Synthetic Creatures of Media Arts:
Biorobots and Other Biotechnological Entities as an Art Practice of Hybrid Ecology

Master Thesis

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Abstract

Digital and biotechnologies are significantly changing our understanding of such concepts as life, environment, and ecology. This thesis approaches the development of nature-culture relations through the notion of the synthetic creature. In this regard, the key question of this study is what are the prerequisites and reasons for the emergence of synthetic creatures as a separate phenomenon of media arts. The paper suggests to consider synthetic creatures as a result of artistic practices seeking to introduce new life forms which emerge in a synergistic combination of contemporary technology and synthetic biology. In historical continuity from first cave paintings of chimeras to first automata the study looks at the shift from ancient animism to the system of thought established due to philosophical and technological developments of Enlightenment. Furthermore, this paper explores how this paradigm that used to be dominant in the Western tradition from the times of Cartesian split up to the recent history of the 20th century is nowadays challenged with various alternative conceptions due to ALife research and (bio)technological practices. Inspired by Gilbert Simondon's view on technology and Bruno Latour's conceptualization of Gaia up to Roy Ascott's visionary pragmatism in moist media environment it analyzes the evolution of the idea of coexistence. Exploring Simon Penny's and Mitchell Whitelaw's writings it looks at the trajectory of the development of ideas about embodied cognition that inspired Alife research and reactive robotics. Combining these prerequisites it suggests to explore how with synthetic creatures of media art their authors are addressing the idea of the sentient living technology and our future coexistence with it. Thereby, in autoethnographic research carried out during the exhibition In Vitro Agencies (Solu Space, Finland, spring 2019) the author of this thesis explores the role of biotechnological art in the emergence of the new thinking patterns on the blurring border between natural and artificial. Case studies of the exhibited artworks cellF and Bricolage by the Australian art duo of Guy Ben-Ary and Nathan Thompson offers particular examples of how synthetic creatures of media arts as analytical models complement the discussion about technological hybridization of planetary ecology and carry a mythological load into culture through art.

Keywords: synthetic creatures, biorobot, In Vitro Intelligence, hybrid ecology, ALife, Cartesian duality, embodiment, sentient technology, moist media, biological arts, coexistence

Declaration of Authorship

I, Daria Vdovina
born the 2nd of August 1992, in Kyiv, Ukraine
hereby declare,

1. that I have written my Master Thesis myself, have not used other sources than the ones stated and moreover have not used any illegal tools or unfair means,

2. that I have not publicized my Master Thesis in my domestic or any foreign country in any form to this date and/or have not used it as an exam paper.

3. that, in case my Master Thesis concerns my employer or any other external cooperation partner, I have fully informed them about title, form and content of the Master Thesis and have his/her permission to include the data and information in my written work.

2 December 2019   ....

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Introduction

Contemporary technologies have stepped over the well-established understanding of what could be considered hardware, software, or wetware. With the development of science, we are witnessing an increasing number of previously unimaginable hybrid technological systems. These systems do not exist in a vacuum but are closely intertwined with our environment. They modify this environment and adjusting to it. These processes have been explored and explained by science. However, like scientific finds of previous eras, they might retain an impulse of enigma and myth for a regular person at the time of their emergence. Media arts in this sense are translators of narratives about the properties, qualities, functions and potential ways of developing these technologies, their standing in our shared future world. This study focuses on synthetic creatures of media arts. Such synthetic creatures are considered to be a result of artistic practices seeking to introduce new life forms achieved by the synergistic combination of contemporary technology and synthetic biology. The first chapter of this research reveals the philosophical and historical outline of the premises for the emergence of such artistic practices. The second and third chapters are devoted to two case studies: examples of relevant artworks. The analysis of the two artworks: *cellF* (2015) and *Bricolage* (2019) by the Australian art duo Guy Ben-Ary and Nathan Thompson offers particular examples of how such synthetic creatures as analytical models complement the discussion about technological hybridization of planetary ecology and, in this sense, carry a mythological load into culture through art. The myth here is not considered as an archaic form of beliefs description, but rather as a tool for collective cognition and explanation of the past, present, and future. Consequently, the findings of this study offer some answers to the question about the reasons for the emergence of synthetic entities in contemporary artistic practices. The study seeks to answer why artists are passionate about the idea of creating such synthesized life forms.

A step-by-step search of answers to these questions begins with the formation of the worldview paradigm of the study. The author assumes that this worldview paradigm also to some extent inspires the community of media artists, and more precisely: it has an indirect effect on their understanding of cause-effect relationships and substantial problems of our time. The key theme of this part of the text is the progressive change in the understanding of nature and the relationship between the natural and the artificial in it. The study discusses competing or harmoniously combined theories and concepts such as the *Anthropocene* (Crutzen, 2000), *hyperobjects* (Morton, 2013), the homeostatic *Gaia* (Lovelock, 1972), the *alienation of technology* (Simondon, 1958), the

moist mind (Ascott, 2000), and *hybrid ecologies* (Crabtree, Rodden, 2008). Each of them in its way addresses the issue of the need for the formation of new principles of coexistence and solidarity between natural, technologically advanced and hybrid actors of planetary ecology. First section introduces the categories that will serve as the background for the case study stage, suggesting to investigate how this worldview paradigm resonates with specific artworks and whether its reflection is traced in the polemics of the authors of these artworks.

Next section flows into the description of the research methodology of the study. This research initially consisted of several stages. The first stage was closely interlinked with practical activities as part of a research internship at Solu Space — headquarter of the Bioart society. It served as a platform for the formulation of topics and terminological apparatus, data collection for case analysis. It was followed by an in-depth study of literature, the identification of topical issues, the preparation and conduction of interviews with the authors of the artworks and the curator of the exhibition at which they were presented. The last step was the analysis of the data collected, the search and description of the links between theory and practice. Accordingly, the first stages were based on ethnographic and auto-ethnographic approaches, the later stages of writing the study were performed according to the method of a case study. The dense involvement in practice and deepening in theory as the research progressed was reflected in the gradual refinement of the research question and problem formulation, as well as in the modification of the categorical apparatus. A notable feature of the study is a special focus on terminology since in the research process it became clear that this artistic field is at the stage of searching for its language.

Some terminology usage, as well as philosophical ideas for this field, are considered to be a heritage from the past. They are implemented, problematized or modified taking into account current trends. Therefore, to understand the problems of this study, it seems important to draw a dotted line of historical continuity. The first chapter of this study is introducing the notion of the creature from the first cave paintings to the first samples of art chimeras created with biotechnologies. The chapter discusses the role of mythical hybrid beings in various ancient cultures and medieval legends. Next, their transformation with the development of science and technology in the era of Enlightenment is analyzed. Attention is paid to the desire to animate, spiritualize mechanical inventions, as a result of which the first automata arise. Discussion of pseudo-living machines, mechanical bodies supposedly granted with soul leads to considerable attention of this study to the impact of the Cartesian duality ideas in Western philosophy. The focus is located on the influence of the manner

to think separately about the material shell and the intangible thinking unit of the being. In this regard, the chapter describes how researchers trace the further tendency of the naturalization of this binary opposition approach in Western thinking, which determined the spiritual and scientific convictions of the following centuries. For example, they trace how the division into *res cogitans* and *res extensa* (Descartes, 1647) influenced such myths of the modern world as artificial intelligence or sentient machines. At the same time, this study describes how, in contrast to the Cartesian paradigm, the ideas of holistic, integral systems in cybernetics, ALife research, and reactive robotics, were developed. It also traces how a new facet of this discussion is being formed as biotechnologies develop and moist media appears by adding actual living matter to this technological equation. Thus, described opposition of ideas offers a reassessment of the notion of living technology. At the same time, it presents new ethical challenges that add a new color to the discussion of coexistence and solidarity in hybrid ecologies. In its entirety, the section suggests a certain perspective on how the modern myth of sentient technology is possibly formed and what incarnations it can receive due to synthetic creatures of media arts. The following sections with specific cases relocate the reader to the domain of current artistic practices, where the connection to some of the introductory passages described above could be traced.

The second chapter of this paper is devoted to the artwork cellF. CellF is an artificial *surrogate performer* (Ben-Ary, 2019, Attachment 1) composed of analog synthesizers and a biological neural network created from modified Guy Ben-Ary's skin cells. CellF is able to perceive the electrical stimuli produced by human musicians during the music play and respond with its musical passages. The viewer is invited to witness such collaboration between human and synthetic media arts creature during live jam sessions with different human musicians and cellF. This study describes in detail cellF artwork and the stages of its creation. Besides, it analyzes the ways of exhibiting this work in the gallery space and during live performances. It analyzes not only the interaction of the audience and musicians with the artwork but also how its creators talk about it in public and in interviews. As a result, the chapter traces how this artwork elaborates on the discussion about the intelligent machine through Guy Ben-Ary's new concepts of *In Vitro Intelligence* — IVI (Ben-Ary, 2019, Attachment 1) and surrogate performer. The IVI concept invites us to imagine that artificially created intelligence with the development of biotechnology can be organic by nature. The concept of a surrogate performer raises the issues of agency and the connection of a human with such technologies. Through Guy Ben-Ary's narration in the interview for this research, the readers of this paper are invited to have a look at the authors' intentions in the creation of this work as they are

articulated and explained to the audience.

The third chapter is dedicated to the artwork Bricolage. Bricolage is an ongoing project: an attempt to create a self-assembling kinetic sculpture that consists of moving autonomous biorobots. Biobots in this work consist of blood cells transformed into heart muscle cells that were seeded onto the liquid silk scaffolds. This study examines the stages of creating and exhibiting a prototype of this artwork. It also analyzes the information about this work broadcasted to the outside world through online sources, artist talks and in the interview with Nathan Thompson for this study. As a result, it is traced how the topics of autonomy, movement, physicality, and sensitivity, which are key for this artwork, expand the concept of embodied intelligence of technology in the tradition of the classic *subsumption architecture* of Rodney Brooks's (1986) robotics. At the same time, special attention to techniques, materials and visual presentation in Bricolage allows the researcher to discuss apart from the causes for the emergence of such artwork also the transforming idea of the artist's role in their creation and messages for the audience that Thompson and Ben-Ary set in their synthetic creatures.

In the section about the outcomes of the research, a discussion of the findings of the previous sections continues. It is proposed to look at what discussion agenda these specific creatures of media arts formulate in the efforts to understand current and future *hybrid ecology*. The foundation for understanding hybrid ecology, in this case, is intertwined with the worldview paradigm described at the beginning of the paper. It is also clarified in the interview for this study by Erich Berger, director of Solu Space and curator of the *In Vitro Agencies* exhibition (Helsinki, 2019). Also, the paper offers several questions that could be interesting to consider in further research on the topic.

Ultimately, all the research work done within the framework of this thesis comes down to offering a more comprehensive and multifaceted perception of the synthetic creatures of media arts as analytical tools for the analysis of myth-making in the media arts regarding autonomous, living and thinking technologies. Based on a limited number of individual examples, this paper is trying to talk about comparatively new and fresh trends in the media arts, as well as only rising ideas about our shared ecology. As a result, instead of value judgments, this study is more likely to gravitate to questioning intonation. Instead of unambiguous categorical statements, it offers a search for new angles from which one could look at certain topics and actively developing technologies.

Background of the study and Literary review

The impetus for the start of this research was coming from several concepts and phenomena. It raised from the thinking about the position of technology in the Anthropocene; about the role of biological art in the ratio of these two phenomena. It seemed interesting to learn how scientific and artistic creations correlate with the organic and digital world, manifest themselves in nature-culture dichotomy. The original interest of this research was to explore how media art works with the category of living and with organic matter as a material. It required an understanding of the history and currents of biological art. It also seemed important to investigate what would be the place of artificial life art in this regard. All these prerequisites led the author of this study to certain speculation with the self-articulated category, a kind of an umbrella term *media arts creatures*. Looking back, it should be recognized that creatures of media arts have become an analytical tool for the author's cognition. Ubiquitous examples of fictional, non-existent digital, robotic, and even partially organic entities were standing out from other examples of media arts and seemed to form a separate thematic layer of artworks. It was tempting to draw parallels where as in wildlife, this layer consisted of completely different species with distinctive differences in their properties and behavior. It was not a task of this research to thoroughly examine and describe the full scope of such technological fauna. That would require a set of good competencies in completely different branches of science and culture and much more time to complete such research. However, it seemed possible to explore why do certain artists have a desire and need to create such creatures. Thus, the synthetic creatures of media arts were not a neologism to be generally conceptualized as a new finding, but rather a temporary frame to investigate the topic. In this research, they became a hypothetical variable, which should have been taken into account in the research on the set of problems focusing on the relationship between humans, nature, technology, and art. In the course of the research, the author of this study has been exposed to an increasing number of different examples from the past and present. Woven into a matter of epochs, examples of technological beings echoed with various forms of fictional creatures of the pre-digital era in the form of cave paintings of chimeras and various magical beasts from ancient legends, folklore, and religious beliefs. This curious tendency toward the all-planetary experience of creating bestiaries that are unique in each culture at different stages of history could not leave indifferent. They suggested to look closer to the mythical properties of media arts creatures. In what myths of our time could they be present and in what form? The search for an answer to this question during the internship conducted by the author in the spring 2019 and further familiarization with the literature expanded

the author's knowledge on the previously familiar concepts, such as bioart, artificial life, Anthropocene, etc. Moreover, the author was exposed to new categories simultaneously due to research texts and in the practical collaborative activities with artists. That greatly enriched the author's understanding of the problem field of this thesis.

