An Exploration of Sensorband through the lens of the work of John Cage

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Sensorband is a contemporary performance group that embraces sonic happenings and builds on the work of John Cage— who himself had the guts to stand in opposition to centuries of established thought regarding how music should sound, and indeed, what exactly constitutes the very instruments that can be used to perform music. As a response to Cage, the work of Sensorband extends some of those best principles, and expands on Cage's work in very innovative ways.

Cage used conventional instruments, such as the piano, but was also enthusiastic to embrace familiar sounds, such as the natural sounds of a city street, or "constructed" sounds drawn from a series of objects in a studio. Sensorband plays unconventional instruments that are designed to incorporate a degree of unexpected sound in their use. On the surface, the connection may not be apparent; looking more closely, the overall gestalt is the same. To this end, it is invaluable to examine Sensorband in the light of John Cage, and consider how their embrace of the technologies of their respective day influenced their aesthetic, and their explorations of similar themes.

To start, let's briefly review the life of John Cage.

Cage was born in 1912 in Los Angeles California. After graduating high school, he traveled throughout Europe for about a year and a half, finally returning to the States. He studied with Arnold Schoenberg in 1934-35 [1], finally leaving when he realized that, stylistically, he had nothing left to gain from staying with him. It says a lot about this break that some time later, Schoenberg rather bluntly declined an invitation from his former student to attend one of his performances. [2] His split with Schoenberg exposed a realization that the traditional structure of

composition based on harmony was a poor fit. His fascination with noise as a musical element wouldn't work in this paradigm, so a new structure was necessary.

Typical of many artists, he had an austere life for many years, as evidenced by the fact that his ability to win commissions was impacted by the classical music world largely dismissing his avant-garde compositional style. [2] Ultimately, though, he found that the modern dance world was rather enthusiastic about his work, and began to find work there. [3] He later observed that the common thread between music and dance is time, and this was what brought delight to both Cage and the dancers who performed to his pieces. Cage had found his structural element that had eluded him during his studies under Schoenberg.

In 1938, while at the Cornish School in Seattle, Washington, Cage began experimenting with his "prepared pianos", in reaction to needing percussion for a piece he was composing for Syvilla Fort. The performance venue was of modest size, and could only support a grand piano, not a percussion ensemble like he wanted. [4] He overcame the limitation of the venue by preparing a piano— inserting objects into the strings, such as nuts and bolts, silverware, and other objects— so that the notes played would create a heavily modified sound, detached from the normal sounds that one expects from a piano. [2] By this means, he resolved the problem of not having the room to support a percussion ensemble, and he also discovered how disassociation could be a part of his work— an idea he examined for the rest of his life, and one that is important to Sensorband.

While at Harvard in the 1940s, he had one of his most transformative experiences when he stood in their anechoic chamber. Hearing two tones— one high in pitch, and one low— he was

told that these were the sounds of his nervous system and the flow of his blood throughout his body. In response to this discovery, he remarked that “Until I die, there will be sounds”.[5] Clearly, this was one of the more formative events that shaped his attitude toward noise as a form of music.

He met Merce Cunningham, a choreographer, and along with Robert Rauschenberg, taught at the Black Mountain School for a period during the 1950s. Not long after, in 1952, Cage composed his best known piece, *4’33”* (where the pianist plays nothing for the three movements of the four minute, thirty-three second piece,) as a delayed reaction to his revelation in Harvard’s anechoic chamber. Cage described it as his most important piece, as “you don’t need it in order to hear it”. [4] He was inspired by his studies of Henry David Thoreau and of eastern philosophies, notably how in India, there is a sense that music is all around us, that the listener need only stop and pay attention to the sounds of daily life to hear it.

