. Distributed creativity refers to the act of creation within an egalitarian creative group setting in which the creation is generated by the equal collaboration between all members of the group (Sawyer & DeZutter 2009). In the case of group creation of a more unpredictable and unconstrained nature, such as in freely improvised ensemble music performance, a process known as *collaborative emergence* (Sawyer 2003) occurs, which is characterized by equally collaborative creative activity with unpredictable outcomes, moment-to-moment contingency and the changing interactional effects of actions and

subsequent actions between members of the group. Players in a non-hierarchical group improvisation setting are equal contributors to the improvised performance, itself unscripted musical performance where the outcome is unpredictable and contingent upon the various actions and reactions from players in the moment. Within group improvisation, *group flow* (Sawyer 2006), the phenomenon in which ensemble members in improvised performance play in synchronicity, becomes an emergent property of the entire group as a collective unit. It is a product of the collaborative emergence from improvisers interacting with one another as opposed to Czikszentmihalyi's flow theory (1990), which represents a particular state of consciousness within the individual performer. According to Sawyer (2003), group flow can be described as "interactional synchrony," where the musicians, in open communication and listening to each other, collectively inhabit a shared sensation of flow while fully attending to each other simultaneously.

3. Experiment & Methodology

This section of the paper will outline the experiment conducted to test the hypothesis that EAI performers engaging in ensemble improvisation experience the flow of time and the sensation of timelessness differently than listeners of EA music recordings. The nature of the experiment will be detailed through description of the design of the study, including a rationale regarding the format of each performance session and the format of the subsequent group discussion. Since the experiment took place online through telematic means, a brief commentary on some of the challenges of performing through network connection will be presented. Following this discussion on telematics will be an overview of the grounded theory approach I used to analyze the qualitative data gathered from performers' responses from group discussion. This study was certified by the York University Office of Research Ethics.

3.1. Procedure

For this research project, 21 improvisers with a minimum of 2 years' experience in electroacoustic improvisation (EAI) performance were recruited to participate in a recorded trio improvisation over telematic connection (network audio/video connection). The musicians (see **Table 2a/2b** below), some of whom were affiliated with the DisPerSion Lab's Electro-Acoustic Orchestra as well as the electroacoustic music community based in Toronto, Ontario; were recruited through open calls on social media, email chains and direct recruitment tactics. The performers recruited for this study had at least 2 years of experience in performing ensemble EAI music as well as at least 2 years' experience in listening intently to experimental forms of music. The instrumentation that various performers had at their disposal ranged from acoustic instruments such as guitars, voice and cello, to electronic hardware instruments like modular synthesizers and Buchla Music Easel, to audio synthesis software interfaces like MaxMSP, cataRT and SuperCollider. Though it was not required for every performer to have an electroacoustic instrument setup, it was a requirement that each performance session feature some form of electroacoustic processing of sounds. The age of participants ranged from 25 to 70 years of age, with approximately 62% of performers based in Toronto, Ontario, Canada and the Greater Toronto Area at the time of each performance session. Other locations of performers include Montreal, Quebec; some regions in the USA, including California, New York, and Massachusetts; Sweden and The Netherlands. Some of the performers were familiar with each other, some had played together in the same set, while some participants

Table 2a. Participant details – Semi-structured improvisation

Trio	Participant	Gender	Instrument
1	A	M	Electric guitar/Pedals
	B	M	EWI/Electronics
	C	M	Electric guitar/Pedals
2	A	M	Blackbox sampler
	B	M	Synthesizer
	C	M	Bass/Electronics
3	A	M	EWI/cataRT
	B	F	Electric cello
	C	M	Analog synthesizer
4	A	M	Modular synth/Voice
	B	F	Voice/Processing
	C	M	Electric guitar/Pedals

Table 2b. Participant details – Unstructured improvisation

Trio	Participant	Gender	Instrument
5	A	M	Max/SuperCollider
	B	F	Voice
	C	F	Computer/Granulation FX
6	A	M	Analog synthesizer
	B	M	Laptop/iPad/Mic/Max
	C	M	Electric bass + FX
7	A	M	Buchla Music Easel
	B	M	Modular synthesizer
	C	Other	Modular synthesizer

were performing, and even meeting each other, for the very first time. A total of 7 trio performance sessions took place, in which all participants connected and performed telematically through online meeting rooms, which I had organized in the online video conferencing portal Zoom.us (see Section 3.2 for more on telematic performance).

Participants were asked to perform freely improvised electroacoustic music for a total duration of 30-40 minutes. 4 of the 7 trio ensembles played in a semi-structured improvisation set organized through durational breaks between players, a format that I had come to be familiar with myself through the DisPerSion lab's Dispersion Relation X telematic performance series. The first half of the performance featured a series of solos and duets divided by durational cues between the three players: the first player performed solo improvisation for a duration of what that player determined to be 5 minutes, followed by roughly 2-3 minutes of duet performance between the first and second

player. After the first duet, the first player would fade to silence to allow the second player to perform solo improvisation for roughly 5 minutes. This structured cycle would repeat for the second and third player, and then finally the third and first player again, before moving into the second half of performance which featured all three performers in trio improvisation until the end of the piece. I had advised the players that it was not essential to rely heavily on the use of a clock in order to keep track of their entry/exit points during performance and encouraged them to use their musical intuition in determining when to start playing and when to stop playing. The durational time constraints served as more of a loose organizational framework than a strict timing of solos and duets, so I had told players that there would be no repercussions if they had or had not exceeded the initially proposed length of each solo/duo. My intention was twofold: firstly, I was interested in determining if the experience of time and/or timelessness during solo performance was different than the experience in duo/trio performance. Secondly, I was also interested in determining if having players become aware of time-based structural constraints would impact their experiences of time and/or timelessness during performance in these sections and if these contrasted with experiences felt in the trio section where players no longer had to worry about keeping track of time until the end of performance. As a further test to this hypothesis, I asked the other 3 trio ensembles to perform in a more unstructured improvisation format where the only time-based constraint imposed was a total set duration of 30-40 minutes. Like the semi-structured performances, I had advised players in the unstructured sets to not rely on clock-time in order to keep track of how long the performance had been, reiterating that there was no pressure for players to have precise timing in their improvising.