Particular attention was drawn to such categories as, for example, the concept of Gaia according to Bruno Latour (2017), the alienation of technology in the original formulation of Gilbert Simonodon (1958), the Cartesian duality of the body and mind interestingly analyzed by Simon Penny (2017), the hybrid ecology in the way it was addressed during the HYBRID MATTERs Symposium (Helsinki, 2016), etc. In this research, the the fusion of this ideas shaped a worldview paradigm that was structuring the exploration of such concepts as artificial life, autonomy, behavior, embodiment, movement, cognition, intelligence, materiality, and agency in connection to biorobotics and entities of synthetic biology and biological arts. This list is voiced here to outline the general focus of the study, hoverer it is not exhaustive. In the course of this paper, the relational dynamics formed among them during the research will be described in more detail. Therefore, it seems logical to start with some of the categories disclosed in theoretical texts. Some of them had served as a starting point at a certain stage and overtime exhausted their potential for the research. Others have formed the root system of the categorical apparatus for this paper. The third group of concepts is the more recent findings, which seem to require further investigation.

It was claimed earlier that the initial driving force of this study was to explore the place of technology in the conceptual framework of Anthropocene. It is common to consider Anthropocene as a certain spatiotemporal construct, which outlines the substantial interference and influence of human activity on planetary, primarily environmental processes (Crutzen, 2000). Discussion of the Anthropocene often points to technological progress, the capitalist structure and the associated methods of production and exploitation of natural resources as the causes of current environmental destruction and future environmental disasters (Haraway, 2015). Thus, the conceptualization of the Anthropocene in its most general terms focuses on raising awareness about potential ecological transformations through the critique of causes. Human activity is considered to be in the avant-garde of such causes. However, closer attention to the texts about Anthropocene brings up the question of whether their inherent post-Marxist focus on criticism of the economic system and the anthropocentricity of this model is unfavorably narrowing down the scope of ideas about global historical processes. Does it consequently tend to reduce the number of potential scenarios for the

development of the future, including the options for a solution to the problems described by the theory itself? It is not a goal of this research to justify humankind's activity or to glorify the technological determinism, but it could be beneficial to search for alternative narratives in Anthropocene theory. Or perhaps there are anticipating alternative visions in media arts theory which would suggest alternative orienting principles for the interactions among human and non-human, natural and artificial, nature and culture?

Jussi Parikka's writings related to media archeology and geology form a voluminous perception of the relational geography of consumption and the interconnectivity of various ecological processes. Parikka (2011, 2014, 2015) introduced the conviction that ecological formation has a global dimension. It is interesting how the comprehension of this global dimension relates to Timothy Morton's object-oriented ontology of Dark ecology (2016). Morton (2013) suggests perceiving such large-scale processes in time, space and number of agents as *hyperobjects*. One of the hyperobjects that he describes is, for example, global warming. In his ideas, one can find similarities with the concept of world objects proposed by Michel Serres (1992). It is noteworthy that, in conceptualizing these objects, both Serres and Morton talk about some modes of *coexistence* for humanity and nature. Timothy Morton (2017) resorts to the concept of *solidarity*. Serres (1992) meanwhile speaks of a *natural contract* that would recognize nature as a subject with rights. All three thinkers emphasize the interconnectedness of processes arising and ongoing on the planet. Besides, it is proposed to recognize a certain agency of nature itself and the corresponding need to take it into account in human relations with the environment. However, the echoes of the discourse of dependency in proximity to the possession, as well as the level of abstraction at which solidarity is interpreted in their writings seem problematic. How exactly can we understand the principle of the coexistence of humans, nature, and technology? — this question became a concern of this study. One of the many possible answers could be found in Bruno Latour's lecture about *Gaia* (2017). Latour speaks of the figure of Gaia proposed by James Lovelock (1972) by analogy with the ancient Greek pre-Olympic divine being of the same name. Lovelock's Gaia, like the Greek deity, is an individual agent, considered as a holistic living organism called the Earth. Latour (2017, p.94) deciphers that with Gaia Lovelock was suggesting a certain "planetary system that includes everything influenced by and influencing the biota. The Gaia system shares with all living organisms the capacity for homeostasis — the regulation of the physical environment at all levels that is favorable for life". Thus, as Latour explains, it is not so much about the existence of a certain environment to which a person, similarly to other living organisms, simply adapts with the attendant

positive and negative consequences for the system:

> *Since all living agents follow their own intentions all along, modifying their neighbors as much as possible, there is no way to distinguish between the environment to which the organism is adopting and the point at which its own action begins...Gaia theory views the evolution of organisms as so closely coupled that they form a single invisible process (2017, p.100)*

Isn't it what Roy Ascott (2000) is saying when he claims that "nature is not "over there", and the ecology sentience of which we recognize through technology is not a victim? Although the principles of his visionary pragmatism are consonant with the concept of Gaia, they are, to a greater extent, a certain forecast for further evolution. As part of this anticipation, Ascott (1997, 2000, 2008) talks about concepts such as moist mind, bio-myth, and technoetics. These concepts became a certain litmus test at the practical stages of this research. What can be the role of technology in the proposed coexistence, and perhaps homeostasis with non-human living agents of Gaia? One of the possible ways to perceive technologies is through the utilitarian prism of its functionality and usefulness for the human. The reason for this may have emanated from liberal humanistic ideas that gained influence in Western thought with the advent of the industrial revolution. Many researchers, such as Katherine Hayles (1999) and Andreas Broeckmann (2016), emphasize that the development of these ideas in the XVIII-XIX centuries is rooted in the epoch of Enlightenment and the work of philosophers such as Rene Descartes. The idea of the Cartesian duality of the body and mind, its influence on the sphere of Alife, robotics, and cybernetics, as well as the relationship of this paradigm with the questions of materiality and corporeality, embodiment and cognition, autonomy and behavior, movement and agency, is of primary importance for this research. These concepts that stood out during the reflection on the action stage of the case study research in this paper are analyzed in the following sections using the theoretical texts of Simon Penny, Mitchell Whitelaw, Christian Kroos, Elizabeth Jochum and Ken Goldberg, Jean-Paul Laumond, Nicolas Reeves and David St-Onge.

However, observations during the practical part of this research also indicated that apart from the utilitarian approach to technology there are many other thought paradigms. Andreas Broeckmann traces their appearance in the first half of the twentieth century. He talks about Bruno Munari's (1938) treatment of machines as the "animate sentient companion species" (Broeckmann, 2016 p.

14-22). Broeckmann (2016) also points out that already in 1950 Gotthard Gunter and Arnold Gehlen talk about still tool-like technical appliances created by humans that nevertheless acquire the characteristic of a certain autonomy to become an independent form of existence between the human and the environment. In this vein, it is useful to look at another work of the late 1950s, written by Gilbert Simondon. Simondon (1958) discusses the alienation of technology through the modern concept of labor. He says that labor is present when a person cannot entrust the technical object with the mediation function between his species and nature. However, in this case, according to him, labor is establishing the synthetic relationship between matter and form — it sculpts matter in form. When in such conditions it comes to integration with technology, the center of the operation itself remains hidden, unknown for a person. However, technical knowledge is lying in the understanding of this very center, which therefore must be produced by the technical object itself. In this case, Simondon says that to construct a technical object, it is necessary to present its functioning as coinciding with its technical operation. Functioning should be perceived as operation and not as labor. Following Simondon's thought, in this case, the form and matter are the ones, and between there is a continuity of technical and natural. According to his convictions, only the labor paradigm compels us to consider the technical object as utilitarian. However, he insists, the condition of a technical object is an act of invention, which is not labor. It is a potential of scientific knowledge, and therefore, cognition of the world. These considerations of Simondon could clarify somewhat the role of technology in Gaia's conditional homeostasis:

> *"A technical object does not simply create mediation between man and nature. It is a steady amalgamation of human and natural, it contains both. It gives its human content a structure similar to the structure of natural objects and allows to insert this human reality into the world of natural causes and consequences. Man's attitude to nature is no longer put into practice in a vague way, but acquires a stable and lasting status, by virtue of which it becomes an ordered reality with its own laws "*
>
> *(Simondon, 1958, translated by M. Kurpatov)*

Simondon's vision opens doors for further inquiry on such topics as on one hand the debate between the hard and soft ALife concepts, and on the other — the idea of a hybrid ecology in the biological arts. Since both of these topics set off new dimensions in the practical part of this research, a more

detailed discussion of them seems necessary. In the subsequent sections brief description of the history and origins of ALife according to Mitchell Whitelaw, Simon Penny and Katherine Hayles are introduced. Writings of these researchers shed a light on a common misconception and tendency to focus solely on a silicon ALife while the artificial life community through history was also preoccupied with the notion of materiality and embodiment. That incorporated hardware and wetware technologies in the 1990s experiments in the ALife field. According to the aforementioned theoreticians, the manifestations of this interest could be traced in robotic and biotechnological artworks from the 1990s until our days. An interesting complementary dimension to the exploration of this topic could be found in Alan Dorin's writings. Dorin (2015) introduces how ALife models are correlating with historical examples of various creatures, hybrids, and chimeras. The impact of these ideas which coupled with an analysis of the artworks created by Nathan Thompson and Guy Ben-Ary drew this research into a closer study of some kind of teratology of biological arts resorting to biotechnology to create artworks.

Mostly owing to the writings of Eduardo Kac, Oron Catts, and Ionat Zurr this research became preoccupied with the predisposition of semi-living entities of tissue-culture, art chimeras, genetic hybrids and other beings of synthetic biology to become a media artists' semi-mythical agents for the cognition of intelligence, homeostatic states, and coexistence. The question here is whether these creatures that have been born in the symbiotic effort of human, non-human organic and technology, becoming something more than they were expected to be. Do they do things that were not expected of them? Bioartists often ask questions about life and what could be considered alive. They create various speculative narratives, try to imagine the sentient machine and the transformation of the world with its appearance. Sometimes artistic inquiry in this field focuses on biopolitics and ethical challenges of the future that is presented by scientists or technological, pharmacological and other industries. Some artists pay considerable attention to environmental challenges, others focus on the dichotomy of natural and artificial, etc. The list is not exhaustive. Nevertheless, precisely these features of the creatures of biological arts to be a mechanism of cognition in the spirit of the Simondon's, Latour's and Ascott's writings could indicate these line of artistic inquiry and is inviting to explore the formation of a hybrid ecology concept with artistic means. *Technoorganic* in the terminology of Laura Beloff (2016) properties of such synthetic entities seem to create a space in the artistic field for a conceptualization of hybrid ecology. Could we say that the notion of hybrid ecology is yet another way to speak about Gaia's homeostasis? The last section of this research touches the surface of the hybrid ecology concept discussion to trace the

correlation between the visionary views of thinkers and artists that are introduced in this study while recognizing the input of the biologically inspired media arts entities in the formation of the hybrid ecology paradigm.

Definition of the problem

The key question of this study is what are the prerequisites and reasons for the emergence of synthetic creatures as a separate phenomenon of media arts. It also analyzes the question of why artists, authors of artworks that are described in this paper, create such synthetic beings. In the process of research, it is suggested that such media arts creatures have mythological properties inside of contemporary culture. It is assumed that, as mythical figures, they can influence or reflect public understanding of such, according to the author of the study, mythological in nature concepts like artificial intelligence and sensitive technologies. Therefore, it is assumed that these creatures are an invitation to a dialogue regarding what relations with sentient partially organic technologies can be built in the framework of possible future scenarios being constructed.

> *The history of technology has always included a history of its utopias and myth that reveal human desires, and serve to express proto-rational points of reference. Myths do not lose their relevance by virtue of being ancient. They are about how we view the world, and as such may be outside of ordinary time. They drive history.* (Grau, 2001, p.227)

In the paper *History of telepresence: automata, illusion and rejecting the body*, Oliver Grau (2001) suggests that attempts to breathe life into techno-artistic creations are an artists' play of demiurges, who thus try to step over the limitations of their bodies and with the help of technology strive to achieve immortality. The problem of body limitation is also characteristic of art practices working with the concept of a cyborg. Its philosophical and historical foundation is examined in detail, for example by Morten Søndergaard, who analyzes the emergence of the *prosthetic aesthetic* (2017) in relation to the artistic practice of Stelarc. In particular, Sondergaard speaks about the new bodily revision in the frame of Stelarc's ideas about the *obsolete bodies*.