Near the mid-point of his career, his student, Christian Wolff, gave him a copy of the I Ching— the Chinese oracular text. It, and star charts, came to heavily influence his compositions. He would use the chance nature generated by the customary application of the book as a tool in writing his pieces, both through consulting the book as intended, and through creating charts of musical phrases, through which “chance operations” (as Cage described it) would inform him how to create a piece. (James Pritchett, in his paper “From Choice to Chance: John Cage’s Concerto for Prepared Piano” [6] outlines the meticulous way in which Cage used the Chinese text to create entire movements of the concerto.) The star charts were used by laying transparent strips over the charts, and he would choose stars based, in part, on the colour in

which they were printed. [4] In this way, he was distancing himself from his music by adding the disembodied sense inherent in randomness to it.

So it would seem, on the surface, that Cage was all about randomness, but this doesn't take into account his embrace of disassociation. Music, in the traditional view, has high regard for predictability— indeed, it's almost mathematical in its structure, and so has prescribed rules as does a mathematical equation. One can listen to an unknown tune, and for any given note, the listener will have a good sense of what the next note will be, especially if the listener is already familiar with the composer's work. But Cage's aesthetic, while it clearly embraced randomness, also embraced disassociation.

At the Theatre and Engineering Festival of 1966, Cage had planned a piece that would involve 12 telephones that were dialed into various locations outside the performance hall— amongst them, the Bronx Zoo, for example. Unfortunately, people from Bell Labs saw 12 phones off the hook, and in an act that might have been unforeseen, hung them up. [7] Fortunately, his piece wasn't solely reliant on the telephones, as he had plenty of other sound sources upon which to draw. But it underscored the idea that Cage was willing to entertain any source of sound as an element in his work. He would also regard the walls of the concert hall as fungible— why not define the outside world, and all its actors, as planned participants (however knowing or unknowing) in his performance? In this sense, he was throwing aside any traditional notion that the composer must be in full creative control, and was welcoming chance happenings as an integral part of his aesthetic.

In 1968, he performed *Reunion* with Marcel and Teeny Duchamp. On a chessboard, he had mounted 64 light sensitive switches that would react to the presence or absence of a piece. These were connected to an electronic controller, which would activate sounds (created by his collaborators in the piece) according to what pieces were on the board, and what spaces were vacant. [8] The concert was one of essentially random sounds, because though chess has its share of popular strategies that have long-established moves and counter-moves, ultimately, each game will be unique unto its players.

The *Reunion* chessboard wasn't the first example of Cage creating an instrument that would incorporate the unexpected in its play. As was noted above, from his time at the Cornish School, years before *Reunion*, he had been making prepared pianos, which incorporated the concept of disassociation into his work. By inserting objects into the strings, he found that the resulting sounds became unexpected, which created a different kind of relationship between the listener and the performer/instrument. A note on a piano comes from the striking of a felt-covered mallet on the various strings. Anything that affects the free vibration of those strings will, by definition, also affect the resulting sound. Cage found this offered interesting avenues of exploration, because by inserting a bolt between the strings, the note would be fundamentally altered. Varying the position (longitudinally) would affect the pitch of the prepared sound. (As an aside, his scores became, by necessity, quite diagrammatic in response to the need for a means to illustrate how preparations and the like should be done.) [9] Unsurprisingly, the pianist is affected as much as the audience, because rather than hearing the traditionally expected note as a consequence of pressing a particular key, the prepared sound would be radically different. [10]

This fundamentally altered the relationship of the signifier and the signified. When we listen to a pianist, typically, we see the position of his hands during the performance, and thusly, we have certain expectations regarding the sound. When the pianist is playing the keys to the left side of the instrument, we expect low notes, and similarly, the high notes from the right side. Additionally, since childhood, most of us have heard the sound of a piano, and so expect a clean note in response to a keystroke. Whether that note is muted or allowed to decay naturally is immaterial to our reception of the sound as normal, and indeed, is regarded as a normal course of events in the playing of a piano.

Nuts and bolts weren't the only things that Cage used to prepare a piano— he would even place mechanical household devices in the piano. None of this is what we expect— again, toying with the signifier/signified issues inherent in his aesthetic. So when we hear a prepared piano, the signifier (the piano and its resulting notes) has a cognitive disconnect from the signified (the mental interpretation by the listener of the sound). "That's not what a piano sounds like!" We experience a disassociation from our preconceived notions of piano sounds, which is another of Cage's great explorations.