After the completion of each improvised performance, players engaged in open discussion with myself related to their experiences of the flow of time and the sensation of timelessness during the performance that had just taken place. In this portion of the session, I was interested in asking participants about their general impressions of the overall flow of time and any experiences of the

time speeding up, slowing down, or the sensation of timelessness. Therefore, I asked each trio the following questions throughout the open discussion:

- *How would you describe your experience of the flow of time throughout the performance?*
- *Were there any moments in the performance in which you experienced the feeling of time speeding up or slowing down? If so, what can you recall about these moments?*
- *Were there any moments in the performance in which you experienced a feeling of timelessness, or a feeling of not having any sense of a regular flow of time? If so, how would you describe such experiences and what can you recall about these moments?*
- *What do you personally think are the specific aspects of your performance (or performing EAI music in general) that directly contribute to these experiences of time and timelessness?*

Although performers were asked the above questions one at a time, every ensemble member had the freedom to interject with responses to other players' responses, stimulating more conversation between each other. Video and audio of each performance were recorded for observational and archival purposes, while video and audio of each group discussion were recorded for the purpose of transcription into written documents. NVivo software was used to extrapolate data from each discussion transcript, where every line of each participant's responses was scrutinized for player actions and then organized into larger salient categories based on said actions, a methodology of qualitative analysis that is somewhat influenced by, but not necessarily akin to, the grounded theory approach (Glazer & Strauss 1967; Charmaz 2014). The salient categories that I arrived at, based primarily on what I had found in the data, contributed toward forming the basis of my hypothesis, which will be presented alongside the results of the study in Sections 4 and 5 of this paper. The results presented some salient observations and testimonials given by various participants from the performance sessions, which provided context for the subsequent analysis section.

3.2. Conducting the experiment telematically

Performance sessions and group discussions with all participants in this study took place over telematic communication, or networked audio/video connection, through the online video-conferencing platform Zoom, which served as York University's primary online platform for meetings, classroom gatherings and conference presentations during the COVID-19 pandemic. Several performers who participated in this study have commented on what was perceived as a strangeness to the transition from playing in a physical performance venue to performing telematically over Zoom. Although some participants had previous experience with performing ensemble music over Zoom, others had little to no experience whatsoever and required much assistance in setting up their network connections. Some players who used sound processed through their computers as their main output into Zoom initially struggled to connect their sound so that their ensemble-mates could hear what they were playing. One player in particular (2A, see **Table 2**) struggled to route the output from his sound setup, involving a Blackbox sampler outputting sound into Ableton Live, into Zoom. These struggles took place before the performance, in which I attempted to assist the participant in fixing the connection issue, and remained an issue during the entire trio performance. This affected 2A's experience in enjoying the telematic performance and resulted in his not enjoying himself in the moment, as will be reported later in Section 4.

Conducting the experiment remotely did yield a number of benefits for this research project and for the performers as well. Firstly, all of the performers were able to participate in the sessions and remain safe in their remote locations without compromising their own personal health during the COVID-19 pandemic. Public health and safety measures such as social distancing and limiting/prohibiting indoor gatherings would have made organizing in-person performances an unethical option for conducting this experiment. Secondly, holding the performance sessions over an online format opened up the possibility of including experienced EAI musicians from around the

globe as opposed to limiting the participant pool to just one local geographic location. Though it would have certainly been possible to recruit the same number of participants for this project from just Toronto alone, the opportunity for performers outside of Toronto, or even Canada, to participate in the study not only eased my own personal concerns for recruiting participants but also afforded EAI musicians the ability to connect with other performers from across the globe who were also experiencing the psychological effects of isolation during the pandemic. Thirdly, participants with little to no experience in telematic performance were given an opportunity to learn how to connect audio output from complex instrument systems and computer audio setups into Zoom to participate in networked music performance. This will prove to be a useful tool for musicians who are not permitted to perform in public spaces during a global pandemic, which, as of the time of this writing, has been raging for more than a year[2]. Finally, the experience of conducting this research experiment afforded musicians an opportunity to perform improvised music at all, which served as adequate incentive for the performers to take part in the study. In every session conducted, many participants were glad to express their gratitude about being able to perform live music again after being prohibited from doing so in public venues due to public health measures. Also, almost every performer (minus the one participant who experienced technical issues with their sound) mentioned that they had fun playing in each performance and some had hoped that they could improvise with their ensemble-mates again sometime in the future. Observing the positive experiences participants were having made the research study feel more worthwhile, considering that many were living in government-recommended isolation.

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[2] The Government of Ontario, Canada declared its first provincial state of emergency in response to COVID-19 on March 17th, 2020.

4. Results & Analysis

This section of the paper will present an overview of various responses from participating musicians in the study based on questions regarding their experiences of time and timelessness during performance. Notable responses were included based on the top 5 most commonly recurring categories of discussion that I arrived at, based on the 21 participants' responses in discussion. These categories are as follows, in order of most occurrences in discussion across all sessions:

- *Awareness of the passing time* (132 occurrences) – Instances of players speaking about moments when they became aware of the passing of time during performance.

- *Relating to musical information* (121 occurrences) – Instances of players speaking about certain musical parameters that were noted in performance.

- *Emotional involvement* (109 occurrences) – Instances of players speaking about certain emotional states felt during performance (feelings of anxiety, comfort, satisfaction, stress, etc.).

- *Intentionality* (99 occurrences) – Instances of players speaking about certain creative choices made during performance and the reasons for these choices.

- *Listening* (92 occurrences) – Instances of players speaking about moments related to their experiences of listening during performance.

With regards to the above categories and moments of timelessness experienced by participants of this study, although the category *Relating to musical information* had the second-highest number of instances in discussion, it is important to note that many participants' experiences of timelessness, which will be explored further in Section 4.4., were less related to direct perception of musical phenomena and more so related to other phenomena that occurred during performance. These results are presented in the subsequent sections below, which are organized based on the order of questions given to participants during open discussion after each performance was finished.

4.1. The flow of time

In being asked to describe their experiences of the flow of time during performance, performers in the semi-structured improvisations frequently commented on the blocks of time separating each solo and duo section of the set before the full ensemble section. During these sections, performers following a soloist were very much aware of the passing of time as they were watching the clock in order to correctly time their entries and exits. Because of the telematic nature of these sessions, where performers were connecting and playing with each other through a computer screen, keeping track of other players' solos and duos, as well as their own, seemed highly accessible with the clock time always displayed at the corner of each performer's screen. Though performers were not specifically instructed to watch the clock to adhere strictly to time constraints, some felt a pressure to ensure that they gave ample space to the performer they were listening to in the moment:

> I was kind of aware of [the passing of time] because I knew that we had these blocks of time and it put a bit of stress on me when I was really aware of it. So I think the time when I was most aware was the first 5 minutes because I didn't want to trample on 4C's solo, so you know I was clock watching there, I did actually know when to come in. It probably wasn't the most artistic choice of when to come in, it was more a "OK, time to come in." [4B]

This was common amongst performers in the semi-structured improvisations where they had given space for the soloist at the moment to use their allotted time to express their individual musical idea, reflecting the nature of the composition of each semi-structured piece. In session 4, 4A was the first soloist for roughly 5 minutes, followed by 4B, who joined 4A for 2-3 minutes of duet performance before she was allotted the opportunity to perform her own solo material. 4B's intention approaching her moment of entry was to respectfully give 4A the chance to be the point of focus during the time that was afforded to him as a form of courtesy during such a trio improvisation where each player is given equal opportunity to perform. When it came time for 4B's solo, however, her awareness of time vanished due to her not thinking about time during her own

performance, as well as the notion that, at a certain point, she did not have to worry about keeping track of time anymore as she was aware that 4C would come in and start to play at the 5-minute mark. Participants 3B and 2C shared similar experiences in their respective performances as well:

> …I just decided to drop the thinking about the time and I knew I was only meant to be in for 2 minutes *[referring to the duet]*, so I was sort of lost in that duet and not at all sure really when I stopped. I certainly thought "Oh God I was probably playing for about 10 minutes…" and then I glanced at the clock and saw that I haven't been, but yeah my sense, in the duo, was I had lost sense of time. And then when I did the solo, I actually thought, "I don't even have to think about time" because it's 4C's job to come in and interrupt me so it's not my problem. [4B]

> There were other times where I felt I was paying attention to the clock a lot, but then once I started playing I'd forget about it and, like 3A was saying, it was almost like a meditation in a way, just kind of get lost in the music, get lost in the sounds. [3B]

> I feel like, being the third, I had to worry about stopping less of course because I didn't actually have to stop because 2A would come in and then 2B would come in after me. So my main time worry, I guess, was my starting […] I knew I didn't have to stop or really…not necessarily look forward to a time of when I needed to stop or anything like that because everyone was just going to join in to what was happening anyway. [2C]

4B, 3B and 2C's experiences above are representative of an interplay between awareness and attention while deeply listening to their respective performances. 4B and 3B found that when their focus shifted toward aspects that were unrelated to listening and reacting to the sound environment, they became aware of the passing of time. 4B's awareness of time constraints in the solos/duos and 3B's awareness of the clock each drew their attentions away from the sound in the moment. However, once they started performing on their respective instruments, their attention shifted away from keeping track of the time to the performance, resulting in getting lost in the music and reaching a meditative state, as mentioned by 3B above. In the case of 2C's experience, drawing attention away from his performance was less of a concern for him because of his placement in the order of soloists. He was the third soloist of three, affording him the privilege of not having to worry about stopping for another soloist after 5 minutes had passed. As he mentioned above, 2C felt like he was only required to carefully monitor the passing of time for his moment of

entry, knowing that he was the one to follow 2B, which also afforded him the opportunity to deeply listen to 2A's solo at the start, in which he felt lost in immersion. After hearing 2B's entry, 2C then felt like he had to pay attention to the clock. 4C had a similar experience, in which he experienced a sense of timelessness during 4A's solo, which was first in the order of soloists, but less so during 4B's solo, which was second in the order. 4C felt like he needed to prepare for his entry, but was careful to not possibly ruin 4B's moment, resulting in a heightened state of consciousness:

> I loved both of your solos, I definitely got lost in 2A's at the start because it took me to that sort of place where you recorded it and it felt like you were in that environment, and then with 2B's you were sitting in this big drone […] but I was definitely looking at the time and trying to […] see when those switches happened and then would gauge when I should start based off of that… [2C]

> …during 4A's solo, you know, I felt it was endless. Just like how long can 5 minutes be? But then when 4B was playing, it's like "OK why the f*** is it going so fast? I'm not ready yet!" She's developing this great idea that I don't want to interrupt, so it's like, you know, this idea of listening vs. being conscious of the time made things interesting… [4C]

In listening back to 2B's solo in particular, performed on a synthesizer, it is clear that much of it featured droning textures with durations vastly larger in length than 5-7 seconds, the maximum threshold for perceived segmentation in sound (Snyder 2000), a temporal feat of which is achievable through synthesizer technology. Despite this, 2C did not express feeling a sense of timelessness during this moment primarily because he was keeping track of the time, a result of his being self-conscious about entering at what he felt was the appropriate time. 2B's comments on his performing during his solo also show a link between the awareness of the passing of time and his attention given toward adhering to the boundaries of time for his entry and his exit, which was revealed to have commanded his awareness during his solo. This anticipation for his exit resulted in a hyper-awareness of 2B's decision-making process during his solo and he notes below that he would have possibly played for longer than 5 minutes had he not been aware of his responsibility to finish his musical idea heading towards 2C's solo:

> I was trying to hit the cues a lot. I mean, not hit the cue, but make those timings so I was very aware of how the timing was passing. When I was just

> playing by myself I…I've done a format like this before and I found that I ran out of ideas really quickly, so I knew that I needed to take a little bit more time to develop a sound and morph it into something else and really…if I have something good, kind of let it sit for a bit […] Besides that, when I was playing I wasn't looking at my clock but I was thinking that "Oh I've got to wrap it up soon." I was always thinking that, and I think that if it wasn't for that I would have played a lot longer. If I was looking for a natural place to just stop I would have played for a lot longer. [2B]

There is no indication in the above comment that suggests that 2B experienced the feeling of getting lost in the sound of his solo performance as 4B or 3B did in their respective performances. 4B's response above indicated that she was not thinking about keeping track of time or when she needed to finish because it wasn't necessarily her responsibility to do so. Her rationale was that 4C would be watching the clock while she was performing in order for him to correctly time his entry, leaving her to not have to worry about it until she heard the sound of his instrument. This suggests the possibility that improvisers can achieve meditative states during performance, in which they find themselves lost in the sounds they are listening to, when they are not actively thinking about time, whether it's in the form of the passing of time or the structural constraints of time boundaries between solos/duos. This also suggests the possibility that the evaluation of how to proceed with performance, whether it's through the awareness of needing to finish one's solo or the recognition of an event in the music that one feels they would like to react to in the moment, can either prevent a performer from experiencing a meditative state (as was the case of 2B above) or remove a performer from a meditative state (as is the case with 3A below):

> So when I was listening, I think there were spots when I was completely lost in the sound, and I wasn't experiencing time as simply something that happens one thing after another. It was more like, I guess a meditative state and then something would happen and then I would jump back into being 3A and start looking around for which buttons to push. [3A]

3A's comment above outlines a shift between different focal points within certain moments of deep listening in performance, where he was listening intently to the sonic environment. What he notes are two different experiences, one being a meditative state in which he was lost in the sound and the other being the experience of jumping back into a state of self-consciousness. The

meditative state is linked to 3A's experience of listening, or focusing on the sound in the moment, while the experience of re-orienting his sense of self is linked to his responding to a new sound or musical moment being perceived in the sound field for the purpose of continuing the performance. Part of the process of 3A regaining his self-consciousness involved shifting his focus to making adjustments in his software patch in cataRT (Schwarz et al. 2008), a real-time granular sound synthesis system. 3A's implication in saying that he was "looking around for which buttons to push" was that, considering the possible complexity of his system, there were a number of different possibilities for how to proceed with his contributions, resulting in a shift in attention away from the sound and towards finding the most appropriate way to proceed with his performance.