This study is trying to clarify whether the creation of thinking sensing machines is solely the ambition of their authors to extend themselves trough technology and rethink their physicality, or it

is a matter of particular cases. Perhaps artists do not consider their dominant advanced potentially technologically modified incarnation as a primary goal, but rather try to think of their position and role in ecology, where the distribution of forces between them, nature and technology is not obvious and therefore problematic. However, the researcher of artificial life Mitchell Whitelaw is also asking the same question. He asks if ALife artists' attempt to empower their creation with autonomy is evidence of "an abdication of the artist's creative will or an ultimate fulfillment" (Whitelaw, 2004, p.3). In his book *Metacreation : art and artificial life* (2004) Whitelaw analyses examples of the art practice of such artists as Yves Amu Klein, Kenneth Rinaldo, Simon Penny, Ulrike Gabriel, Bill Vorn and Louis-Philippe Demers to explore how their practice is incorporating our understanding of the principles that establish life from within and throughout the technology. This study continues this discussion by examining how it is affected by the inclusion of biotechnology as exemplified by synthetic artworks of Guy Ben-Ary and Nathan Thompson.

Methodology

This research foundation is nominalism. It means that opposed to realists, in the quest for the answers to how the world works the author of this paper relies on the premise that personal experience of "pure reality" is not achievable. Our experience of interaction with the "real world" is always filtered through our inner subjective interpretation. According to the nominalist approach, this inner subjectivity is deeply rooted in culture, and our beliefs, cultivated in a specific cultural context that determines how we comprehend the world. Therefore, unlike realists seeking objective truth, I adhere to nominalist positions in my research and try to work with specific cases, practices and a detailed description of the literature that have inspired my vision of the field that this research is dedicated to. Thus, this research strives to outline only one of the many approaches. It signifies this study as based on the constructivist worldview which requires a qualitative approach. My informational "habitat" and personal history have been shaping my tools for comprehending and interpreting phenomena. From an epistemological point of view, I study the mechanisms for understanding meanings, interpretations created by others and, consequently, myself. Therefore, the research that is carried here springs from self-reflection and positioning myself inside of it. In many ways, it happens in natural settings. Important for the study is the process itself. The initial logic, questions, methods are evolving within it through time with newly introduced interactions, knowledge acquirement, and process of rethinking.

Thus elements of auto-ethnographic, ethnographic and case study methods are used in this research. They serve to "self-consciously explore the interplay of the introspective personally engaged self with cultural descriptions mediated through language, history, and ethnographic explanation" (Ellis & Bochner, 2000, p.742). Among other components, this research includes a narrative element while focusing on socio-cultural scientific inquiry, which is an important aspect of auto-ethnography in the words of Heewon Chang (2008). It also meets Anderson's requirements for an auto-ethnographic approach. These requirements could be described as the "integration of the researcher into the social world under study and researchers pronounced presence in the text" (Anderson, 2006, p.375). But most importantly, autoethnography requires from the researcher self-reflection, which was decisive for this study at the initial stage of my work.

This study operates with the umbrella-term *synthetic creatures of media arts*, which initially served as an analytical tool to get acquainted with the fields of ALife and biological arts. Attempts to conceptualize it at the beginning led to a decision to do an internship in the Bioart Society, where I hoped to learn how professionals are looking at suggested topics. Auto-ethnographic and ethnographic approaches were an important part of this stage. I watched, listened, reflected on my thoughts arising in the context of the topic at different stages of the internship. I discussed that with the team and artists at Solu Space while outlining for them my interest in media art creatures, which I described at that time as media artworks which are embodying or seeking to represent or create the living entity in any form, regardless of the used medium. It was also suggested that there might exist a cause-effect relation between these works and the modern nature-human-technology plexus. I was questioning what are such works and if they could be considered as an artistic reflection on the reality and possibly the future. Over time, I realized that all my claims and questions, starting from the very attempt to conceptualize the phenomenon of media art creatures and trying to define its meaning, specify its categories, distinguish certain functions, are deeply rooted in my own beliefs, in my current level of academic proficiency and my personal everyday experiences. By this, it should be underlined that I was approaching the question with a high level of subjectivity. Such subjectivity is generally unavoidable but should be treated carefully with a distinctive amount of confrontation and problematization to prevent the rise of major premature personal assumptions in the scientific inquiry. It was tempting and easy to use personal assumptions as a foundation for academic research in a generally profound way. Therefore, I decided to take a step back and instead of fighting subjectivity turn it into the fuel for the research. A further decision was to decode personal assumptions and by doing so try to inspire the research that would be aiming to

comprehend the core concepts of the topic that became the focus of this study. Diversity of interrelated subjects that seemed significant for my initial inquiry could have made this project to run on endlessly, considering the number of approaches, cross-subjective topics, and methodological complexity when it comes to the question of life both generally and specifically in media arts. Consequently, an understanding of the need for the special approach raised. Such an approach should allow crumpling the surface of the informational cloth to change and reduce the distance between folds on it: bringing different schools of thought, terminology, literature, and practices closer to each other and close enough to be analyzed in the same paper. It seemed that the force that could crumple this canvas could be the clash and juxtaposition of experts' opinions formulated during the free maneuvering between questions that were bred on my assumptions and scattered around the core concepts for this study. Several procedures were coming in mind as a solution for the need to create conditions for the described scenarios.

The autoethnographic design of this stage inspired further steps. I tried to comprehend and track down the origin of the categories with which I have been operating in the initial formulation of the research problem. Afterward, these categories were suggested during informal conversations in the group that had a certain level of recognized understanding of the field and simultaneously became my colleagues due to the fact of integration into the daily professional activities of this group in the Solo Space. The aforementioned group included some representatives of the Bioart Society leading the Solu Space. Among other participants were artists, researchers, curators, etc. who have been collaborating with the Solu Space during the predetermined period. The time frame, as well as the place, were chosen not accidentally. Firstly, this institution directly influenced the discourse in which I have been rotating and formulating the terminology to operate with, as long as the Bioart Society has had a long history and a wide network of representatives working on an exploration of the phenomenon of the living in the media arts. The second reason derived from the intention to do an internship at the Solu Space in March—April 2019. Both reasons are closely related because the design of this study was requiring a lot of data collection in participant's settings.

In other words, having in mind this methodology, I have resorted to such functional tools for collecting, analyzing and interpreting the data as: open-ended questions; observation; documentation; analysis of respondents' feedback and personal reflections on it noted in an assigned diary; analysis of audio-visual data that was collected; and consequently interpretation of themes and patterns that I have managed to eliminate as the result of the aforementioned procedures

conduction. These procedures were carried out to specify the boundaries of this research and identify topical issues for further study by partitioning and analyzing personal assumptions. Later within this framework, a detailed study of particular cases will be developed in the next chapters of this thesis. These cases are the artworks cellF and Bricolage that I had a chance to interact with during the internship. These artworks were explored through analysis of audio-visual data, texts and other archival materials. Interviews with artists Guy Ben-Ary and Nathan Thompson are yet other tools for the investigation of the issue. In the design of the open-ended questions for the interviews, a lot of attention is dedicated to the word choice as an entering point for the discussion of different aspects of artworks. It was a conscious decision to design questions around terminology, since according to my assumption that could provide artists with the freedom to kick off from those terms and guide the conversation into the direction of their actual interest. Consequently, that allowed to pick out ideas that preoccupied Guy, Nathan, and Erich in relation to their work and topics that are explored in this study.

Investigating the topic while having the findings of the internship and case studies in mind, I simultaneously and post-factum turned to theoretical writings. This literature provided descriptions of the historical canvas of the topic's development and contemporary discussion in the field, which occasionally touches on the speculations about the future. A combination of the findings from theoretical works and personal insights acquired with an empirical approach in practice, allowed this study to outline certain directions that could be useful for further research on such category of artwork as synthetic creatures of media arts.

Chapter 1. Introduction to the Notion of Media Arts Creatures

1.1 Mythical creatures: from folklore to automata

Human history is full of examples of mythical beasts, chimeras, monsters and all kinds of magical creatures that are different from any living organisms created by nature. For centuries, our imagination brings to life griffins, centaurs, sirens, unicorns, mermaids, medusa, minotaurs, sphinx and werewolves. In her curatorial statement to the exhibition *My Monster: The human-animal hybrid*, which took place in 2018 in the RMIT Gallery (Australia) Evelyn Tsitas (2018) speaks about *Löwenmensch figurine* — one of the first known examples of figurative art. Lion-man is a human-animal being that was created approximately 40,000 years ago and was found in a German cave in 1939. Moreover, in the work, *Artificial Life Art, Creativity, and Techno-hybridization* Alan Dorin (2015) mentions the image from some 30,000 years ago on the walls of what we know as Chauvet caves in France. The name for it is the *Venus and the Sorcerer*. The Sorcerer in this drawing appears to be a mythical creature with the features of a man and a bison that reminds of a much later image of the Minotaur described by Homer in the *Iliad* (Dorin, 2015). Examples of all kinds of creatures and chimeras are scattered geographically and in time. For example, as Dorin(2015) mentions dragon of ancient China, according to the descriptions of Wang Fu had body parts of a camel, a stag, a cow, a snake, a clam, a carp, an eagle, and a tiger, while Chilean Cuchivilo was a hybrid of a pig and a snake. It became common to refer to such beasts as chimeras whose derivative name was inspired by an actual mythological Chimera as a fictional animal with the goat's head, lion's body and a snake instead of a tail. To put it simple *chimera* is the bits and pieces of various animals combined in fictional species. Another group of imaginary beasts is human-animal hybrids such as the Brazilian Cuca witch (woman-crocodile) and Cupendipes demon (man-bat). The third group of alive against all odds as Pinnocio or vampires seems to have mostly anthropomorphic features with distinctive modifications and special properties. Therefore, a separate category of creatures that appeared to be composed of organic matter and non-organic materials of man-made origin could be single out. For instance, in the mythology of Greenlandic Inuits, the supernatural creature Tupilak is known as a shamans' tool for self-protection and personal revenge. Tupilak was usually composed of parts of the body of dead animals, babies corpses and occasionally household items. Going a bit ahead of the conversation it is interesting to note the affinity of these creatures with biotechnological chimeras and biorobots.

It's hard to argue that, throughout history, such magical creatures gain their symbolism due to their infiltration into pop culture and through the appropriation by various stakeholders. The destiny of ancient Greek Medusa Gorgon is one among plenty of different examples. A female creature with snakes instead of hair in the 20th Century "was adopted by many women as a symbol of female rage" (Tsitas, 2018, p. 16). Not to forget however that such creatures were already originally a product of the human imagination seeking to explain the nature of incomprehensible phenomena. They served as one of the tools to grasp the world. In the religion of the ancient Egyptians, for example, it was customary to worship the man-falcon god of the sun Horus and the ruler of the underworld Anubis with the body of a man and the head of a jackal who personified death. Moreover, these creatures not only served as an explanation but also as a catalyst for fears and anxieties regarding the incomprehensible or unknown past, present, and future. From medieval European bestiaries, we know about Aspid who supposedly was devastating the land, destroying the crops and was commonly imagined as a winged snake with a beak and two tails. Later Gothic stories like Hoffman's *The Sandman* (1816) or Mary Shelley's *Frankenstein* (1818) analyzed in Elizabeth Jochum's and Ken Goldberg's paper *Cultivating the Uncanny: The Telegarden and Other Oddities* "indicated a popular fascination with the *uncanny* that predates Freud's essay" (2016, p. 155). A reservation should be made that these hybrids could be considered as "notable instances of automata and robots in fiction" (Jochum & Goldberg, 2016, p.155). These creatures are often associated directly with attempts to rethink the concept of the living and the mechanical nature of human functioning by the thinkers of Enlightenment.

It is worth noting that two centuries before the appearance of the proto-robots in Gothic novels, Europe became acquainted with the *Wunderkammer* phenomenon. The attempts to collect natural wonderments in such cabinets of curiosities signified the desire to categorize knowledge about the natural world and reframe the understanding of aliveness. Creatures gained a physical space to be exhibited. From folklore and mythology, the idea of oddities of life moved into private and commercial collections of ethnographic and scientific finds and amusements. In Wunderkammer, collectors placed both natural oddities and technical innovations like telescopes and automata. Exhibits were often on display exclusively to refined audience e.g. depictions of ningyo — mermen and mermaids of Japanese mythology created by Far East masters that traveled directly to private scientific collections in Europe (Dorin, 2015). Though some private collections were eventually made public. In 1727 the first museum in Russia Empire Kunstkamera was opened in St. Petersburg. On a par with more conventional examples of art the natural rarities from Peter the

Great's collection formerly stored in the Winter Palace were presented in a public space of the new museum. The collection was inspired by tsar's visits to the Danish anatomist Frederick Ruysch and merchant Levinus Vincent in the late XVII century. The flasks with embalmed two-headed Siamese twins or human malformed embryos resting in formalin are just a couple of examples for the genetic errors of nature that the emperor collected to increase the plebs' knowledge about the world. Entertainment for the people of that time often circled around the topic of shocking, amusing or scary about themselves and the surrounding. Bearded women, dwarfs and other people whose appearance was considered abnormal were forced to parade in various freak shows while allegedly breathing blinking automata, such as Pierre Jaquet-Droz's *Musical Lady* (1770s) were put on a display to earn on human interest to bizarre "alive" machines.