> *"The opposite and necessary coexistent of sound is silence."*
>
> *John Cage [10]*

Almost ironically for a composer of music, Cage was interested in the role of silence in music. For Cage, it was an opportunity to enhance his composition with the noises of the outside world. Rather than insist that his work be evaluated from within the sterile confines of an idealized performance hall, Cage's belief that all noises could be artful sounds required that the

ambient noises of a space— including whatever traffic noise permeated from outside— be regarded as intended parts of his composition. If, during a performance of *4'33"*, an ambulance passed by the concert hall with its siren blaring loudly, Cage would be delighted to have that encroachment, whereas a traditional composer would certainly frown on the mundane, crass outside world violating the sanctity of the hall; such noises having no place in conventional concert performances.

His attitudes toward recordings of his work were almost schizophrenic in character, because on the one hand, he disliked the idea. Inherent in his music was the embrace of outside sounds, and the creation of a moment. As mentioned above, to him, the invasion of street noise was a crucial element of a piece like *4'33"*. He found much of what we normally consider noise to be music to his ears. The sounds outside his New York apartment were those of a massive, endless symphony, waiting for him to listen in and tease out all their layers of being. But seeing that recordings would be made anyway, he encouraged as many to be made as possible, so that no one recording could be considered the canonical edition of that piece. [10]

Cage believed that sound should be heard as such, not as language. To this end, he felt that music as composed by more traditional composers had too much of a narrative— this was music crossing over into literature, and for literature, we already have writers. In his words, this is the "primacy of sound over metaphor." [11] Music should be true unto the particular things that are unique to music, not try to be something that it isn't.

To the end that his embrace of natural sounds would, by default, include unpleasant sounds, he likened this to Zen Buddhist teachings— that one must accept that which is not beautiful

along with that which is beautiful. This is easily apparent in a performance of *4'33"*, as soon as the sound of a passing siren permeates the space. Fundamentally, there can be no positive associations with that particular sound. Expanding on this idea, Cage intentionally included preparations in his pianos that would create unpleasant sounds. Curiously, despite his celebrated belief that all noises and sounds had the ability to become music, he drew the line at vibraphones, refusing to take pleasure in its sound— Cage remarked "I find it sickeningly sweet". [12]

During his life, and since his death, his work has been cited by many as that which gave them license to push their own bounds in music-making and composition. Geoff Smith noted that this license had an invigorating effect on the traditions of the day, on composers such as Philip Glass, Harold Budd, and George Crumb, who saw Cage's work, and allowed it to endow new freedoms on their own compositions and (more importantly) attitudes. [11]

But aside from a vague notion that by being a composer, he was a standard-bearer for music, he took a recalcitrant attitude toward the traditions of music. His break with Schoenberg was over his disinterest in embracing harmony— later, he defined atonality in relation to this: "atonality is simply the maintenance of an ambiguous state of affairs. It is the denial of harmony as a structural means." [13] and it was the search for a new structure that gave him his sense of necessity. It was his experimental attitude combined with his reverence for sound above all that enabled him to break through the walls of traditionalism that even the most avant garde composers of the day weren't willing to approach. Indeed, as Cornelius Cardew observed, "...it implies and demands a breakaway from conventional concert presentation, and sets about

creating new modes of making music rather than a re-ordering of the emotional material of traditional music." [14]

With John Cage and his many and varied accomplishments in mind, it's time to turn our attention to Sensorband. A trio of electronic musicians—Atau Tanaka, Edwin van de Heide, and Zbigniew Karkowski— Sensorband resembles a "power trio" in the pop-music sense, in that each musician is a well respected musician in his own right— thusly constituted, Sensorband can be thought of as the whole that is greater than the sum of its parts. Unlike Cage, who used musical instruments (principally piano) for many of his performances, Sensorband takes on a new stance to the definition of what makes an instrument, notably with regard to the computer. Louise Provencher, in her 2006 paper, wrote that they elevate the computer— a generalist electronic tool— to musical instrument status. [15] Their questions include many of the same things Cage explored, such as the potentials of new forms of composition, but also include questions about how music, and the technologies used to make it, interact with each other, the audience, and their aesthetic.