This type of shift in attention between listening and coordinating one's sound during performance took place in another key moment within the overall structure, one that was common to sessions of both semi-structured and unstructured improvisation sets, which was the moment when each performer realized that the end of the performance was approaching. In these moments, when players became aware of the approaching end, they experienced a switch from focusing on listening to the sounds in the current moment to focusing on how to change their playing styles in order to coordinate with the other players on collectively reaching the conclusion. 4B referred to this mode of awareness as "finding an ending mode," while 7B referred to it similarly as "How were we going to end this? mode." Both performers recognized this moment as not only a switch in awareness of the environment of the performance but also a switch in awareness of the passing of time. In checking the clock at this moment of switching modes, players had become aware of the duration of clock time that had passed while also becoming aware of the remaining duration of clock time in the improvisation. After realizing how much time was left, players had to focus their attention on their contributions, while listening for the contributions of the other players in the trio, in order to successfully navigate to a conclusion with the others:

> So for the first 29 minutes exactly I was completely lost with zero perception
> of time. I looked at the clock at 6:29 and thought "Oh we've been playing for
> just under half-an-hour" because I know we started around just after 6, so I

thought "OK we've got about 10 minutes left" and I only checked the clock one more time after that and it was at 6:40, so that last 10 minutes or 11 minutes seemed slower because I was actually conscious of time at that point. The first 29 minutes I was just free, so it basically got to a point where I thought "I don't know how long I've been playing" when I realized, when I acknowledged time in my own mind, and that's when I looked at the clock and it was 6:29 and I thought "OK we've got about 10 minutes left." [6C]

4.2. Time slowing down

In his response above, 6C noted that time felt like it was passing by more slowly as he was approaching the end of the performance because he was more conscious of the passing of time after checking the clock, whereas he described his experience before checking the clock as "free." He was unsure of how much time had passed within that 29-minute duration, suggesting that improvisers may not think about time when they feel free during performance (more on this in **Section 4.3.**). In contrast to this experience, checking the time and realizing that the end was approaching caused 6C to no longer feel total freedom in performance as he realized that he was now responsible in that moment for navigating to the end in an effective manner with his ensemble-mates. This mode of listening required 6C to become more attuned to his perceptual surroundings and the real-time evaluation of his own mode of performance at that point, especially knowing that the only time-based condition of his trio performance was that the total duration from start to finish was to be roughly 30-40 minutes. As previously noted, the maximum length of performance was not a strict condition and all players were informed that there was no pressure to be exact with the overall time. Despite this, 6C, among other players, still felt the need to start shifting toward a mode of performing where he was actively working toward reaching the end with the rest of the ensemble as opposed to during the first 29 minutes in which he was performing with a more carefree view of time.

6C felt a stronger sense of urgency heading toward the final moments of performance, which I argue was a contributor to his experience of time passing by slowly in that section. Let's recall 3A's experience of time during his solo section and the nature/complexity of his electroacoustic

instrumentation. In contrast to 3A's EWI to cataRT system, his ensemble-mate 3B performed the improvisation on an electric cello with little to no processing used, apart from the application of filter effects. 3B's ability to sustain sound during performance was entirely dependent on her level of physical engagement with the cello, requiring a certain mode of constant attention toward playing her instrument. 3A's more electroacoustic instrumentation afforded him the option to have a particular process set in place to carry his sound input, meaning that 3A didn't necessarily have to physically engage with his instrument in the way that 3B did. 3A has the ability to momentarily step back and listen to his sound while a particular process in his system modulates his input, whereas 3B's sound output would come to a halt if she were to remove her cello bow from her strings. It is implied that 3B may have felt an urgency to not stop playing during her solo performance to avoid empty sound-space, which in turn may have likely caused her to experience time as moving more slowly. 3C also experienced time in his solo as having gone by slowly, feeling similarly to 3B in that he felt exposed with his instrumentation, comprising of an analog synthesizer:

> …I felt when I was playing by myself the time was going by slowly. It was almost like when you go on stage and you have to give a speech, like "Oh I hope I fill up the time! I still have 3 more minutes! I still have 4 more minutes!" So when I was by myself I felt there was more like an urgency with the time… [3B]

> …when slow it was when I was playing the solo. I came to some parts where it's like, I started to think about, "What am I doing?" Having the solo exposed, feeling a bit naked like that […] I'm playing a very hard instrument. It's an analog synth here and it's rather chaotic […] the sounds are very rough, it's no reverb or anything and can be very harsh sounds. So it was very exposed. [3C]

Other players' experiences of slow time were also directly related to moments in which they felt a sense of urgency or were not in a complete state of comfort, often impacted by negative emotional responses to certain moments in performance which ended up contributing to a broader awareness of time passing. Anxiety was the most common negative emotion recounted by players during discussion, reasons of which were contextually dependent from player to player. For example: players in improvisation 7 commented on a sense of time passing slowly within the first

10-15 minutes; this was linked to the players' experiences of playing improvised music with musicians they had never played with before:

> …I think the first maybe 5-10 minutes, probably a little less, almost felt to me like time went by a little slower because perhaps I was still getting into it and I was very excited and also just feeling like, what 7B and 7C were saying, kind of like "Oh we're doing it! This is cool!" and making some adjustments to try and get the mix on my mind how I want it to, but then once we started, once we more so "got into it" it felt like it went really fast. I don't know exactly how long we played, but to me it almost felt more like 20 minutes rather than…I think it was probably closer to 40, right? [7A]

> I think 7A was saying that it seemed to be going a little slower at the beginning when you're figuring things out, which is interesting because I was reading recently about how people's perception of time is modulated by stress. If you're under a stressful situation, things will slow down so you can deal with it (the perception of time), so maybe a little bit of that was happening, and then I think it did seem to go faster as it went… [7B]

> …I think 7B's right about the stress thing, new people – new situation. So yeah the beginning definitely felt slower for me as well… [7C]

There is documented research supporting the links between the perception of the passage of time and moments of distress, such as in moments of waiting for news of a medical diagnosis (Sweeny & Falkenstein 2015) or waiting for the results of academic exams (Rankin et al. 2019). Rankin et al. suggest that the link between the experience of time passing slowly and the experience of stressful waiting periods can create a downward spiral in which feelings of distress are exacerbated (2019). These experiences are related to each person's *internal ticking clock* (Droit-Volet & Meck 2007) and the ways in which our measurements of these internal clocks are distorted by positive or negative emotions and experiences. According to Droit-Volet and Gil (2009), pleasant experiences draw our attention away from our internal clocks, leading to the missing of "ticks" in the clock and causing us to underestimate how much time had passed, whereas stressful situations cause our internal clocks to accelerate and accumulate more "ticks", causing us to overestimate how much time had passed. This overestimation of time passing can occur in EAI performers who are experiencing technical difficulties with their sound setup, either in their instrumentation or in their telematic connections to other players. This occurred in one of the

sessions where one player, who had less experience in performing live music telematically, experienced technical difficulties with his audio connections that resulted in periodic cuts to his own audio monitoring, meaning that he wasn't able to hear his own instrument at times, though he was able to hear audio output from the rest of the trio:

> So it was unusual for me in the sense that […] I was aware that it would start to crap out after a certain period of time, so I was kind of eager to say something, for lack of a better term, before things started to fall apart […] so I quit Ableton immediately after finishing my bit because I could hear it was starting to crackle. I could still hear the audio though, so my received audio was fine. There's obviously still something that wasn't quite correct in the setting somewhere, but it was strange because it would just appear over time, first crackling and then finally it would just…the signal would fall apart. So I have to say I was a little bit eager to get things done […] In terms of time, I was aware of time but not in a…in more just a fear of collapsed *[sic]* kind of way. It wasn't musical time as much as it was technical time. [2A]

2A interestingly makes the distinction between what he describes as musical time and technical time, implying that the time he became aware of while experiencing his sound issues was not musical. It was time through the lens of technical difficulties and stress, suggesting that musical time may not be experienced through feelings of stress or anxiety. His eagerness to finish his solo section is representative of his negative emotional response to the situation he was experiencing. Being unable to control his sound issues as they were materializing resulted in his inability to achieve immersion and fully enjoy performing in the trio, which is revealed to have impacted his experience of time throughout:

> …it's not fun playing when you're very much aware that things are sort of on the verge of disintegration […] it was slightly immersive but it wasn't that sense of immersion that you get when you really hit that groove and things are flowing […] and I think that makes a huge difference in terms of how you treat the length and how you experience time. That was in my case: everything was working for everyone else but I think from my perspective that was very much in operation right here. [2A]

Other players had also talked about the connections between feelings of stress or anxiety and the ways in which time is perceived. Whether experiencing feelings of comfort and ease or feelings of tension and anxiety, as shown through 1B and 4C's comments below respectively, players felt that their perceptions of time were impacted by such emotional states:

…emotion has an element in there for me definitely, and so the confidence that I had in both 1A and 1C […] removed anxiety and I wasn't concerned about whether any of us would be playing over each other or not playing or whatever, I figured we'd all be actively gauged appropriately, whereas I think if I had been feeling anxious I think the time would have felt like it was interminable, and so I felt like a flow, not a rush. So that was an element in there, just the confidence and comfort level I felt with you all. [1B]

If there is a certain sense of urgency, that you have to do something in a specific moment, you get this anxiety and that could distort how you perceive, you know, when this is coming or, you know, that whole time piece, but also if you're enjoying the moment it makes you perceive time in a different way. You don't want that moment or emotion to end or the opposite: you feel like "Oh this gig is going forever and this is going nowhere," and you look at the clock, it's like "OK so only 5 minutes and we have to play 40 minutes…" so, you know, I guess it's all that emotional attachment that you give to that performance. [4C]

1B's comment regarding his removal of anxiety during his performance also relates to his experience of the end section of his trio performance, which he described as "luxurious" and "unhurried." By not experiencing a sense of anxiety during performance, 1B could comfortably experience the flow of the improvisation, implying that the feeling of anxiety brought on by feeling rushed would have prevented him from experiencing such a flow. 4C's comment more so emphasizes the experience of feeling anxiety during performance affecting the performer's perception of how much time had passed. According to 4C, when a performer does not feel positive about their performance, it may cause them to feel like their performance is taking a long time to get through, perhaps longer than they'd like. It is suggested in 4C's response that when performers feel positive about a particular musical moment, where they are not experiencing any anxiety or tension about their performance, they can reach a state of enjoyment and satisfaction that they don't want to end. Connecting 4C and 1B's responses, it is suggested that positive feelings (feelings of enjoyment or relaxation) and negative feelings (feelings of anxiety or worry) towards participants' own performances had an impact on their level of connection to the group flow, which in turn may impact one's perception of the flow of time.

4.3. Time speeding up

When players were asked to describe any experiences of time speeding up during performance, two phenomena emerged from players' responses. One type of response described the experience of time speeding up in relation to the density of sounds in the sonic environment, as described by 3A below:

> As far as the flow of time goes, to me somehow there were spots where there was…as if there was a lot of peace and there wasn't a lot of activity, and so time slowed down, and when things got more dense, it seemed as if things were being sort of pushed along, not so much by any of us but by the sound itself, and since we were only making sound for the first time, it's as if we were sort of holding on to the sound and getting pulled upon in the time, and it became dense and so things seemed to speed up, even though there's no pulse… [3A]

3A's comment connecting the perception of musical texture with a high degree of density and sonic activity to the perception of time speeding up (and vice versa) relates closely to Noble's hypothesis suggesting that perceived experiences of time are linked to human information processing of perceived sounds. In the case of 3A's experience above, less density in sonic texture resulted in a perceived slowness in time, as IOIs between sounds are larger or temporally more spread apart in the sonic space-time, whereas a higher density of sounds with shorter IOIs resulted in a perceived increase in speed in the flow of time. The other experience of *fast time* noted by some performers was described purely in retrospect where, instead of time being perceived as speeding up in the moment, time was remembered as having gone by quickly in certain moments. This perspective suggests that performers may not be thinking about time in the moment of performance, with some participants in this study admitting that they actually had no idea how much time had passed. Despite this, these participants recognized the moment as having gone by quickly when reflecting upon it later:

> …I wouldn't say fast, it's just gone, and then it's almost after the fact, you're going "Oh crap, that was fast," but it doesn't feel fast, you're just in it [..,] I wouldn't say I was sitting there thinking that time's going fast, it's more "Oh time went fast" if that makes sense. It's more of a past tense for me where it's like "Oh, ok. That went fast!" [6B]

> The time seemed to go by really fast when we were playing together all 3 of us and just improvising and I didn't even realize, I couldn't tell you "Have we been for 5 minutes? Have we been playing for 20 minutes?" It just all meshed together in a good way. [3B]

Similarly, 7A described the majority of his performance after the initial 5-10 minutes, when the trio members were starting to become more familiar with each other and then "getting into it," as having gone by fast (see Section 4.2.). He had indicated in discussion that that he truly enjoyed the performance overall, which I believe, based on similar experiences from other players in the sessions, contributed to his perception of time having gone by fast. However, it was posited by 6B during discussion that the feeling of experiencing an event as having gone by fast is actually the same experience as *timelessness*, considering that players may not be consciously aware of the passing of time in such moments:

> Timelessness […] when the time goes fast, it is that feeling. I guess it could happen the other way where you sort of lose time when it hasn't been that long, but I don't think that tends to happen much for me. If I'm losing time, it tends to go quick. But for me, it would be in that 10-minute mark, that's where, for me, you kind of fall in that, and then it's very much that loop of listening and doing and not thinking so much or not thinking about what you're doing. You just do it and go and not think about time like that, because if you're thinking there "Oh how much more time do we have?" you're almost getting in your own way, especially with what I'm doing. So it's almost like you just don't worry about time, you let it go, and then you're very much listening and then bringing, going in and out, doing whatever seems to make sense in the context of what you're hearing. [6B]

4.4. Timelessness

6B's comment makes a clear connection between listening and not thinking about time, suggesting that improvisers cannot think about the passing of time in order to achieve the ability to listen to what's going on in a given performance, raising the possibility that players may experience timelessness when they are truly, deeply listening in performance. Many participants had spoken about their experiences of being in a *meditative state* during performance, in which they were lost in the sound field and not concerning themselves with any notions of the flow of time. I believe that these were sensations of timelessness for these participants, constituted by the feeling of losing

one's orientation of the passing of time or a lack of awareness of the passing of time in a given moment during performance.