Christian Kroos, in his article *The Art in the Machine* (2016), claims that automaton was interesting for natural philosophers of that time in connection to what pseudo-living machines could say about the mechanical nature of processes in the human body. At the same time, the uncanny feeling generated by these mechanical toys, according to Jochum and Goldberg (2016), arose as a result of ambiguity about the authenticity of experience or the aliveness of an artifact. Jochum and Goldberg (2016) are stating that the progression of thinking about living bodies in mechanical terms receives its impetus in philosophical ideas of the 17-18th centuries. Especially in René Descartes (*The Description of the Human Body*, 1647) and Julien Offray de La Mettrie (*Man a Machine*, 1748) works. Consequently, as Jochum and Goldberg (2016) suggests, due to tangible examples of the idea that biological functions could be reproduced mechanically with the help of the first automata and thanked to public scientific lectures of the late 18th century, mechanical beings acquire their relevance for the works of fiction writers in the 19th century. Therefore, the Enlightenment interest in oddities and monsters from the natural world that eluded classification became the subject of scientific inquiry into the "invisible and dynamic processes of life […] and the automaton became a symbol for the pursuit to replicate these processes through engineering" (Jochum & Goldberg , 2016, pp. 153-154). Nicolas Reeves and David St-Onge in the paper *Still and Useless: The Ultimate Automaton* (2016) develop the idea that the myth of the machine that is not solely mimicking life, but infused with it, animated, is located at the base of all robots and automata genealogy. They also claim that this myth is "transforming its creator into a demiurge" (Reeves and St-Onge, 2016, p. 232). Demiurge as the god-like artist-designer of the world.

Thus, shall we proceed with a metaphorical chess battle that is claimed to be happening between the

spirituality of the previous centuries and the scientific skepticism of the post-Enlightenment? Uncanny man-made mechanical "monsters" challenge 19th-century humans' beliefs, becoming yet another pawn on a chessboard. The monster category here is used with the caveat that the natural can be ugly, but the monstrosity is the property that derives from the category of unnatural according to Harriet Ritvo (as cited in Caccavale & Reiss, 2011). According to the approach of Elio Caccavale and Michael Reiss in *Miracles, Monsters and Disturbances* (2011) presently there exists a tendency to explain anxiety and fear through the emerging sensation of threat from the unnatural generated in particular by a new round of technological progress: biotechnologies. This, in turn, invites us to proceed further through the imaginary museum of "magical" creatures from the hall of mythical monsters and natural oddities, through a hall with mechanical beasts, automata, and robots, to a room with synthetic art chimeras and biorobots that appeared relatively recently due to the development of biotechnologies. With technological advancements, we seem to approach closer with every step to the notion of what could be potentially one of the great myths of the present time: a myth about the sentient machine.

1.2 The ghost in the machine

Reeves and St-Onge (2016) trace the lineage of the historical human desire to animate inert matter from Adam to Frankenstein. They talk about automaton as an idea of animated machines. They point out a mystical dimension of this idea where inanimate objects allegedly acquire soul (anima) through the movement and behavior. To emphasize the spiritual aspect of this idea while criticizing the Cartesian duality, Kroos uses the expression "the ghost in the machine" (Kroos, 2016, p.20) proposed by the British philosopher Gilbert Ryle (1949). It is crucial to highlight that outside of the philosophical discourse, automata and robots are certainly different. Jean-Paul Laumond in his paper *Robotics: Hephaestus Does It Again* (2016) explains that automaton movements are limited and predetermined, and computers are capable of managing information, but not moving. In contrast, robots are designed to interact with the world through movement, defined and controlled by a computer through the so-called "perception-decision-action loop" (Laumond, 2016, p.71).

It is clear that in this case there is no conversation about the movement and the behavior of an incorporeal consciousness. Kroos (2016) is emphasizing the importance of the embodiment in the construction of behavior that is not defined solely by the mind. He says that in the case of robots different embodiments suggest different behaviors proposing logical development through Demers

quotation from The Multiple Bodies of a Machine Performer (2016): "Embodiment in robotic art is overwhelmingly understood as going beyond the self-evident aspect of giving the robot a physical form, it is seen as the embodiment of the control system too, rejecting the Cartesian dualism in the same way as in biological agents and using the physical world for and instead of computations" (Demers as cited in Kroos, 2016, pp.24-25). Thus, a robot's ability to move and act without human interposition also determined by its physical properties outlines the degree of its autonomy. How in this case should we evaluate the autonomy of a robot that has biological structures and living matter as its component? What is the autonomy of the biorobot? What determines the movement and consciousness of a biorobot? How does it correlate with the visionary position of Roy Ascott, who speaks about the "marriage of cyberspace with Moistmedia, combining self-assembling structures and self-aware systems" (Ascott, 2000, p.4)? Several texts will be analyzed further to open up the discussion of these questions in subsequent sections.

Already in the 1990s, Katherine Hayles (1996) distinguished three domains: software, hardware, and wetware in which researchers of artificial life worked at that time. The software domain was seen as purely digital and involving the simulation of life-like behavior in computer code with the possibility of its further visual or sound representation. For example, we can recall how Christa Sommerer and Laurent Mignonneau depicted their evolutionary algorithms as graphic projections of outlandish creatures in an aquarium in their work *A-Volve* (1994-97), while Jon McCormac left his creatures incorporeal, but able to make sounds in the work of *Eden* (2004). Hardware domain of ALife was preoccupied with the creation of mindful mechanical bodies in robotics such as Rodney Brooks's *Allen* and *Herbert* robots (late 1980s) or Yves Amu Klein's *Octofungi* (1996). The wetware domain focused on the usage of laboratory settings and organic materials for artificial life composing. For instance as in the case of the beast of the tissue culture technology from the early 2000s — *Vacanti mouse* with an artificial human ear on its back. The division into software, hardware and wetware domains had practical convenience as it allowed to designate the medium, tools, and materials that were dominant or had greater importance for the artworks and scientific practices. However, this separation nowadays could be perceived as inconsistent regarding current technological development and practices. It is annihilating the interconnections of various methods in contemporary technologies in the spirit of Cartesian thinking. The modern world and technology are much more complex and require different categorical apparatus. In this context, Roy Ascott says: "a new media shift is occurring, in which the dry, digital, world of the computer is converging with the wet biological world of living systems producing what can be called moist media" (Ascott,

2008, p. 1). Ascott suggests that in our time, various technologies are merging, and the virtual, mechanical and biological worlds in their interrelation create moist media as an agency of change. The spiritual aspect and the communicative role of moist media seem to be important topics in the Ascott's works, because through them according to Ascott (2000) the art constructs a *technoetic fluid reality* and *multiconsciousness*, expanding knowledge of the world and perception of life within interconnectivity that is forming interactive and *psychoactive moist mind*. Notably, Ascott himself coins the term Bio-myths: "We are still bound up with the search for myths. The context now is biological and behavioral — zooming through the micro/macro levels. Get ready for the great bio-myths, ALife legends" (Ascott, 1997). Isn't he though simultaneously constructing this myth himself? Isn't he describing the myth about the figuratively speaking thinking Gaia: moist mind, a universal creature as a homeostatic unity of agencies comparable to a biological body? In the case of the proposed zooming, as the body consists of cells, so moist mind is composed of multiple interconnected living systems, ALife legends. Closer attention to them will be dedicated in the subsequent sections.

1.3 Role of the Cartesian split in ALife research, cybernetics and robotics

Before further analysis of the biotechnological creatures, it is important to clarify the concept of artificial life and how the principle of the Cartesian duality of the mind and body affected it. In his research on ALife Alan Dorin (2015) draws a parallel with the chimeras of the past. According to him, the similarity lies in the initial desire to create believable new life forms. He assumes that creatures from folklore are the "life-as-it-could-be, assemblages of ready-made parts sourced from life-as-we-know-it" (Dorin, 2015, p.) undoubtedly referring to Chris Langton who also coined the term *ALife* in 1986. Laura Beloff (2018) adds that the increasing artistic interest in ALife in the 1980s that is gaining momentum in the 1990s initially showed a greater preoccupation with the life-as-it-could-be and paid less attention to the life-as-we-know-it. Langton (1986) proposes the separation of *life-as-we-know-it* and l*ife-as-it-could-be* as two vectors of artificial life researches seeking through mimicry and simulation to create a synthetic model of life, a system that behaves like a living organism as e.g. evolutionary algorithm. In the particular case, the desired incarnation is a software: a kind of an *autopoietic* in Maturana and Varela's (1972) terminology, creature — computer code. Meanwhile, ALife community divided in the 1990s. Simon Penny in his book *Making sense: cognition, computing, art and embodiment* (2017) is tracing how ALife was germinating from the research of self-organizing systems in cybernetics and cognitive behavior of

nonhuman animals in biological studies to model lifelike systems via emerging computational techniques. He points out that it was a field that included such areas as evolutionary simulations, reactive robotics, connectionism, and neural networks. Penny (2019) acknowledges the repetition in the division of the ALife community similar to previous AI community fractions. Similarly to the way that AI researchers were proponents of *weak* or *strong* AI, ALifers stood for either *soft* or *hard* understanding of silicon-based (digital, software-based) artificial life. Soft ALifers preferred to speak of evolutionary simulations as pure representation and considered ALife as models and emulations for the research. Hard ALifers demanded to recognize that this form of digital life was truly alive. In addition, Penny mentions a third group of "wet ALifers" (Penny,2019, p.141) who pioneered contemporary synthetic biology by including actual living organisms in their experiments. Therefore, this division fostered the discussions around the concepts of autonomy, behaviors, movement, embodiment, intelligence and materiality of the ALife artworks in the broad definition of the term.

The broad definition of the ALife art suggests that along with the silicon ALife we should recognize a biological ALife. For example Edwina Bartlem in her paper *Immersive Artificial Life (A-Life) Art* (2005) claims that "term artificial life (or ALife) can refer to a range of creatures or organisms that are created and augmented through diverse medical, prosthetic and digital information technologies" (Bartlem, 2005), where she divides those into animated creatures with life-like behavior (virtual creatures and robots); living organisms and explored by Ionat Zurr and Orron Catts (2003) *semi-living entities*. Notably, the aforementioned categorization goes against the approach of some researchers in the field of bioart. It could be traced with the help of the chart originally composed by Pier-Luigi Capucci, inspired by the George Gessert's definition of bioart and later modified based on the discussion between the editors of *Field_Notes: from landscape to laboratory* Beloff, Berger, Haapoja (2013) and Capucci. As we can see in the chart ALife is suggested to be placed in the non-carbon realm of media arts. That would exclude from the ALife domain any work that is dealing with the living mater. Such an approach highlights the original understanding of ALife art as rooted in algorithms and non-carbon robotics. According to the aforementioned table, living organisms and 'semi-living objects' unambiguously refer to the carbon-based realm. Thereby entering in opposition to the definitions suggested by the ALife community itself that recognizes biotechnology as one of the tools of contemporary ALife art. It should be clarified that this understanding of ALife as a practice of a non-carbon realm of research was predetermined by limitations of the biotechnological field of that time. Since those technologies

and their accessibility have changed, therefore the chart may require reconsideration due to the current changes in the field.
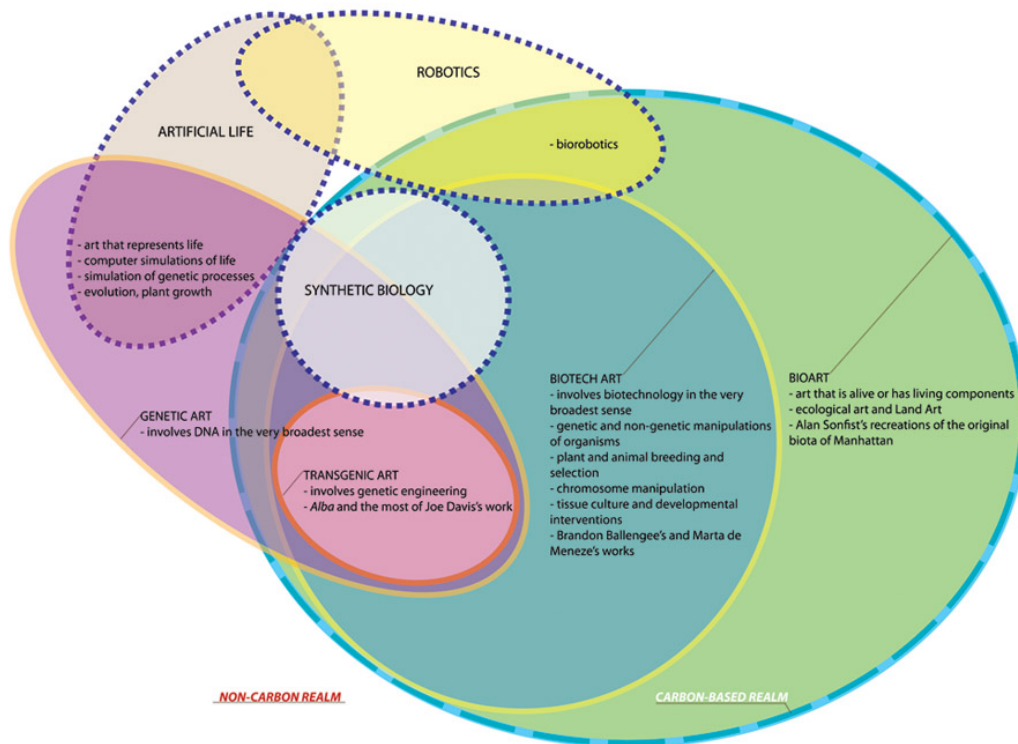

Figure 1: the image is based on the original chart by Pier-Luigi Capucci (2008), updated in 2013. In *Field_Notes: from landscape to laboratory, 2013, (Eds.)* L.Beloff, E. Berger, T. Haapoja. Reprinted with permission.