Tanaka uses a device called the BioMuse, which is a set of electrodes strapped to his arms, and create MIDI signals based on the electrical impulses that contract his arm and hand muscles. [15] By flexing his arms and hands (waving them in space, for example), he builds and manipulates sounds. Van de Heide uses the MIDI Conductor: a baton that has various location-sensing technologies built in that can detect the baton's orientation and position in space. The MIDI Conductor can shape sounds based on not just their orientation and position, but also based on the proximity to his hands. Karkowski uses a framework of 32 infra-red sensors that detect his body's position in space within the framework. By moving around the space, extending his

limbs, he creates his sounds, seemingly without an instrument— almost from thin air. Compare this to traditional music-making, and one is basically limited to whistling, clapping, or singing as ways one can make music without an apparent instrument. [16]

Their self-designed electronic instruments allows the ultimate in ability to prepare their instruments, which goes straight to the heart of Cage's prepared pianos, and his found sounds derived from whistling kettles, and the like. In many ways, Cage's approach was the more natural, in that his interactions with the physical world were as humans have been doing for millions of years, without mediation. Discovery was a personal affair— he could be cleaning up his cook pots, and notice that plunging the lid into a sink full of water makes a particular sound. Walking down the street, the sound of a police whistle could inspire. But his interactions were at the level of personal, physical interaction. Sensorband, in using electronic devices, has a mediated component. There might be a physical act of discovery, but then they would have to record that sound, whereupon it becomes a string of bits on a computer. More significantly, with the advent of the internet, they can exchange sound samples with people they meet online, or even buy them from vendors, none of whom they actually meet in the flesh. Computers themselves allow the spontaneous genesis of new, unheard of sounds, created out of thin air with only a few clicks of a mouse or a few strokes on a keyboard. Cage's approach could be seen as more limiting, as how many whistling kettles can fit in a concert hall? On the other hand, his approach can nurture a deeper relationship with the sounds. He only had a comparatively small number, so had the ability to investigate the characteristics and aesthetic possibilities of each, which is something that isn't possible if you're looking at a practically infinite array of sonic possibilities. But Sensorband can ask a different question— is this the sound that I really want?

If it's not what they envisioned, they have the freedom to change sounds via electronic mediation in a way that Cage couldn't.

The fact that an electronic instrument is, at its core, simply a collection of electrical switches and sensors, means that it requires an interface between the instrument and the amplifier in order to make any kind of sound. Unlike, say, an electric guitar, which still makes audible sounds— however softly— when strummed, an electronic instrument is functionally dead to the world without both an amplifier and some sort of mediation in terms of software. In the context of an electronic piano, you press a key (which is actually a switch) and software then mediates that electronic signal, describing the resulting note's timbre, pitch, duration, and so on. All of the attributes that make a sound are thusly mediated in software. The signal then goes onto an amplifier, where its volume is raised to a level that is appropriate to be heard in a particular venue. [17]

Where Cage would require a physical intervention using nuts and bolts in order to prepare a piano, and in so doing, affect the attributes of a note, Sensorband musicians need only physically interact with the sound-mediating elements of their instruments (i.e. the MIDI interface) as much as it takes to manipulate some software. That software takes the place of hardware doesn't necessarily imply those preparations are easy. Indeed, by engaging in a realm that offers virtually limitless choices for expression, electronic musicians may actually have the harder task in making creative decisions. Physically speaking, the act of preparing a piano is a more involved task than manipulating software (besides needing the piano), so in that regard, it can be a more daunting task than composing by computer. But there is an exchange of difficulties — Cage had the difficulty imposed by the physical realm, that preparing a piano required one to

stick things into the strings. Sensorband has the difficulty imposed by the realm of functionally limitless choice. (Contrast both Cage and Sensorband with a composer like Karlheinz Stockhausen, who in his 1962 paper "The Concept of Unity In Electronic Music" [18] described how he made his electronic compositions by using voltmeters, electrical filters, and manually splicing magnetic tape, and one is left with a richer sense of the relative ease by which Cage and Sensorband make their music!)

