



Owner of a Lonely Heart: Zebrafish Embryonic Heartbeats

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Abstract

The work presented here was developed in collaboration between the media artist Clarissa Ribeiro and the scientist Huanqi Zhu, by the time they worked together as researchers at James Gimzewski lab, UCLA. The 8 (eight) screenshots and the derived (sonified) environmental sound that integrate the piece “Owner of a Lonely Heart”(2014), were traces of an observation – a scientist measuring the heartbeat of a zebrafish (*Danio rerio*) embryo’s lonely heart. After recording the data, using a microelectrode precisely prepared for the experiment, the scientist generated a series of graphs using the software OriginPro 8.1 and started zooming in different regions, looking for specific points where the patterns fit his expectations according to the main purposes of the research. Despite the procedures were initially part of a bigger project involving several labs and researchers, the actual collaboration was developed as a parallel experiment were the scientist joined the artist in a poetic reflection about the scientific procedures that became part of the artwork itself. Integrating the artist solo show at the Art|Sci Gallery, UCLA (June/July 2014), the work invites the audience to reflect critically about the importance of observation in the creation of ‘truth’ in science, what plays a crucial role in the creation of ‘reality’, having radical influence in the ways we behave, in our survival strategies, in who we are.

Keywords

Art and Science, Data Sonification, Problem of Measurement in Quantum Mechanics, Observer-observation relations in Quantum Mechanics, Heart Beating Patterns of Zebrafish Embryo.

Introduction

In the work ‘Owner of a Lonely Heart’, the authors invite the audience to think about the role of observation in the creation of reality – a basilar concept related to problems of measurement in Quantum Mechanics. Observation, from this perspective, is the active agent that collapses quantum possibilities into actualities. Bell [1] reflects on the consequences of a misuse of the word ‘measurement’, what can make it easy to forget that the results of quantum experiments “[...] have to be regarded as the joint product of ‘system’ and ‘apparatus,’ the complete experimental set-

up.” He emphasize that, as we learned from names like Bohr, the instruments don’t play a purely passive role.

Taken as a poetic reflection about these considerations, beyond the realm of Quantum Mechanics, the 8 (eight) screenshots and the environmental sound that integrate the installation are memories of an experiment where a scientist was measuring the heartbeat of a zebrafish embryo. The microelectrode where the heart extracted from the embryo’s body was placed and accommodated; the electronic microscope; the web cameras; computer hardware and software; human’s hands; the eyes; the human heartbeat... – all intertwined in a quantum level as parts of a system (the apparatus included) that creates the observation itself.

Extended-Altered-Entangled

Our computer-mediated world amplifies our natural perceptual abilities and we can be non-locally engaged in observer-observation relations which nature and implications goes far beyond the use of our so called 5 (five) senses. In this scenario, engineered systems and sensors integrated in apparatuses of all kinds, help in approaching levels of reality from cross-scalar perspectives, bringing to the horizon the emergence and potentiality of exploring innovative aesthetics, procedures, technologies, discourses. This is the context from which the work ‘Owner of a Lonely Heart’ emerges. A context in which, if we consider ourselves as active elements of Complex Affective Systems (CAFFS), it could be easy to think about the ways we can non-locally affect and be affected by universal forces, by each other, by ourselves, creating realities from a multi-level perspective. A Complex Affective System (CAFFS) is a term the author coined to describe and discuss certain Complex Adaptive Systems (CAS) focusing on affectiveness as the main bond between the systems’ elements, relating this aspect of system’s interconnectedness, and the ability its elements have of non-locally communicating, to the phenomena of quantum entanglement.