Nevertheless, the tendency for the categorization in binary oppositions such as carbon and non-carbon realms, or the less supported nowadays division on software, hardware, and wetware are intertwined with the question of the liveliness of ALife artworks. Possibly it can be rooted in the systematic perception of life forms through the prism of the Cartesian binaries where behavioral digital representations of the "higher order" of artificial intelligence opposed to material manifestation, physical body, interface, and material. Langton himself creates a bridgehead for it saying that "life is a kind of behavior, not a kind of stuff" (1996, p.55). In this connection, Bartlem asks: "Can life in all its complexity simply be reduced down to a string of numbers? What role does the embodiment play in conceptualizing and experiencing life?" (2005).

Back in the late 90s, Simon Penny (1997) and N Kathryn Hayles (1999) describe how Descartes'

ideas influenced computer science. The oppositions of the mind, information, thinking and consciousness to the body and the material shell resonated with the separation of software and hardware. The mind, memory, knowledge, system, behavior, and program were recognized as the dominant ones — the dematerialized world of data for which the hard drive, the "body of the machine" served as a repository and tool (Bartlem, 2005). The Cartesian way of perceiving the living as a combination of two separate opposites (mind and body) was to a certain extent questioned by cybernetics, ALife research and robotics. Simon Penny shows that the development of artificial life was a kind of a chicken and egg situation for the return of material instantiation of information that drew upon biology for inspiration:

> *It valorized, explored and replicated the mysterious phenomenon of 'emergence' […] The rise of ALife in the 1990s was then both a reaction to the perceived failures of physical symbol system conception of AI and a renewed interest in biological models, which harkened back to cybernetic ideas (Penny, 2017, p.143).*

Penny (2017) suggests it in line with the explanation of the preceding cognitive turn connected to the so-called common sense problem in AI research and following developments of bottom-up theories in robotics. Both these prerequisites help him to elaborate on his critique of Cartesianism and to speak of situated cognition as an alternative understanding of intelligence providing examples of related theories in various fields of study.

ALife origins according to Simon Penny are located in cybernetics, as "a science of systems and the role of feedback loops as a mode of organization" (Penny, 2017, p.41). This discipline is based on the belief that homeostasis of systems is achievable through a complex of feedback mechanisms inside of the system and with its environment. This approach is known as one of the verges of complexity theory. It was described by Ross Ashby in his work Self-organizing systems already in 1947. Thus, intelligence in cybernetics was explored through the idea of situated machines and sensorimotor engagement with the world (Penny, 2017). Hence, a new surge of interest was related to autonomous machines that could sense their environment and make decisions to change their behavior. As a result, although cybernetic ideas were going through hard times in the late 1970s, they happened to find their continuation a decade later. These echoes of cybernetic ideas were taking shape in ALifers' interest in emergent complex behaviors and self-organizing systems as well

as in *subsumption architecture* for robots, suggested by Rodney Brooks (1986). Not the last role in this was played by the collapse of the computationalist paradigm that was feeding the AI research in the 1980s.

The difficulties that computationalism (cognitivist model) was experiencing according to Penny (2017) was caused by failures in several domains at the same time. Since for cognitivism senses are secondary to thought, artificial intelligence research relied on the Cartesian spirit of separation and superiority of res cogitans over res extensa: a kind of non-material thinking unit over a physical body. Fueled by the traditional logical philosophy and mathematical logic, these studies focused on separated from the world and occurring in the black box abstract manipulation of symbolic tokens (Penny, 2017). However, with such an approach, as Penny explains the common sense problem: "computers were simply not good at achieving things in the world" (Penny, 2019, introduction). Not to mention the complete unattainability of more complex characteristics of intelligence, such as improvisation or creativity in solving problems. This problem was described in detail in *What computers can't do* (1972) by Hubert Dreyfus.

These struggles in combination with the development of the philosophy of mind, neurosciences and cognitive sciences, that focused on embodiment, spatiotemporal processes, and context impact on sentient systems were constantly questioning the nature of cognition and Cartesianism. Consequently, it provoked what Penny (2017) describes as a *cognitive turn*. This turn was marked by the fact that in the next few decades a new understanding of intelligence and cognition began to form. Such scattered in time of their emergence, but actively used in the last 20 years concepts as *umwelt* (Uexkull, 1934), *autopoiesis* (Maturana and Varela, 1972) or *affordance* (Gibson, 1979) were blooming with new flowers that were watered with the researches on the microbiome and other discoveries of biological sciences:

> *"According to this formulations cognition is held not to occur (exclusively) in the head or necessarily in some immaterial space of logical manipulations of symbolic tokens. These approach propose in different ways, that cognition is embodied, integrated with non-neural bodily tissues, or extended into artifacts, the designed environment, social systems, and cultural networks" (Penny, 2017, XXVIII).*

In robotics, such turn came out in "embracing, more holistic and situated models" (Penny, 2017, p.

18). Penny (2017) and Whitelaw (2004) suggests to trace the impact of the late 1980th reactive and biomimetic turn in robotics through Rodney Brooks work. They both mention how Uexkul's idea of umwelt and rejection of unitary, integrated or representational approaches to cognition inspired biologically based, embodied and situational architecture of Brooks's robots. Significantly subsumption architecture of these robots was grounded in the bottom-up approach which was similar to ALife premises of rhizomatic horizontal structures and opposed the "top-down hierarchical models of AI" (Penny, 2017, pp. 150). To put it in a nutshell, ALifers and reactive roboticists were experimenting around the interaction of simple independent systems. Meaning that the focus shifted to autonomous embodied agents. That as we will see from the cases of Bricolage and cellF remained topical and gained new incarnations with the development of synthetic biology and the introduction of the organic matter into robotic systems.

Summing up in cybernetics and artificial life intelligence and cognition were researched in a completely different from functionalists' abstract strictly logical hierarchical direction of dualistic thinking. Alternatively, they acknowledged peripheral or secondary for AI cognitive capacities of so to say 'body' e.g. sensorimotor properties of embodied entities and physical interfaces. Interaction, sensing and distributed thinking for many disciplines became the undeniable trade of real intelligence of any living creature: either born naturally or synthesized artificially. Binaries of mind and body, res extensa and res cogitans were heavily problematized to the point of demolishing for the sake of the development of better technologies and further researches on the nature of thinking. Therefore, it is interesting to recognize that this discussion continues in arts with the liminal life figures of such media arts creatures as cellF and Bricolage.

1.4 Moistmedia legends: from first biotechnological hybrids to biorobots

In the introduction to *Signs of Life: Bio Art and beyond* (2007) Eduardo Kac mentions a statement by Jorge Luis Borges regarding his work The Book of Imaginary Beings. The Argentinean writer argues that no matter what monsters we invent for our narratives, they will remain stillborn. "Thank's God" — he adds (Kac, 2007, p.7). However, with the advent of transgenesis, this statement seems to be losing its relevance. Modern biotechnologies make adjustments creating previously unfamiliar but completely real life forms. Grafting techniques have been familiar to humanity since the 17th century. However, hybrids created in those days, such as *Bizzaria* — part orange and part citron probably would not seem too frightening in their liveliness even for people of

those days. Especially in comparison to Nexia Biotechnologies' goat that produces a BioSteel instead of the regular milk due to the introduction of the spiders genome (Caccavale & Reiss, 2011) or Eduardo Kac's *GFP Rabbit Alba* that emits green light due to injection of the DNA of a Pacific Northwest jellyfish into the fertilized egg of an albino rabbit.

Fluorescing bunny Alba often becomes a topic of debates due to controversial statements regarding the way it was produced. Nevertheless, precisely because of this wide coverage in media sources this example illustrates how the very thought about the genetic hybrids with different types of genetic material from different species in one creature (chimeras - creatures with a set of embryonic cells from different species and other creatures (Caccavale & Reiss, 2011) heats the discussions and acquire mythological properties in the public. Dmitry Bulatov (2008), for example, speaks about the techniques of neogenesis, degenesis, and transgenesis in connection with the engineering of "art chimeras — a field of artistic creativity, which purposefully rearranges new genetic combinations that do not exist in nature, in order to produce organisms with specified heritable aesthetic characteristics (Bulatov, 2008). Also, this field is known as transgenic art. Eduardo Kac himself mentions the first genetic chimera Geep (1980s) — the crossbreeding of a goat and a sheep as "the first sensational example of the biotechnology offspring" (Kac, 2007, p.6). It is worth emphasizing though that similarly to the symbolic weight of objects from the cabinets of curiosity, the value of man-made creations of biology and botany were recognized much earlier than the advent of cell culture or xenotransplantation. An example is the 1936 exhibition at the Museum of Modern Art in New York dedicated to the hybridized and mutated as a result of mechanical and chemical manipulations flowers delphiniums (MoMA archive). Which, according to Kac himself, Edward Steichen created "to state that genetics is an art medium" (Kac, 2007, p.11).

These days bio-artists apply a much more extensive list of primary scientific practices associated with biotechnology. For example, in addition to the ones mentioned above, we are also talking about the synthesis of artificially produced DNA sequences, tissue engineering, neurophysiology, and medical self-experimentation, just to mention a few (Hauser, 2008). For instance, the Australian art duo of Ionat Zurr and Oron Catts also known as Tissue Culture and Art (TC&A) Project uses tissue engineering techniques. They grow semi-living entities from cell-cultures over a degradable biopolymer support-structure as art objects and artistic expressions that problematize biotechnologies themselves as a phenomenon. The works of their colleagues from SymbioticA: Nathan Thompson and Guy Ben-Ary are the cases for the detailed analysis in this paper. Thompson

and Ben-Ary are also using tissue culture technologies. However, their distinguishing feature is their work with iPSc (Induced Pluripotent Stem cell) technology. This technology allows changing the cells of certain tissues into stem-like cells. The creator of this technology Shinya Yamanaka received a Nobel prize for it in 2012, only six years after the big discovery. The great future has been prophesied for the technology itself in a technologically deterministic manner. And despite many difficulties that slowed down the way of this technology into the various industries, artists feel the necessity to provoke a critical discussion around the phenomenon.