Either way one judges the ease of one form of composition over another, the unlimited nature of software in terms of creating a sound means that Sensorband isn't limited to what sounds can be made from wedging a handful of screws between the strings of a piano. Tanaka observed that the computer liberated the musician from the physical limitations of traditional instruments and their performance in his 2000 piece "Musical Performance Practice on Sensor-Based Instruments". [17] Speaking to that idea a little further, if they want to create a situation where Tanaka makes sounds like a violin, and Van de Heide makes sounds like a guitar, but when they both play a particular note, it comes out sounding like a frog croaking at middle C, that's entirely doable. Cage needed to engage the services of an electronics engineer to build his chess set, but modern music software has arrived at the point where any aspiring high school aged musician can do something similar with ease.

Gesturally speaking, the work of Cage and Sensorband stand in two related, but different worlds. In a Cage performance, the instruments are laid bare, with everything plain and simple for the audience to see. There's not a whole lot of work relating to gesture, apart from that which is outright required to manipulate an instrument. True, there is a certain theatre, when, for example, John Cage performed *Water Walk*, with its vast array of household objects like a rubber

duck, kitchen blender, and 5 radios. [19] But a performance of *4'33"*, or of *Dream* represents a far less gestural experience.

Sensorband, on the other hand, openly embraces gesture. Karkowski believes that the idea that computers are unable to create gestures is an outmoded one, and embraces the challenge of creating an overtly gestural musical performance. [16] He goes on to recognize the importance of the punk rock movement to their work, as it was that movement that clearly demonstrated that the presence of the performer can have as equal importance to the concert as the music itself— indeed, that presence can even be more important, undercutting (in his estimation) the value of a recording of the music. This last observation goes to the heart of Cage's attitudes about recordings of his music, as well. But the overt, gestural qualities of a Sensorband performance stand in marked contrast to their instruments' ephemeral qualities. It is true that their music would be nothing without the crates of computers and amplifiers, much of which occupies the same stage as the performers. But the instruments themselves occupy very little visual space— apart from the SoundNet, of course. The movements of the performers is the only indication that anything is being done to make the music that is being heard. Without this single indicator, the audience's reception would be different— the music might be regarded in the same gestalt as a recording, even though it was being performed live. The gesture of the performers, then, is the crucial element that makes the performance real.

Stepping forward from Cage's era of the more arduous forms of computing into present day, it's clear that the advances in technology, that have given us a near-instantaneous form of computing, as well as sensor technology, have propelled us into a realm where computer music can be made in the studio, as in the past, but it's also fast and responsive enough that electronic

music in the performance hall is a reality. This opens up the realm of the gesture as a means of expression— something observed by Sensorband. Cage laid down the groundwork, in requiring his performers to manipulate their instruments in novel ways, but it's the computer that has opened up the next step, by freeing the composer to think about the spontaneous moment— that moment where the gesture becomes a mediating element to the reception of the music. [17]

It is, however, this mediation of the computer that provides a principle aesthetic of Sensorband: that of disembodied musician. Similarly to the earlier discussion of how a piano player's hand position provides visual cues as to the expected sounds, we think of pitch in terms of a linear frame of reference. Typical associations are up for higher pitches, and down for lower. But regardless of an actual direction, we also assume that a performer will move in the same direction for a similar pitch. A pianist will be on the right hand side for all higher-register notes, and vice-versa. A guitarist's hands move up the neck (toward the head) for lower notes, and down the neck (toward the body) for higher notes. With any of the Sensorband instruments, nothing could be further from the case. The programmability allows total freedom in this regard, and even with that in mind, a freedom from any kind of logical linearity. Thus, the motions creating a particular low note could be largely the same as one for a high note, on the same side of the body, etc. An audience member has no traditional visual cues to help anticipate what sounds will next come out of the amplifier. This isn't lost on the band, and it's an element of their performances that they cherish— robbing their audience of the visual connecting elements found in traditional performance. [16]

Against the lens of Cage, we see two issues at hand, regarding the reception of the aesthetic gesture by the audience— they both involve a sense of disembodiment. Cage disembodies by

taking a traditional instrument and distorting the relationship between the expected and the received sound by making his prepared pianos. Sensorband takes this a step further, and through the mediation of electronic devices, utterly divorces that relationship from our expectations, and furthermore, stops it from even growing legs in the first place, by basing its performances on instruments with which the audience has no traditional relationship.