In the semi-structured improvisations, many players experienced a sense of timelessness during their own solo performance. 4B's experience of getting lost in her solo was connected to her "dropping the thinking about time," in which she felt that the act of thinking about time, or being aware of the passing of time by keeping track of the clock, was not compulsory during her solo performance. In addition to her solo, 4B also stated that she experienced a sense of timelessness throughout the trio section of her improvisation, where all three performers were improvising together, up until the moment when she switched to "*finding an ending mode*" to make calculations for how to navigate to the conclusion. Switching to this mode of awareness caused 4B to drift in and out of the sensation of timelessness for the remainder of the piece, as is expressed below. 3B experienced a similar perception of time during the trio section of her improvisation, in which she was unable to accurately recall how much time had truly passed:

> I think in my solo I did have a sense of timelessness really, I wasn't thinking about time at all and I have no idea how long or short it was, and the same with the duo with 4C and with the trio, except that at a certain point I was just doing some calculations and thinking "Oh we have to finish at 8:04 to get the full…" you know, I said the brain was kind of doing that […] I came in and out of timelessness for the last one. For the trio to start with, apart from being worried that I cut into their duo, yeah the trio I started off with, yeah a strong sense of timelessness, I think, once I settled into it, which stayed more or less until the end. [4B]

> I felt like, at that point when it was a trio, it all started to really come together toward the end and that's when I guess I had no idea how long we played together for, it just kind of made sense and it was almost like lost in time. [3B]

Worth noting with regard to the 2 responses above is that both performers had similar experiences of timelessness during the trio section of their respective improvisations while each were playing wildly different instruments. 4B's instrument system involved a software application that electronically processed her vocal input with effects such as looping, pitch-shifting and granulation, while 3B's electric cello playing featured no electroacoustic processing whatsoever,

apart from filter and delay effects. With respect to this, it is also worth noting that 4B and 3B had nearly opposite experiences of time during their respective solo sections, with 4B experiencing a strong sense of timelessness and 3B instead experiencing the time as going by more slowly. 3B suggested in her earlier response (see Section 4.2.) that the sense of urgency she experienced while performing by herself contributed to her feeling of time as slow during her solo, which could also suggest, with regards to the nature of her instrumentation, that this may have been linked to a newly perceived self-consciousness that emerged during her solo due to either the limited temporal sound palette of her unprocessed cello or a heightened level of attention needed to remain physically engaged with her instrument or perhaps both. However, there is no conclusive evidence to validate such a suggestion.

Regardless, the link between 4B and 3B's experiences of timelessness is that they both experienced the sensation during group performance when all 3 performers were playing together simultaneously. In describing their experiences during these moments of performing, neither 4B nor 3B mentioned any perception of temporal or textural phenomena within their respective sonic environments, which seems to suggest that simply performing with their ensemble-mates without any thought put toward how much time had been passing by was enough to achieve a meditative state of timelessness. 1A's comment below takes this a step further by implying that the act of thinking about time during performance is actually distracting and detrimental to his ability to improvise in the moment:

> During my own solo section, my sense of time vanishes completely, at least for me personally, like I'm not very good at that […] for me as an improviser, when I'm actually doing a solo improvised piece or a section like that I just end up going to a very inward place that has very little reference to the outside world, so the idea of time, when it arises in my mind in those moments, I sort of bat it away. It's like a nuisance to me…I don't really need you right now, you're not the point… [1A]

1A's conception of time as a nuisance during his solo and his distinction between "going to a very inward place" and "reference to the outside world" seem to suggest that the idea of time exists *outside* of the performance. By expressing his desire to *bat time away* when it arises in his mind

during performance, 1A recognizes that thinking about the passing of time actively pulls his attention away from the performance at hand. 1A's ensemble-mate 1C had a similar experience where he did not concern himself with keeping track of the time as soon as he began his improvised performance, also stating that his perception of the flow of time was dependent on his level of immersion in the improvisation. Where 1A's testimonial relates more specifically to the experience of improvising in a solo context, 1C relates his experience to the broader context of playing with others and navigating a shared musical space:

> Well I tried to have a stopwatch going to sort of just get a better sense of where we were within the spectrum of time that we had allotted to the performance as well as for my own personal solo […] As soon as I started actually playing, I never looked at the stopwatch since because being immersed in that environment where you're responding very much so to…I feel that because of the level of awareness I think you need to allocate, or dedicate rather, to being able to improvise, especially so within a space of this being shared by others who are also improvising…timing the specificity of how long becomes so much less important than whether or not it feels appropriate […] if I am immersed deeply in what's going on, I'm a lot less conscious of time. [1C]

1C's comment mentions there is a level of awareness that performers need to allocate to the performance in order to be able to improvise while stressing the importance of whether or not a creative choice in performance feels appropriate to the improvisation. This suggests that, when listening to others perform in the group, players may be evaluating the possibilities in creative choices they could make in reaction to their ensemble-members' creative choices. 4C's comment below shows how the evaluation of his creative choices pulled him out of the feeling of detachment from the performance in a moment in which he experienced a sense of timelessness:

> There was a moment that I was playing a chord that…it was doing, like, this really beautiful melody…I love those type of situations because you can just listen as…I don't know…depersonalize and be the spectator as opposed to being the performer, and it was like "OK so I got the chord figured out so I could just stay on this beautiful melody," so you just kind of like detach from whatever you're doing and just appreciate the beauty of the music that's happening, but then you come back, it's like "Am I supposed to be on this chord for, like, you know, that long?" It's like "probably it's boring, I'm not adding anything to the ensemble" so it's changed to something different… [4C]

This perspective seems to imply two different forms of engagement during 4C's performance: engagement with the sound vs. engagement with the performance. In detaching himself from the

performance and enjoying the qualities of that particular musical moment, 4C was purely engaging with the sound. He removed himself as a performer in that moment and became a spectator. In wanting to purely focus on the sound and take the time to enjoy the moment, 4C temporarily detached from any sense of responsibility as a performer. This feeling changed in him once he began to consider the next steps in moving forward with the performance, knowing that he had a responsibility to keep the improvisation sustained through the repeating cycle of action/reaction. This ultimately suggests the possibility that moments of timelessness may be achieved in improvisers of group EAI when they are engaging more with the sound than with the responsibilities of live performance. The responses below from 7B and 6A also contribute to this possibility:

> The only thing I can really think of as a feeling of timelessness is if I'm focusing on a particular sound, like if I'm doing whatever and I've got my headphones on and I'm getting into the structure of some sound or I'm focusing on that then I will lose track of time doing that. I won't have a perception of the passage of time, I'll be thinking about "What is this sound like?" or "Why isn't that working?" or something like that, whereas I think when I sit back and have that worked out and I'm just performing it, that's more when I would perceive time as flowing… [7B]

> …it takes a while to settle in and I find that phase of the performance seems interminable. I'm checking the clock going "OK it must be 20 minutes…Oh, oh…no ok it's fine, it's fine," and then as I start to engage more with the sound, my perception of time evaporated, I wasn't conscious of it very much anymore, and then at the end it was like "Oh my God it's over already?" Which is really strange, so maybe I'd say the first 10 or 15 minutes seemed like they went on forever and the last 15 or 20 minutes – I'm not sure how long we went, but the last 15 or 20 minutes just seemed to go by almost in an instant, but yet I wasn't aware of the time at all, like I wasn't conscious of it at all. [6A]

Similarly to 4C's response, both 7B and 6A's responses illustrate a distinction between engagement with sound vs. engagement with performance, with both performers experiencing a sense of timelessness when engaging with sound over performance. Regarding 7B's response, what he describes is not simply the act of listening to a particular sound to acquire a better understanding of its sonic qualities, but the act of doing so in a detached manner, not thinking about the responsibilities of being a performer. Listening to and thinking about the properties of the sound in the moment became the focal point, resulting in 7B not thinking about the passage of time. This changed for him once he reoriented his attention to the overall performance, causing him to

perceive time as flowing again. In the case of 6A, checking the clock every so often within the first 20 minutes of playing is representative of his engagement with the structure of the performance rather than the sound. Knowing that the improvisation's overall duration was meant to be 30-40 minutes, it was a responsibility for him to ensure that he performed with that restriction in mind. However, engaging more with sound resulted in 6A not thinking about the responsibility of time, which led to his perception of time dissipating.

With regards to timelessness and its relation to specific musical information, very few performers spoke about experiences during performance in which specific spectral phenomena caused them to feel the sense of timelessness. 2C mentioned in discussion that listening to 2A's solo, which consisted of unprocessed field recordings of outdoor ambient spaces, specifically caused him to experience a sense of timelessness. However, the response suggests that the sensation was more so related to 2C's immersion in the imagined space created through his concentration in listening to 2A's field recordings instead of being related to any sense of non-human temporal organization in the sound:

> So the ambient stuff that 2A was doing at the beginning is definitely very out of time for me, I guess, because it sort of mentally puts me in that space and I'm just sort of experiencing the space without necessarily thinking of musical timing, even though it is musical of course. [2C]

Unless the output of these recordings was being affected through some kind of electronic processing, one could hardly classify the sound of a nature park as particularly non-human, although one can argue that, for example, the dense sequence of crickets chirping in a field as a consistent sonic texture in nature could be perceived as having an endless quality. Regardless, these are sounds that take place in nature settings, locations that many humans have experienced and are able to visualize in their imaginations. 2C was immersing himself in the sonic environment of these field recordings, not only placing himself in the imagined location but also temporarily being transported to a location that was not the performance. This is the crux of an immersive experience, during which 2C was not conscious of the time or "thinking of musical timing." The excerpt below

taken from conversation between 5B and 5C also shows the role that immersion and listening play in achieving states of timelessness:

> **5B:** That's the thing I find magic and really helpful about improvisation during the pandemic. It gives a sense of being out of time and place, and that really happened after a few minutes, after finding the others, being able to trust the others, knowing where they were and what I could expect […] knowing I hear them well, that they have a spot in my mind, time and space seem to disappear and it feels like I could be on stage, I could be somewhere else doing sound. I'm no longer in my tiny apartment, that's a big plus. It's not only time, it's space too that disappears.

> **5C:** Yeah, I really like that concept 5B because I felt that, particularly when there was a harmonic moment at the *[sings 4 notes]* that was being echoed, it really did feel timeless to me, but I would say that it was very much a mutual space we were in that was not any one individual's space but it was really that, yeah. And I have the same feeling: I'm suddenly outside my apartment!

5. Summary

Based on the results presented above, I have arrived at three prevalent trends related to the experiences of time and timelessness in ensemble players who participated in this particular study:

1) *Experiences of timelessness in participants of this study were less related to perceptual phenomena in sounds made by improvisers during performance and more related to players' levels of immersion during performance.*

2) *Player immersion in participants was dependent on whether players were engaging more with the sound or engaging more with the structures of performance.*

3) *Participants engaging with the structures of performance were more aware of the passing of time, while players engaging with sound were able to achieve immersion, leading to experiences of timelessness.*

Noble's research into the temporal perceptual thresholds in contemporary music (particularly of the electroacoustic variety) was a large inspiration for this current research project. In order to test his 2018 hypothesis, which suggests that musical phenomena that temporally subvert or exceed the perceptual parameters of human information processing lead to perceived experiences of timelessness in the listener, Noble et al. (2020) gathered listeners for a study that involved

listening to short excerpts from contemporary and electroacoustic music recordings that represent examples of excess and subversion in 5 perceptual categories of temporal organization: segmentation, grouping/sequence, pulse, meter and repetition; the fifth was added for its ability to subvert listening expectations through lack of repetition or diminish the listener's sense of retention and protention through excessive repetition (Husserl 1928, 1964). Listeners were asked to rate their perceived experiences of time throughout each excerpt. Results of this study showed that, though contextually variable, experiences of musical timelessness were unquestionably related to the excessive and subversive temporal organizations in music created through electroacoustic means, with increased sense of timelessness correlating most commonly with music featuring prolonged durations of sounds and resonant silences. Results also showed that the perceived pace of time (time speeding up or time slowing down) correlated with increase or decrease in certain musical parameters such as tempo, textural density, sound intensity and spectral distribution (Noble et al. 2020).