Chapter 2. CellF

2.1 Introduction to the case studies

I have been in the process of cognizing the diverse universe of media art creatures when I started to help with the preparation of the exhibition In Vitro Agencies in the Solu Space in March 2019. The exhibition was focusing on the artistic practice of two Perth-based artists: Guy Ben-Ary and Nathan Thompson, who are currently working in SymbioticA. Back then already it was clear that SymbioticA was an important phenomenon for this research since it is a fairly unique artistic research lab at the University of Western Australia. It is pioneering in the creation of what the lab's founders and artistic duo under the name of Tissue Culture & Art Project: Ionat Zurr and Oron Catts define as semi-living (2003) artworks. I wondered what kind of beast is the semi-living entity. In a nutshell, a semi-living artwork is a type of work in which the tissue of living cells is elements of an art object. However, this explanation was just the tip of the iceberg. Soon I was about to find myself preoccupied with this term on a much deeper level. During the preparation of the In Vitro Agencies exhibition, I found out that artists often buy primary organic materials such as cells and tissues for such works from special cell-banks, which commonly are the suppliers of the biological laboratories as well. The material for Bricolage was obtained in this way. Moreover, among the many facets of this project, one of the important issues that Bricolage was expected to spotlight was precisely the questionable transparency and ethics of the receipt and distribution of these cells by commercial pharmacological enterprises. On the other hand, sometimes artists are getting cells for their work directly from donors or becoming donors for their artistic creations themselves. This was the case for the cellF project. In the later stages of cells transformation into the artists' working material, they undergo various modifications to grow as tissues outside of any living organism's natural body. Thus, providing the right conditions for maintenance, such as proper temperature and light, absence of undesirable organics, presence of nutrients, etc., the vitality of the cells of such tissues could be supported by artists artificially. This is done to use living tissues for artworks. However, is it correct in this case to use the preposition "for"? The question is not accidental. It served as a kind of preamble to my internship. Who is an active agent and what is a passive tool in such artworks did not seem obvious. In this kind of art piece, we are talking about organic matter, living tissue with a certain autonomy, but to some extent controlled and modified with and by technology, at least with complicity, and in many ways only by the will of a human. This raises a number of questions. How to perceive a living substance in such artworks and scientific researches: as an object or as a

subject? What agencies would it be appropriate to recognize where the organic matter is merging with hardware and software, each of which is an integral component responsible in a certain way for the existence and functioning of the entire bio-mechanical holistic entity? Such questions of agency, vitality, embodiment, and consciousness are relevant in studies of artificial life and biological arts as in discussions about biorobots for example. However, there are no consensual answers to such questions. Moreover, should the consensual answers be desirable and possible at all? This doubt is at the core of any research based on relativistic premises. Therefore, I decided to focus on the place of my internship: on the views of artists practitioners and curators, as well as on artworks with which I have had the opportunity to interact more closely. Through this proximity to one of the many sources of knowledge, I hoped to discover some options of answers through discussions with the creators of synthetic creatures of media arts.

The exhibition In Vitro Agencies was introducing two artworks called cellF and Bricolage. cellF at the time of my internship was a finished artwork. It should be noted that the protocol for its functioning assumed a periodic repetition and recreation of some stages of its activation. Such as, for example, the cultivation of new organic matter (neural network) or modifications of the sound of synthesizers for each new performance of artwork itself. Nevertheless, the main narratives articulated by the artist, the appearance of the work and the logic of the performance were already quite refined and fixed during several years of exhibiting the work. Bricolage, on the contrary, was at the research and development stage, and therefore all elements of the work, except for a few key ideas concerning the main message and some techniques, were on the stage of testing, rethinking and changing. This allowed me to observe the relationship of artists with their creations simultaneously at two different stages. On one hand, it was possible to track the attitude to the specifics of such art both at the stage of its formation and after the fact, in the process of its interpretation and communication for the audience during performances and exhibitions.

The In Vitro Agencies exhibition space was zoned into two separate rooms. In the first room, there were artifacts documenting the stages of creation and explaining the idea and principles behind cellF functioning. Material objects, such as petri dish and cellF mockup, were side by side with photographs showing the chronology of the project creation, its electronic components and microscopic images of the neural network. The room had two screens. One of them allowed using headphones to listen and watch a brief talk by Guy Ben-Ary about cellF on the levels of concept and technical functioning. Records of previous cellF performances were projected onto the second

screen. The hall was a kind of archive and museum of former cellF's achievements. It was also serving as an introduction for two upcoming performances that were about to take place in Heureka (Finland) in the following weeks.

Figure 2 : Archival materials of the cellF project at In Vitro Agencies exhibition
(Solu Space, Helsinki, Finland, spring 2019). Photo from personal archive

The second room was darkened according to the technical requirements for the life support of the prototype of the artwork Bricolage. The appearance of the prototype was situational and, as I learned later, was modified for the presentation of the final version of the work in the winter of 2019-2020. During the In Vitro Agencies exhibition, an audience was suggested to observe the ellipsoidal structure made of metal and plastic, which supported dishes with "biobots". On the opening day of the exhibition, the Space also housed the microscope necessary for an impromptu performance — a demonstration of the biobots' qualities that at that stage of the development of the work were not yet visible to the naked eye, although in the future they should have become such. The decision to organize this demonstration was made a day before the opening of the exhibition in connection with the "naughty" behavior of biobots that did not develop to the predicted level on time. Their movement was still weak and not obvious, contrary to the forecasts of the artists.

Observing the aforementioned ways of exhibiting these artworks, I noted one of the key issues that accompany other challenges of creation, curation and exhibiting of biological artworks, especially so complex as ones that work with tissue culture. It seemed that the unpredictable behavior of such

works put artists in front of a choice. They could choose to risk the biomaterial and the reputation of the work itself for the sake of the real physical presence of the unstable organic artwork in the exhibition space. On the other hand, as in the case of cellF demonstration of works in the exhibition space can be reduced to the presentation of documentation about the time-based art, art object in conditions of its physical absence. However, playing safely, artists are sacrificing often an important element of the artwork — namely, the direct interaction of the audience with the art object. This problem was not unique to the cases I was analyzing. On the contrary, it is widespread and is one of the urgent challenges of modern curatorial and artistic practices in biological arts.

Notably, I began to give preference to the term biological arts instead of bioart also in connection with the observations during the internship. Since biological arts term seems to be "more inclusive" (Berger, 2019, attachment 3). Another term that I began to widely use when discussing media creatures with Nathan, Guy, and Eric is entities. It is important to note that from the very beginning of our discussions, the word "creature" caused some discomfort to all three interlocutors of mine. Nathan emphasized that the vague, mystical and mythical connotations inherent in the word are at odds with his artistic desire to create understandable and transparent works. Erich was disturbed by some infantility and fairy-tale allure inherent in this word. Eventually, it was Guy who first proposed to use a more neutral term entity. This term has been enshrined in my vocabulary, however, could not completely supplant the concept of creature, since, contrary to the doubts of the people that I have talked to, it seemed important to analyze a mythical and fantastic prism — as one of several options for how such artistic entity could be perceived by the audience.

I started to look at these synthetic media arts creatures as at the certain enigmatic living techno-entities that are being established through embodied manifestation in vitro and interface. Consequently, starting to recognize the link between ALife conceptual premises and these entities artificially composed of living matter and synthetic materials. The next sections of this paper will be looking at cellF and Bricolage as carbon-based artworks that explore ideas of artificial life and intelligence, while slicing layers of cultural phenomena that these synthetic creatures bring into the scope of interest. Among the surprising personal discoveries that arouse during the practice of observation would be for example the juxtaposition of two statements which could be perceived as echoes of Cartesian duality and mottos for two analyzed artworks accordingly. Namely "Movement is life" in Bricolage vs. " Cogito ergo sum" in CellF — everlasting concepts for disputes in the discussions about living and intelligence in ALife research and robotics.

2.2 Introduction to the CellF Project

CellF is a collaborative project of Guy Ben-Ary with artist Nathan Thompson, musician Darren Moore, electrical engineer Andrew Fitch, and scientists Stuart Hodgetts, Mike Edel, and Douglas Bakkum. Research for the cellF project started in 2012 when Guy Ben-Ary received governmental financial support to create what he called at that time a biological self- portrait (Ben-Ary, 2014) in the form of wet-alogue (Ben-Ary, 2014) neural synthesizer. With such neologism, Ben-Ary suggested to underline two main composites of the finalized form of the artwork. On the one hand, cellF should be considered analog since all sounds are delivered with analog modular synthesizers. On the other hand, those are controlled in the Multi-Electrode Array (MEA) by the artificially grown neural network that is born in a petri dish (out of the human body) and produced due to Induced Pluripotent Stem cell (iPSc) technology. That should be recognized as the "wet" part of the project as the one that introduces the wetware "brain" of the media artwork. Putting it in a nutshell, the artwork consists of the wetware: "thinking", responsive and living component — neural network, and analog hardware in the form of synthesizers that are sounding in a predetermined by authors patterns (such as possible range of tones, pitches, and styles of sounds) but under the real-time (un)conscious guidance of the wetware component.

My first encounter with cellF happened long before we met in Finland. In the fall of 2017, cellF was shown at the Ars Electronica festival. At that time, I was just starting to study media arts and had little knowledge of biological art. At Ars Electronica I was lucky to have a long conversation with a representative of the festival staff, who kindly provided some basic information about cellF: what this artwork was consisting of and how it is expected to perform. At that level of my awareness, most of the information that she presented sounded to me like pure magic. It felt as if I was facing the infant of the intricate alchemists' fantasy, which was extremely difficult to comprehend and relate to the physical object that was in the room.

An art object looked like a spiral-shaped metal shell from the opening of which was prolapsing an unimaginable set of diverse wires. Later, delving much deeper into the topic, it became clear that these wires were connecting customized analog synthesizers with each other, matrix mixer and with a mobile sterile hood — a mobile laboratory in which an organic neural network was located on MEA in the Petri dish. The metal frame that was described earlier as a shell served as a storage and body for these organic and electronic "organs" of cellF. In a state of sleep, the "brain" of a creature

— a neural network would function continuously, however, the absence of external stimuli would allow the art object to remain at rest. In the daytime, at the Ars Electronica festival, cellF was playing solo. In the sense that the signals from the synthesizers of the cellF itself (output) were fed back to cellF as an input that would stimulate the neural network. In these cases, listeners witnessed a reaction of the creature to his own action.
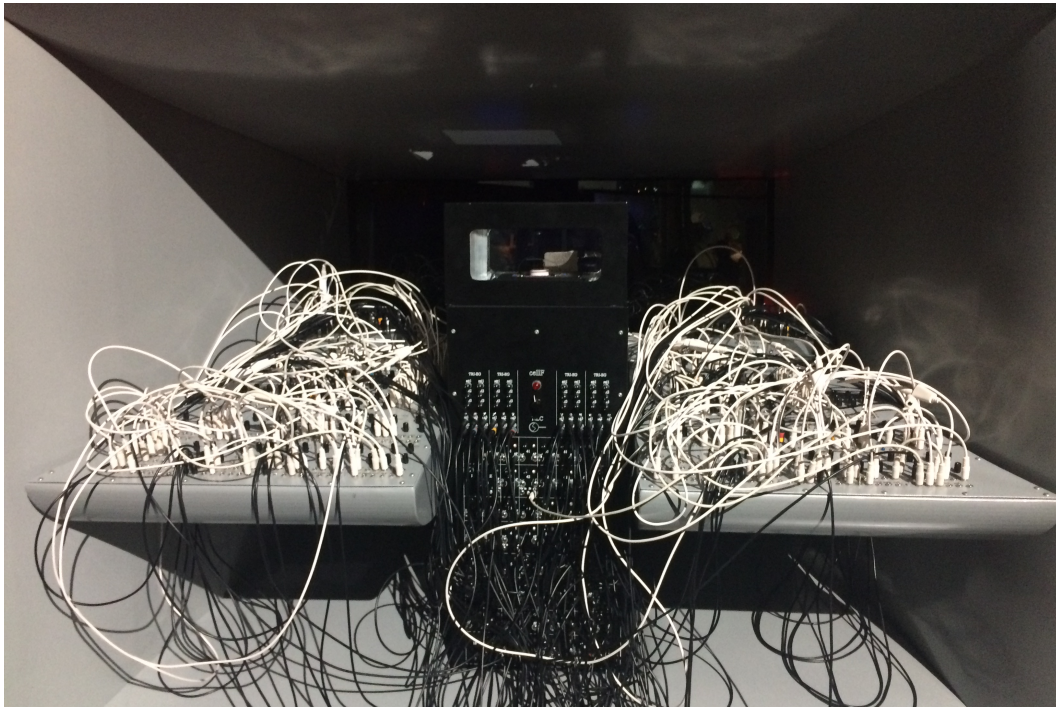
Figure 3 : Inside the cellF: incubator and analog synthesizers
(Heureka, Vantaa, Finland, spring 2019). Photo from personal archive

This self-reflection was interrupted for the duration of performances with human musicians. The sound of their musical instruments and microphones was broadcast as electrical impulses on MEA. These pulses provoked the activity of a neural network that responded to a signal with electrical impulses arising in neural connections. MEA was simultaneously a "reading and writing system" (Ben-Ary, 2014) which made it possible to recognize these signals and translate them for interpretation into synthesizers. The sounds made by the synthesizers depended on the place of occurrence of the electric impulse in the neural network and, accordingly, their location on one of the   sections of the MEA consisting of 64 electrodes. In other words, cellF received "information" (electrical impulses) about the sounds made by his human performance partner and answered with his musical passage, broadcasted from 16 speakers located around the perimeter of the space. Each speaker corresponded to a specific section on the MEA, which according to the

author's idea was to give the listener a spatial understanding: which section of CellF's "external brain" (Ben-Ary, 2014) is reactive and active at each exact moment of the jam session.