Bert Bongers, in his paper "Electronic Musical Instruments: Experiences of a New Luthier", raised an interesting point about the form factor of instruments, and the way in which they're designed. For the most part, a traditional instrument has design parameters that follow the capacities of the humans that will be manipulating them. [20] That a flute, for example, is about two feet long is partly a consequence of the fact that this is roughly how far a person can reliably reach in order to manipulate its valves, and be able to do that continuously without strain for the duration of a concert. It may well be that a far richer sound would come from a flute that measured five feet long, and was made of granite, but the hypothetically richer sound would never be heard, as no human could realistically play such a thing. So why would one make an instrument that was half as wide as a stage, and as tall as a house?

Sensorband invented a new instrument— the SoundNet— with an aim of collaboration. A physically imposing structure at more than 10 meters tall and more than 10 meters wide, the SoundNet has an array of cables stretched across it, such that someone could climb upon them. These cables are connected to motion sensors that can detect when someone is pulling on a particular cable. In a certain sense, one might think of it as analogous to a gigantic guitar. That the cables appear that they could be climbed upon belies their actual purpose: SoundNet is "played" by the members of Sensorband actually climbing up the cables. In reaction to a cable

being stood upon, hung upon, or just wiggled, the individual sensors send electrical signals to a MIDI controller, where the software then assigns preprogrammed sounds to an amplifier—similar to a conventional electronic keyboard familiar to many. [17] But what sets the SoundNet apart from most other instruments is its multi-user nature. While it's true that piano four-hands is a relatively commonplace collaborative musical form, other musical forms that include multiple performers on the same instrument are few and far between. (Drums and xylophones are the only other instruments that come to this author's mind.) Its mammoth size requires all three performers to be activating its cables during a performance. Again, the role of unpredictability enters the aesthetic. Tanaka could be standing on a cable, bouncing, but then Karkowski might grab that cable with his hand, and in hanging from it, dampening the bouncing of Tanaka, and in adding his own weight to the cable, changing the pitch or introducing other variables to the sound. Control, then, becomes central to the aesthetic of SoundNet.

What also makes SoundNet unique amongst even the largest of traditional instruments is its incredible size. This impacts a performance in a subtle way that is not necessarily apparent to the audience. Because it's not practical to leave the instrument set up in a practice hall, typically, the only time that the performers have to get familiar with the instrument is in the time surrounding a performance. Compare this idea with traditional notions of how a musician gains expertise with his instrument. K. Anders Ericsson holds that it takes at least 10,000 hours of study to become an expert. [21] It is this author's estimation that even the most optimistic estimates would clock in Sensorband's total time (including performances) with the SoundNet at an order of magnitude less, based on assumptions of other demands on their time, such as practice with their other instruments, time spent in composition, etc. Said Tanaka, "As the instrument requires significant

space and means to set up, we have had little time to live and work with the instrument". [17] In his interview with Bert Bongers, [16] he said that 20 years of work with a violin is needed for mastery, and went on to discuss the rapid pace of technological change, and how it defined not just their relationship with their instruments, but also with technology— the three musicians have ended up drawing a virtual line in the sand, explicitly making the decision to work with the instruments they have, as they exist, without regard for further technological enhancement, in order that they can amass this crucial experience. So an additional level of randomness arises from the sheer inexperience the musicians have with their extraordinarily uncommon instrument. Aside from performance, this impacts composition as well, as it is with an intimate knowledge only that one can appreciate the full range of capabilities of an instrument, and then compose a piece for it. One could fairly argue that Cage had a certain level of experience using a tea kettle, or a whistle; but as musical instruments, there is a limit to how far one can go with these devices. Compositionally, though, Cage had an idea as to their limitations, even though, for example, naturally, when playing a tea kettle, there will be some randomness. But even with this in mind, SoundNet is certainly a worthy expansion of Cage's ideals on a grand scale, because with all the inherent randomness, it is an incredibly fertile ground for experimentation, for sound-making, and for discovery.