With regards to this current research study, responses from participant discussions directly after ensemble EAI performance indicated that the moments of timelessness experienced by participants in this study were mostly linked to their perceived level of immersion throughout performance rather than the perceived non-human temporal organizations of sounds within the performance. In recounting moments in their respective improvisations where participants felt a strong sense of timelessness, very few players commented on the timbral qualities of sounds heard in the moment while most, if not all, instead described these moments in relation to the level of attention that was given toward certain aspects of their playing styles as they related to the overall structure of their performance. This suggests the possibility that players engaging in group EAI performance may not be able to allocate more attention toward listening to sonic characteristics in their collective sound in order to sustain awareness of other elements they are deeply listening to simultaneously, including awareness of structural constraints, the act of making adjustments to their instruments, being physically engaged with their instruments, other performers' contributions,

and making calculations on how to proceed with their own sound in the moment. Despite this, some performers in the semi-structured improvisation sessions who were 3rd in the order of soloists experienced a sense of timelessness while listening to the 1st performer's solo, whereas some performers who were 2nd in the order of soloists did not experience timelessness during the first solo, mainly due to their need to keep track of time during the 1st player's solo in order to adhere to structural time constraints in the first half of performance, where solos and duos were specifically timed. This switching between focusing on the sound and focusing on the external structures of performance was a strong determining factor for participants' experiences of immersion during performance, which also seemed to determine players' experiences of time and timelessness. Emotional states like anxiety or relaxation were also strong determinants of certain participants' experiences of immersion, with 13 of the 21 performers commenting on feelings of relaxation or comfort in performance contributing more towards their sense of immersion while feelings of anxiety or tension remove them from immersion, thus making them more aware of the world outside of the improvisation.

Recalling Sawyer & DeZutter's research on distributed creativity (2009), one of the key aspects of collaborative emergence is that actions within group improvisation are contingent upon previous actions creating a moment-to-moment contingency in the activity. This requires attentive listening from all parties in the group and also presents players an obligation to participate and be actively involved through recurring action in order to sustain the activity; otherwise it would collapse. Performers of ensemble EAI music thus have a responsibility to action, reaction and the continuation of this cycle to ensure that the music not only survives, but thrives as well. Listeners of electroacoustic music recordings, on the other hand, are not obligated to sustain the music being listened to because it is simply a recording that will exist with or without the active involvement of the listener. All that is required of the listener is to *deeply listen* to the recorded music, to actively trace the mental images within their own perceptions of the music. Important to note is that the listener has autonomy in this act; they can choose to deeply listen to the electroacoustic music

recording while also being afforded the choice to stop listening to said recording with no consequence, apart from losing out on the potentially interesting experience of a captivating electroacoustic music recording. There is no urgency in voluntarily listening to EA music recordings for one's personal satisfaction, although one may argue that listening to EA music recordings as part of a research study could bring an element of urgency to the participant who may feel a pressure to listen more carefully than usual to ensure they provide the best possible result. The obligation for participants to engage in sustaining the action of performance, as seen in each performance session in this study, created a pressure to not only listen to what others in the ensemble were sounding but to react to those sounds with what they felt would be an appropriate contribution for others to react to. This was made evident in discussing the performance with players, who mostly spoke about the ways in which they were navigating their way through the improvisation. Players frequently talked about specific creative decisions that were made during performance while thinking about their experiences of the flow of time, meaning that experiences of time and/or timelessness were at least partially linked to these decisions. For instance, in semi-structured improvisations, awareness of structural boundaries in the solo/duo sections hindered certain players' focus on the sound of their fellow performer's solo performance. This was particularly true for players with the second solo. This position in the order of solos actually prevented the player from achieving immersion because they felt like they needed to carefully monitor the passing of time in order to enter at the appropriate time. The player who was 3rd in the order of soloists understood that it was not a requirement to keep track of the time until they heard the 2nd player's sound, resulting in an opportunity to immerse into the sounds of the opening solo and then a shift in awareness to prepare for entry after the 2nd solo.

Interesting to also note is the experience of perceived change in the pace of time that participants recognized in the music. Similarly to Noble et al.'s study, which showed that perceived changes in the speed of time's flow were related to increase or decrease in certain musical parameters, the perceived pacing of time recognized by players in this study was linked to increase

and decrease in parameters such as spectral density, tempo and note segmentation. Though these musical parameters contributed to perceived changes in time's pace, responses from players did not indicate that experiences of timelessness were specifically influenced by such parameters. I believe, based on the participants' comments about awareness and attention in performance, that participants were unable to fully focus on the spectral qualities of performed sound while simultaneously fully focusing on maintaining the creativity of the ensemble improvisation.

6. Future Work

Many participants commented on the telematic nature of the performance sessions that took place in this study, with some expressing initial tension over not having prior experience performing over telematic media and one in particular having his experience of the performance seriously impacted by technical difficulties. Therefore, it would be worthwhile to organize a similar study with trio EAI performance sessions that take place within a physical performance space as opposed to a telematic connection in which the performers are physically located in their homes. It is possible that players' home locations may turn out to have a larger number of unforeseen distractions that could impact the player's ability to perform. The DisPerSion Lab at York University would be an ideal location to host future performance sessions due to its wide array of immersive audio capabilities, including surround loudspeakers, subwoofers and haptic channels (the latter of which running through the floor of the space). It could be worthwhile to explore differences in experiencing immersion over telematic connection vs. experiences of immersion within a physical space, as well as differences between experiences of time/timelessness in telematic vs. physical space. It would also be worthwhile to have participants from this study listen to excerpts of their own performances and rate their experiences of time and/or timelessness from purely listening to performed EAI music as opposed to performing. Similarly to Noble et al.'s study, the performers would be asked to participate in a series of listening trials where they operate an interface that allows them to

quantitatively rate the experience of time speeding up and slowing down as well as the experience of timelessness while listening specifically to excerpts of their performances from this study's sessions as opposed to recordings of notable electroacoustic compositions. This could further contribute to the hypothesis that the experience of timelessness in ensemble EAI performance is different from the experience of timelessness in listening to EA music through comparison between the results of this study and the results of such listening trials.

7. Conclusion

This research study can be viewed as a starting point towards possibly suggesting that there are fundamental differences between the experience of timelessness in listeners of electroacoustic music recordings and the experience of timelessness in performers of ensemble EAI performance. Though they share similarities in experiences of perceived change of pace in time's flow through increase or decrease in certain musical parameters, musicians engaging in ensemble EAI performance may not experience the sensation of timelessness simply as a result of non-human-temporal organizations of spectral sonic content achieved through live electroacoustic instrumentation, as suggested by participants' experiences of performing in this study. According to results from Noble et al.'s study (2020), non-human temporal organizations of sound materials in electroacoustic music recordings are connected to listeners' experiences of timelessness when they are solely focusing on the act of listening to the music, allowing them to deeply engage with the finer sonic details. The results of this current study suggest that ensemble EAI performers may be required to maintain a consistent balance between engagement with the sound and engagement with the structures of performance in order to successfully navigate through improvisation to the end of the performance as a collective. Performers may have had opportunities to temporarily detach from the responsibility of performance to listen to and truly appreciate a particular moment of performance, where they could relax, remove themselves from the performance and likely

experience a sense of timelessness through deep listening. However, the improvised performance required players to pay attention to aspects of improvising with other musicians, such as listening to other performers' sounds, evaluating their own creative process, and being mindful of the overall time. As performer 1A said in his discussion session, in order to remain fixated in the immersive experience of improvised performance, ensemble EAI performers may be required to bat time away when it arises in their mind, leading one to potentially experience a state of timelessness through immersion.

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