In the meantime, I wondered what precisely was this external brain (Ben-Ary, 2014)? How could someone create something similar to the human brain from scratch and what was the primary organic block for its creation? Moreover what level of consciousness and autonomy does the cellF get from owning a human-like brain consisting of neurons? I borrowed the expression external brain from Guy Ben-Ary. The author himself emphasizes that to some extent this formulation is a metaphor. After all, the real human brain consists of about 100 billion cells, while its synthetic creation has only 100,000 neurons. However, despite this, in the process of growth and development CellF's neurons, similarly to the cells of the human brain, are able to create neural connections, subjected to a lifespan and exhibit properties of plasticity. Therefore, like the human brain, they can respond to stimuli and produce a big amount of data (Ben-Ary, 2014). Nevertheless, we should not forget that Guy Ben-Ary creates two-dimensional tissue culture which is still quite different from a three-dimensional human brain.

Taking the above said into account and supposing that there is no common practice of extracting or storing human neurons from the brain of a living person, the question arises about the way in which Guy manages to grow such a system in vitro. Puzzled by this question, I came across and started to familiarize myself with Induced Pluripotent Stem cell technology. In his presentations in Solu Space and Hureka (Finland) Ben-Ary (2019, video) began his explanation of this technology to non-scientific audiences with a poetic, simple and catchy proposition that this technology: "forcing cells to forget themselves and acquire a new identity". Thus, in a curious way flirting with semiotics in the natural sciences through animation or even animization of what laboratory stuff would call simply "working material". Delving into the scientific explanation of the technology, iPSc method converts adult specialized cells of any human tissue into a form similar to stem cells by the introduction of several extra genomes. It is a common knowledge that stem cells are highly valued in medicine because their embryonic state allows scientists to reprogram them to become any kind of cell of different tissues. In the case of Bricolage — into the heart muscle cells (cardiomyocytes), and in the case of cellF — into the brain cells (neurons).

Ben-Ary's manner of explanation was suggesting and providing pieces of evidence that the invention of this technology by Professor Shinya Yamanaka was significant simultaneously for

modern science and for the philosophical discussion on the nature of living and visionary speculations and myth creation about the future of sentient technology and mankind. Moreover, I registered that the ways of explanation and choosing of words have their impact on the patterns of perception of such technologies by a public. Using iPSc technology in their artworks Ben-Ary and Thompson invited their audience to participate in philosophical discussions and speculations. As we will see later in the text, they suggested the viewer to critically evaluate the potentials, promises, and risks associated not only with Induced Pluripotent Stem cell technology but also with any other new developments in the field of biological sciences at least.

On a practical level, for cellF Ben-Ary harvested his skin cells which were taken with a biopsy from his wrist. Later through the cultivation of this tissue with iPSc technology skin cells were transformed into stem cells and pushed down the lineage to become neurons with a constantly developing network. This neural network is precisely what the artist called his external brain. It is important to point out that in the history of cellF plenty of such neural networks were created. The reason for this lies in the difficulties in maintaining the desired level of vital activity of organic matter, especially in connection with the transportation of biomaterials. Indeed, on the one hand, neurons, unlike neural stem cells, are not subject to freezing. But even hypothetically if that one day would be possible it would be problematic to declare them at customs when crossing state borders. This is important to note in the course of the general discussion as one of the small examples of the "future challenges" that are through speculation about them in artistic discussion with the audience shape the myth about the intelligent technology. Moreover, the fact of the creation of multiple "copies" of the external brain for one artwork is interesting for the author's approach to his own organic matter. After all, despite the fact that Ben-Ary speaks of cellF as about his *wet-alog alter ego*, he is compelled to regularly destroy the organic brain of his "David Bowie twin" (Ben-Ary, 2014). And while we can recognize here the idea of artistic desire to replicate or extend oneself through technology in a manner suggested by Søndergaard (2017) and Grau (2015) this example highlights a much wider gray zone of hypothetical challenges of the future. Such as the ethics of attitudes toward biomaterials capable of generating data; shifting beliefs on who and what could be identified as sentient and what role in their recognition should be set aside for such properties as autonomy, embodiment, and appearance, etc. Considering the Bricolage, I also encountered how a new verge of this issue is explored with the feature of the movement.

Therefore, for every new performance, Ben-Ary grew a new neural network over a MEA. A Petri dish with neurons had 64 electrodes that would send stimulations to the neurons and record neural signals. The connection of MEA with a signal amplifier and custom-built synthesizers was standing for a sound-producing body of the neural network (Ben-Ary, 2014). As mentioned earlier the neural interface was reactive to the input stimulation and replied with the electrical signal (output) to be interpreted into the sound of synthesizers. In this case, human music transformed into electrical stimulations to the neurons would be an input. For output, the amplified neural signals would be routed to the synthesizers. Therefore apart from synthesizers, custom-build modules would consist of a "Frigate" stimulation controller and sound specialization module, matrix mixer that would distribute sound to 16 different speakers which reflected the pockets of activity of the neural network in the MEA dish. (Ben-Ary, paper!)

2.3 Performance or the myth creation

In Finland cellF performed twice in the premises of the popular-science center Heureka. On the first night, it jammed in a duet with electronic musician AGF (Antye Greie-Ripatti). On the second the stage was shared with the pioneers of Finnish electro-acoustic music Defunensemble and jazz drummer Olavi Louhivuori. The genre and stylistic differences in the music of cellF's various jam partners touch upon another intriguing question about cellF's functional plasticity and learning in vitro. What are the chances and prospects of this neural network to train and develop over time by being exposed to various music styles? Guy Ben-Ary repeatedly emphasized his interest in this issue in response to audience comments during the performance, although at this stage he did not undertake research in this direction. It is important to mention these details even on the periphery of this research since the issue aroused the interest of both the creators of cellF and especially of the visitors of the concerts and questioned the synthetic creatures' capacity to learn. Speaking more on the design of the experience for the audience, the performance program in Heureka consisted of two sections. At first, participants were given the opportunity to immerse themselves in the direct experience of listening and observing CellF during a live concert. This was followed by a brief verbal presentation of the artwork by Guy Ben-Ary and a questions and answers (Q&A) session at which the audience could ask questions to the musicians and the creators of the project. During the performance, the musicians and cellF were located next to each other in front of the observers. There was no physical zoning between the stage and the audience. Before the performance, all visitors were informed that they have all the freedom to approach cellF during the concert.

However, interestingly the audience refrained from crossing the invisible psychological borderline between them and the "stage" space. In the meantime, musicians did not miss the opportunity to interact with cellF not only through music but also through some theatricality of gestures.

AGF during her set spoke to cellF, demonstrating with her poses and gestures that she is referring directly to an art object being in a dialogue with it. Defunensemble musicians, on the contrary, until the last minutes of the performance neither openly interacted with each other, nor with the neighboring huge snail-shaped metal object. The performance, however, culminated in a dramatical gesture by one of the musicians, who stopped playing and slowly approached cellF to theatrically switch it off. After that, Nathan and Guy ejected dish from the cellF's incubator, offering the musicians one by one to take a group photo with the metal creature and its "brain". Each musician stood in front of the camera with a Petri dish on the palm, taking pictures with this moist-media jam session partner.

Later, while analyzing what was happening and rewatching the video recordings of the performances, I was noticing how such artistic gestures generated and boosted the feeling that there was a living being next to people on a stage. Whether it was the participants' conscious intention or a spontaneous creative impulse such animation of the art object transmitted the idea of agency in this moist machine. It seemed like musicians mystifying the whole experience of interaction with the artwork for the audience. Fruitful for further thoughts on this subject were subsequent questions from the audience. For example, listeners were curious to know how exactly cellF decides what to play as if the art object had the will. On the one hand, Guy responded with a close to a scientific, dry description of the processes. In particular, he explained that it was the creative team that was responsible for patching. Since neurons themselves are not producing sounds but producing electrical signals, the kind of sounds was selected and defined by artists and was following the rhythmic behavior of neurons. Moreover, AGF and Defunensemble were aware of the specified threshold that was defined by stimulation module Frigate. It would separate inputs in accordance with the intensity of electrical signals, a difference of mini-volts. Designed by Daren Moore this module defined the gate for stimuli that would be able to pass and actually affect the neural network. Meaning that during the soundcheck musicians would be able to experiment and notice to a certain extent which kind of sound that they are producing would trigger cellF and which will go unnoticed. Even though MEA has 64 inputs, only 2 to 4 of them would be used during the show to avoid stimulation of all electrodes simultaneously. That would be a preventive measure against

saturation of the dish and the creation of too much noise. Therefore as Guy would acknowledge a lot of human-made decisions would be involved in the way cellF would sound. On the other hand, after unpacking the technical details of sound production Guy would summarize it with a statement: "though once all of this is set and we let the beast play, it becomes very close to 100% autonomous system" (Q&A session, Finland, 2019). In this case, he would leave a further explanation of the idea of the autonomous beast behind the brackets. This example can serve as a direct illustration of some controversy in how the cellF artwork was communicated. On the one hand, its authors strived to clarify in the most understandable way the limitations of cellF's intelligence. On the other hand, poetic expressions that were sometimes used perhaps for the sake of illustration, and perhaps for some greater appeal of the artwork could have created the illusion of its consciousness. As a result, the audience asked questions like: "Did you train …what was HIS or HER name… cellF… did you train cellF with some data-sets before the geek?" and "how was it to interact with HIM?". And got ironic replies from the Defunensemble: "during the performance, cellF was very active and wanted to take a lot of space". cellF's behavior became a vastly discussed topic of the audience's inquiry. It felt like some kind of empathy towards the cellF was rising during the Q&A session. People would ask how artists are feeding it. And Guy would say that for the non-scientific community he would call cellF's food — a chicken soup, meaning something nutritious and good for cellF (that is actually a nutrient chemical solution). After the performance moderator of the event would separately thank musicians, cellF's team and cellF itself. Since Guy mentioned that to use only one neural network during the performance he had created almost twenty extra networks just in case people would question what is happening to unused samples. Guy would have to express his regrets to upset the audience with the fact that the next day "nineteen networks will be killed" (Q&A session, Finland, 2019). Cutting down this game of metaphors someone would ask then if Guy thinks that these neural networks are developing consciousness. And would receive the final response that those neurons are likely not conscious. Guy would highlight that the underlying idea of his projects is lying in the problematizing of technology. The artist wanted to question the biological technologies that are shaping our future or changing our bodies right now. He insisted on his effort of trying to poke and trying to silly about where those are taking humankind. He would say that cellF is suggesting that in the future there will be a potential to control, to create, to bioengineer intelligent beings. And that he is considering it to be a scary prospect because people might not be ready to handle that. So his task is to bring such suggestions to the public and ask to think about it to generate a dialog about dealing with relevant kinds of technologies (Q&A session, Finland, 2019).

2.4 In Vitro Intelligence. Analysis of the interview with Guy Ben-Ary

A new depth of this discussion was reached in the second interview with Guy. We had this new round of discussion in November 2019, much later after events in Helsinki. In this conversation, Guy proposed a sufficiently more developed and reflected interpretation of his neologism In Vitro Intelligence (IVI), which he has been developing over the past year. The term arose as a result of what the author calls the taxonomic void (Ben-Ary, 2019, Attachment 1). He points to a lack of terminology that forced him to create new categories. Therefore he is giving this new name to phenomena and processes that are the core of his artistic practice and do not have exact terminological equivalents known to us. As a result, the term characterizes the new class of intelligence, the emergence of which is explored in scientific circles as well.

IVI according to Ben-Ary (2019, Attachment 1) is intelligence that is produced by bioengineered living neural networks that are functioning outside of the body, where they are capable of processing data and controlling robotic bodies. Thus, IVI relies on living matter, not machine-learning techniques and computer algorithms. Thus it is an idea of a thinking system that is both approximate and significantly different from both the human or animal brain and from artificial intelligence in the generally accepted understanding of this area of research. With IVI, the emergence of the living entity is not caused by processes of reproduction and birth laid down by nature, but rather involves the creation of creatures by humans manually in laboratory conditions. However, unlike artificial intelligence, we are no longer talking about using digital tools to replicate thought processes. Moreover, the concept of IVI's body lies beyond a classical perception of the hardware that should be used as a mechanical executor, material storage of data, or shell for the codes and algorithms standing for the thinking structure.

To explain it Guy calls cellF a surrogate performer (Ben-Ary, 2019, Attachment 1). A surrogate performer is 'based on' or rather 'is' an In Vitro Intelligence. At the same time, a surrogate performer is connected psychologically and through agency to the donor of cells. At the same time, a surrogate performer's operation is independent, its functions are not dependent on the agency. Crucially, its embodiment is extremely important at least as a guarantor of the feedback looping and the framework for the neo-entities to live and operate through communication with human collaborators during the performance. Thus, a surrogate performer becomes a unique example of

artificial life that follows the conceptual traditions of reactive robotics. It is capable to process data, learn and evolve due to its own bodily manifestation that shapes its way of interaction and communication with the environment.