Rounding out a trio of the most notable instruments played by Sensorband is the Global String. A truly collaborative instrument with an unprecedented level of randomness incorporated at the core of its being, Global String is a single cable, set up in a gallery where one end of the 15 meter cable is connected to a motion-sensor, and the other end of the cable is attached to the floor— the string is stretched taut at a somewhat shallow angle as it cuts across the space. Either

a musician, or gallery visitors can play the instrument. Striking the cable causes vibrations that are detected by the motion sensor, and those motions are sent, via the internet, to another associated location, somewhere in the world. A Global String installed at that location could be feeding sounds back to the original gallery, or to another gallery somewhere else in the world— one could have countless Global Strings all over. [17] More interestingly is that there is a magnetic actuator mounted on the string, and so vibrations "sent" via the internet connection from a remotely located string will vibrate the local one, making the instrument a collaborative piece. [5] This takes the 1966 John Cage piece, with the 12 telephones, a step further: embracing the local/remote connection, but inviting a more direct engagement of all parties in all locations. The collaborative aesthetic is taken to a new level that Cage likely could never have imagined.

Said Tanaka: "Musical instrument characteristics are defined as much by their limitations as they are by their capabilities." [17] Reflecting on this, most musicians seek out imperfection in their music, and stamp it out. Tanaka, who invented the Global String, embraces the various artifacts imposed on the internet signal— what cities each information packet passed through on their way, the latency of the network, and so on— and incorporates them into the MIDI programming. By doing this, even two identical cable vibrations will have different sound forms when they arrive at the distant gallery. Of particular interest is the temporal issues imparted by network latencies— it becomes "a kind of unique acoustic of this media" in his words. [22] To this end, Tanaka prefers ISDN-based internet connections, as they represent an older network technology that offers more opportunity for artifact insertion— just like Cage regarded a prepared piano to be superior to an unprepared one, and especially like the encroachment of outside ambient noises during a performance of 4'33". The network connection, and all its warts,

is as integral to the instrument as is the string, the MIDI controller, and all other physical attributes of the instrument themselves.

It is no surprise, then, that one can easily regard Sensorband as perpetuating and extending the loftiest ideals envisioned by John Cage. I have documented their embrace of Cage's randomness, of noisemaking, and of experimentation. Well recognized by the performers is that their musical phrasing is affected by technological limitations that they have designed into their instruments— a concept that, perhaps, goes against centuries of traditional instrument design, but was pioneered in large part by John Cage with his *Reunion* chessboard and his prepared pianos.

Speaking more closely to his chessboard, Cage set the stage for imposed randomness; a stage that Sensorband would seize with their instruments and ISDN lines. A Cage performance was bound by traditional instruments that gave traditional cues— even in the presence of Cage's preparations— but again, Sensorband pushes it futher by designing their instruments to revoke the sense of control over the experience that the audience typically has, by disassociating their gestures from the direct link to an anticipated musical tone.

Sensorband takes the work of Cage and brings it to new levels, and has opened up new avenues for investigation in the very spirit that guided Cage— that the question most worth asking is the one that can't be answered. In so doing, Sensorband breaks new ground in music, by following the course of one of its revered titans.

Bibliography

1. Pepper, I., *From the "Aesthetics of Indifference" to "Negative Aesthetics": John Cage and Germany 1958-1972.* October, 1997. **82**(ArticleType: primary_article / Full publication date: Autumn, 1997 / Copyright ¬© 1997 The MIT Press): p. 31-47.

2. Cage, J. *John Cage: An Autobiographical Statement*. 1989; Available from: http://www.newalbion.com/artists/cagej/autobiog.html.