In an objective observation in science, considering the procedures involved in laboratorial experiments in the most diverse areas of investigation, the ideal observer is the one who causes no perturbations to the system under observation. Nevertheless, the physics of the 20th century faced the challenge of questioning the role of the observer. From the Quantum Mechanics' perspective, the observer and the system observed become somehow intertwined that the results of any observation seemed to be determined, partially, by the actual choices of the observer. This problem concerning observer-observation relations is represented by the wave function. The main intention in this collaboration was 'to observe/integrate the scientific observation', building a 'meta-point of view' to poetically reflect on how, by means of observing having an hypotheses in mind, the scientist radically influences the results of the experiment. According to Edgar Morin,

“The meta-point of view is only possible if the observer-conceiver integrates himself or herself into the observation and the conception. This is why complex thought requires the integration of the observer and the conceiver in its observation and conception.”[2]

In 'Owner of a Lonely Heart', together, collaborating, the scientist and the artist become part of the observation itself and the system (CAFFS) 'scientist-artist-apparatuses-observation' become the 'reality' encapsulated in an art piece. As part of the procedures, the heart of the zebrafish embryo was extracted from the fish's body in search for more precise measurements. The interval from life to death of the 'extracted heart' accommodated on the top of the microelectrode, varies – it can last around one minute or so.



Figure 1. The entire dataset in OriginPro 8.1: the zebrafish embryo heartbeat caption's resultant graph from where the 'zooming procedures' start.

After collecting/recording the data, the scientist generated a main graph (figure 1) using the software OriginPro 8.1 and started zooming in different regions of the graph, looking for specific points where the patterns fit his expectations, according to the main research hypotheses. In this specific case, the purpose of the experiment was to study the beating pattern of zebrafish at different developing stages. The beating patterns can serve as markers to help identifying healthy and mutant hearts, being, in turn, used to test drugs that can improve specific functions of the organ. A control sample with healthy heart was studied. The detected electrical pulses were strong, regular and consistent. An experimental sample with a mutant heart showed the electrical pulses were very irregular and weak. After the administration of a specific drug, the heart function from the mutant sample was restored, and the detected electrical pulses became periodic and normal – an indication of the validity of the initial hypotheses referent to the functional reparatory qualities of the drug.

The Owner of a Lonely Heart

'Observing poetically an observation that could be decisive in a near future by making precise assertions about specific drugs that can effectively fix a damaged human heart' – this was the position of the collaborators in the conception and production of 'Owner of a Lonely Heart'. Together with the scientist, the artist was following and observing the procedures – from the measurements to the search for patterns in the resultant graphics and never-ending datasets.



Figure 2. Beating pattern selected from the entire dataset by the scientist, looking for equivalence with healthy human heart beating patterns.

Eight different screenshots from the entire dataset analyzed were selected to integrate the installation. Each screenshot represents a decisive selection made by the scientist in the search for patterns that matches his expectations – a regu-

lar pattern that is similar to a human’s healthy heartbeat; an irregular pattern that indicates a malfunction. These specific patterns can only be found in extremely short segments of the dataset, considering that the heart of the zebrafish was extracted from the embryo’s body, placed on the top of a microelectrode, and was beating for no much more than one minute. From life to death – from the first screenshot to the last one, the audience could observe in the gallery the lifespan of the embryo’s heart from the scientist-artist-apparatus meta-point of view.



Figure 3. Graph showing the zebrafish’s heart near death.

Gentler and deeper: mindful awareness

The sound was derived via data sonification from the entire dataset – full range of data, sampling rate 1000Hz. The artist manipulated the data using the software *Audacity* and *Adobe Audition*, altering the speed and adding effects to give it spatial qualities and explore specific nuances in the perception of the raw data patterns. Similar strategies for data sonification have becoming common during the last two decades, in works that emerge from collaborations involving artists and scientists. One work that was very influential to the artist in the development of the present project is the ‘Blue Morph’, collaboration between media artist Victoria Vesna and nanoscientist James Gimzewki – an interactive installation that uses nanoscale images and sounds derived from the metamorphosis of a caterpillar into a butterfly. According to Vesna and Gimzewski [3], the sounds used in this piece were acquired and recorded by detecting nanoscale motions of the pupa surface using atomic force microscopy (AFM) and optical beam deflection during the developmental stages of metamorphosis.

According to Walker and Nees, from Georgia Tech [4] in sonification it matters which specific sound dimension is chosen to represent a given data dimension. Reducing the speed from the original (corresponding to 0,000) to -

98,000, was a strategy to enable the audience to perceive subtle variations in the raw data (22,400 lines/ values; Figure 1) directly sonified in Audacity 2.0.5. In a subsequent edition of the exported .wav file in Adobe Audition CS6, effects as echo were applied to give the sound qualities that could stimulate mindful awareness and relaxation.