3. Cage, J., M. Kirby, and R. Schechner, *An Interview with John Cage.* The Tulane Drama Review, 1965. **10**(2): p. 50-72.

4. Cage, J. and R. Kostelanetz, *His Own Music: Part Two.* Perspectives of New Music, 1988. **26**(1): p. 26-49.

5. Broeckmann, A., *Reseau/Resonance: Connective Processes and Artistic Practice.* Leonardo, 2004. **37**(4): p. 281-284.

6. Pritchett, J., *From Choice to Chance: John Cage's Concerto for Prepared Piano.* Perspectives of New Music, 1988. **26**(1): p. 50-81.

7. Cage, J., R. Foreman, and R. Kostelanetz, *Art in the Culture.* Performing Arts Journal, 1979. **4**(1/2): p. 70-84.

8. Cross, L., *"Reunion": John Cage, Marcel Duchamp, Electronic Music and Chess.* Leonardo Music Journal, 1999. **9**(ArticleType: primary_article / Issue Title: Power and Responsibility: Politics, Identity and Technology in Music / Full publication date: 1999 / Copyright ¬© 1999 The MIT Press): p. 35-42.

9. Cage, J., *Reflections of a Progressive Composer on a Damaged Society.* October, 1997. **82**(ArticleType: primary_article / Full publication date: Autumn, 1997 / Copyright ¬© 1997 The MIT Press): p. 77-93.

10. Tone, Y., *John Cage and Recording.* Leonardo Music Journal, 2003. **13**(ArticleType: primary_article / Issue Title: Groove, Pit and Wave: Recording, Transmission and Music / Full publication date: 2003 / Copyright ¬© 2003 The MIT Press): p. 11-15.

11. Smith, G., *Composing after Cage. Permission Granted.* The Musical Times, 1998. **139**(1864): p. 5-8.

12. Reynolds, R. and J. Cage, *John Cage and Roger Reynolds: A Conversation.* The Musical Quarterly, 1979. **65**(4): p. 573-594.

13. Dudley, E., *New Beginnings. Edward Dudley Hughes Reflects on the Works and Ideas of the Late John Cage.* The Musical Times, 1993. **134**(1799): p. 14-15.

14. Cardew, C., *Cage and Cunningham.* The Musical Times, 1964. **105**(1459): p. 659-660.

15. Provencher, L. and T.t. Barnard, *Atau Tanaka: Le corps sous tension ou de l'loquence du geste / Atau Tanaka: Live Bodies, or the Eloquence of the Gesture.* Parachute no, 2006. **121**(January/February/March 2006): p. 62-77.

16. Bongers, B., *An Interview With Sensorband.* Computer Music Journal, 1998. **22:1**(Spring 1998): p. 13-24.

17. Tanaka, A., *Musical Performance Practice on Sensor-based Instruments.* Trends in Gestural Control of Music, 2000: p. 389-406.

18. Stockhausen, K. and E. Barkin, *The Concept of Unity in Electronic Music.* Perspectives of New Music, 1962. **1**(1): p. 39-48.

19. Chaudron, A.; Available from: http://www.johncage.info/workscage/waterwalk.html.

20. Bongers, B., *Electronic Musical Instruments: Experiences of a New Luthier.* Leonardo Music Journal, 2007. **17**(ArticleType: primary_article / Issue Title: My Favorite Things: The Joy of the Gizmo / Full publication date: 2007 / Copyright ¬© 2007 The MIT Press): p. 9-16.

21. Ericsson, K.A. *Expert Performance and Deliberate Practice*

An updated excerpt from Ericsson (2000). 2000 16 August, 2010]; Available from: http://www.psy.fsu.edu/faculty/ericsson/ericsson.exp.perf.html.

22. Barbosa, A., *Displaced Soundscapes: A Survey of Network Systems for Music and Sonic Art Creation.* Leonardo Music Journal, 2003. **13**(ArticleType: primary_article / Issue Title: Groove, Pit and Wave: Recording, Transmission and Music / Full publication date: 2003 / Copyright ¬© 2003 The MIT Press): p. 53-59.