The intention was to produce a sound that could allow for a perception of the data recorded via microelectrode array (MEA) from a poetic perspective that brings all the fragility and subtleness of a life in its early stages. In addition, another intention was to emphasize all the ephemeral qualities a heart extracted from a fish embryo could awake when the audience gets immersed in a rhythmic travel from the moment it was recently extracted and is pulsating in all its strength (Figure 2) to the very last moments when it is dying (Figure 3).

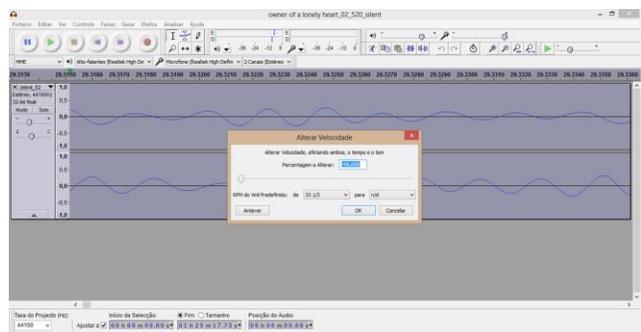


Figure 4. Direct Sonification using Audacity 2.0.5

Subtle Apparatuses for Extrasensory Affectiveness

The installation is a result of the artist’s most recent project that is focused on the conception of a series she named ‘Subtle Apparatuses for Extrasensory Affectiveness’, some of those were in her solo exhibition at the Art|Sci Gallery, CNSI – California NanoSystems Institute, UCLA, in Los Angeles, from June 5th to July 5th, 2014. The ‘subtle-apparatuses’ could be understood as semi-material systems conceived as exercises on experimental metaphysics – performing ventures in realms beyond the physical domain, bearing questions about the nature of reality and our bodies, our affective dimension, consciousness and the self. According to Professor Michael Punt,

“The fact that technologies rapidly become associated with a class of objects that are fundamentally material should not deflect our attention from the semi-material: another class of objects that emanate in our fullest relationship with the world as necessary mnemonics to our affective dimension.” [5]

By means of the artist approach in the work ‘Owner of a Lonely Heart’, apparatuses are not taken as external forces that operate on bodies from the outside. Following the considerations of Karen Barad, apparatuses could be considered as “[...] material-discursive practices that are inextricable from the bodies that are produced and through which power works its productive effects.” [6] According to Roy Ascott, apparatuses as the “scanning tunneling microscope (STM), as an example, calls for touch rather than vision to navigate the nanofield and to manipulate individual atoms.” [7] Professor Ascott emphasizes that “[...] the nanofield mediates between pure matter and pure consciousness and that its significance as an interface between two levels of reality can hardly be overestimated.” [8] Travelling through touchable and untouchable, ‘Owner of a Lonely Heart’ is a call to explore the very power of observation in the creation of the realities we inhabit.

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Authors Biography

Clarissa Ribeiro, Ph.D., is a media artist and researcher. She is currently the main Associate Professor of Roy Ascott Studio in Shanghai, China. Recently, she was awarded a Fulbright grant in Arts, and was living in Los Angeles, California, as a Postdoctoral Research Scholar, connected to the UCLA Art|Sci Center and Lab, collaborating with artists and scientists that are running cutting edge projects in their areas. During her Ph.D. in Visual Arts by the University of Sao Paulo, Brazil, by the time she was together with the Gilberto Prado’s group, she was a visiting research member of the CAiiA-Hub of the Planetary Collegium, UK. As an independent artist, she has been producing and exhibiting a series of experimental interactive installations exploring complex affectiveness through macroscale metaphorical translations of the non-local phenomenon of quantum entanglement. At present, regardless of living in Shanghai, she is still ‘non-locally’ collaborating with the Art|Sci Collective.

Huanqi Zhu, Ph.D., is a researcher at Nano and Pico Characterization Research Lab, UCLA, specialized in quantitative analyses and predictions in physical systems. He has hands-on experience and working knowledge in physical sciences, with extensive experience in noise isolation and noise cancelation with comprehensive training and skills in data processing.