Additionally, cellF as a surrogate performer and IVI become an interesting example for studying the nature of communication between actors of the shared ecology. Of interest is the nature of communication and relationships between this nonhuman liminal life form and human performer, audience and surrogate self (Ben-Ary, 2019, Attachment 1) — donor and in the cellF's case simultaneously the artist himself. In this regard, the concepts of autonomy, agency, and even improvisation acquires somewhat different semantic boundaries, since each of these properties in the case of a surrogate performer is liminal on its own. A surrogate performer is both autonomous and dependent on creators, musicians, and audiences. It is self-sufficient and nevertheless, from the very beginning, it is predesigned and saturated with agency. It improvises and at the same time, we will be carefully avoiding to say that it acts outside of the predictable framework.

Summarizing Ben-Ary (2019, Attachment 1) says that the characteristics and capabilities of IVI and AI are different. And in this sense, it resonates with Simon Penny's writings concerning distributed thinking that manifests itself through physicality and materiality of intelligence in the body and its interaction with the world. IVI in this context seems to be a new concept in the field of artificial life research, which has the potential to answer those questions which provokes periodic fluctuations in interest to the studies of AI and ALife in their attempts to recreate life and intelligence as it is or as it could be.

These observations open the discussion about the potential of a surrogate performer and IVI to contribute to what could be called the essential understanding of intelligence and intelligent technology. At the same time, as could be concluded from the cellF example, a surrogate performer as a phenomenon contributes as well to an external, emotional, ethical, cultural understanding of intelligence. So not only exploring the essence but also layers of constructed perceptions that humankind tends to establish through attitude, opinion, and behavior towards this essence. It would be beneficial to use an example from the interview to illustrate this thought with Ben-Ary's point of interest. For instance, the very terms like external brane or surrogate performer already "suggests the presence of some sort of relationships between the donor and the entities" (Ben-Ary, 2019, Attachment 1). The work becomes very personal and personalized. Simultaneously the work

generates a lot of emotions in the audience through the feeling of empathy to the semi-living entities (an interesting example of the case of MEART — semi-living artist's death could be read in Guy's interview in the attachment 1). Finally, as both Guy and Nathan underline they are bringing IVI into the galleries and on stages to generate the dialog with the viewers about life and death, about contestable futures and sentient technologies. Therefore their IVI artwork is becoming an embodied medium for these topics within and throughout their material existence in the artistic frame.
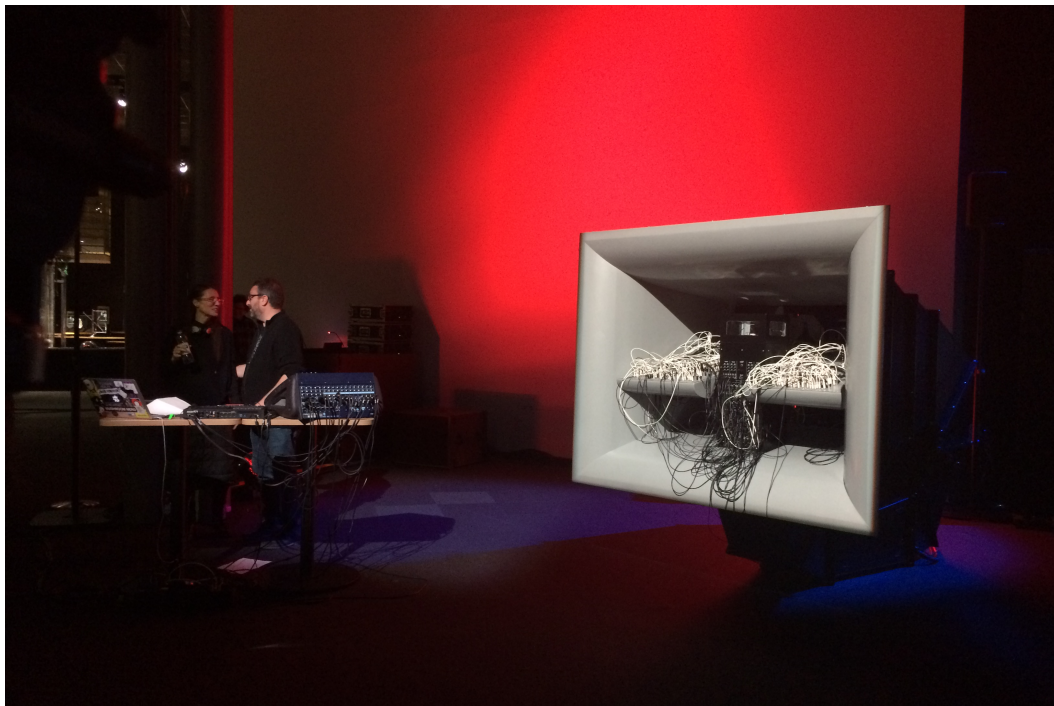

Figure 4 : Guy Ben-Ary with AGF next to cellF before the performance
(Heureka, Vantaa, Finland, spring 2019). Photo from personal archive

Chapter 3. Bricolage

3.1 Introduction to the Bricolage Project

Bricolage is the name for the current artistic research rather than of a completed artwork that is nowadays carried out by Nathan Thompson and Guy Ben-Ary in SymbioticA. Nevertheless, during the In Vitro Agencies exhibition, it was possible to present a prototype — the beta-version of the artwork that should become a climax of the research. The artwork's material representation should become a self-assembling living kinetic sculpture. Primary construction blocks for it are human heart cells in the silk scaffolds. Similarly to neurons in the cellF project, heart muscle cells in Bricolage are differentiated to stem cells with the iPSc technology. Later they are pushed down the lineage to become cardiac muscle cells. The hardware element of the artwork consists of the customized incubator that supports living conditions for cells and simultaneously serves as an interface that reveals the performance of the sculpture during the exhibition duration. In the previous stages of the project, artists were addressing the organic components of this artwork as "microscopic biological robots that eventually have the ability to self-assemble in the space" (In Vitro Agencies, 2019) due to a special property of heart muscle cells to twitch or beat without external stimulation and spontaneously. Though the 'biobot' category was problematized in discussions during the exhibition period, that will be unveiled later in the text, the main reason standing behind the usage of this term remained crucial for both the project and this paper. The questionable term was used to underline autonomous features of the represented semi-living entity. It was also brought up to speculate about potential ethical issues regarding terms of exploitation of future sentient technologies by humans. Another crucial aspect of the artwork derived from the notion of movement as the trait of life and actively explored the property of self-assembly in contemporary robotic studies. With the Bricolage artwork, several topics that are problematizing the biological art field were explicitly touched. Among technical ones was the issue of sustainability of the 'living' artworks. Among ethical considerations were the choice of topics and specific correspondence of personal artistic practice involving living matter to the artists' claims maid about it. Further aforementioned aspects of the Bricolage artwork will be analyzed with precision and alongside the discussion of the range of concerns pointed out during my internship. Such as current and potential attitude towards technology that is stepping into natural processes. This analysis was inspired by the desire to understand if Bricolage could be considered as a synthetic media arts creature and if media art creatures could serve as constructed analytical tools that similarly to

mythological creatures are serving for the cognition of the world and speaking on behalf of human perception of it.

My modest participation in the Bricolage project began with a request from Nathan Thompson to 3D-print a small detail for an incubator. In the future, this incubator was supposed to become an interface for an artwork, while serving as a habitat that would sustain living conditions for cardiomyocytes (cardiac muscle cells) planted into the liquid silk. The heart muscle cells were supposed to be spliced with a number of microscopic silk scaffolds. In this way, they could acquire a pre-selected dynamic plastic form. Such design was serving authors' initial idea. Conditioned by the growth and development the differentiated from stem cell cardiomyocyte should have developed and demonstrate typical behavior for cardiac muscle cells. Namely: to twitch spontaneously without any external stimulation. Thereby, it would modify its shape and position in space. A number of such biological neo-entities from living matter with a silk skeleton were located in a nutrient medium. This liquid medium would be filling test tubes — Petri dishes. The prototype version assumed the presence of four such Petri dishes. Those were placed around the perimeter of an elliptical incubator made of metal and plastic. The controlled microenvironment of the incubator with 37 degrees, 5% of CO_2 and nutrient solution in test tubes ensured cells living conditions. The incubator was hanging from the ceiling. The motion sensors on it when triggered would switch on and off the lamps. Situational illumination was necessary to ensure the visibility of the living elements inside of the incubator. It was placed in a dark room to secure photosensitive entities from overexposure to light. Thus, standing full-hight under the incubator and raising one's head to the light source, the viewer had the opportunity to closely examine the contents of the petri dishes in which the silk-cardiomyocyte hybrids were living. According to basic physical principles the spontaneous bitting of these entities should have been provoking their autonomous movement in the medium. It was assumed that the periodic collision of individual units during their movement inside the medium is inevitable. The artists planned to use this factor to create a self-assembling kinetic sculpture. Subject to the technology of DNA origami the cells were expected to acquire the ability to form connections, cling to each other after collision. With the constant clashing and continuous glueing of all new units, the sculpture was suppose to grow in size. Over time it should have increased to the scale that would be easily visible to the human eye. At the prototyping stage, the authors themselves were referring to the term 'biobot' when describing the processes of entities assembling into a living sculpture. They wanted to reach the point when it will be large enough to

be displayed for the public without the use of such mediation tools as microscopes, screens and cameras for macro video recording.

Figure 5: Nathan Thompson installing Bricolage for In Vitro Agencies exhibition (Solu Space, Helsinki, spring 2019). Photo from personal archive

It should be noted that the production process of the prototyping stage and further exhibiting of the outcome required some adjustments and introduced several modifications of the project at its technical, conceptual and semantic levels. Before exhibiting a prototype in Finland, Thompson and Ben-Ary successfully performed the above-described operations of cardiomyocytes differentiation and seeding them on silk scaffolds with the further maintenance of their vital activity in a test tube under laboratory conditions on the basis of SymbioticA. The exhibition In Vitro Agencies was expected to become a platform where subject to the successful repetition of these processes, the biobots should have been demonstrated for the first time using the interface described earlier — the incubator. In practice, several difficulties prevented the desired result. The main problem was the mistake in the design of the incubator, which caused overheating and drying out of the nutrient medium in Petri dishes. In this situation, the biobots that were left without a watch died overnight.

The situation, however, gave the artists an understanding of the nuances that must be reconsidered before the creation of the final version of the artwork. Moreover, it provided me with a personal experience of witnessing the complications and challenges that are arising in creative (whether scientific, artistic or any other) practice that is pointing to the gap between everyday hands-on experiences of human-nature-technology interaction and more abstract and theoretical constructions about the homeostatic Gaia, moist mind, hybrid ecologies, etc. The practice didn't contradict or neglect theory. But the case reminded that only precedent and attentive to details investigation of practice can serve to a more nuanced and less profound interpretation of theories.

3.2 Moving biobots. Analysis of the interview with Nathan Thompson

Further, it seems important to examine in detail the key conceptual ideas of the work in its original formulation to understand which ideas and principles were laid in it and which narratives inspired the authors and were articulated to the audience. In parallel, I will describe my observations of the process of preparing and presenting a prototype during the exhibition In Vitro Agency. This experience is an important source for questions that leaked into my interviews through the gap between the original author's idea of the future project and the actual course of events and the outcomes of the prototype's exhibiting. First of all, it is important to dedicate attention to the term 'biobot' and the discussion that has occurred around it in the Solu Space. According to the Eduardo Kac definition "a biobot is a robot with an active biological element within its body which is responsible for aspects of its behavior" (Kac, 1999). During the round, of Q&A at the Guy Ben-Ary's artist-talk, the curator of the In Vitro Agency exhibition Erich Berger, challenged the term emphasizing that it carries certain cultural baggage that can confuse the audience. He suggested that the term is loaded with both factual and constructed meanings which could lead inexperienced viewers away from the original content and intentions of the Bricolage project. He explains that the name biobot limits the artwork:

> *Biorobotics would be just one little aspect of how you could name it when you look at it. But it's so much more. And also it was a very utility way to look at it: through an application… Because when you tell the audience this is bio-robotics, what they see is basically a robot. Then at some point that is something which is doing something for somebody and repeating it until it kind of cannot do it anymore.*
>
> *(Berger, 2019, Attach.3)*

Thompson and Ben-Ary considered the argument to be pointful and suggested that a possible more accurate alternative could be the term automaton, which would emphasize the limited autonomous pattern of the behavior of this moist media artwork. Later in an interview that I have conducted with Nathan Thompson, he clarified that for some time already and still around the time of the interview he was looking for the most appropriate definition, but insisted that:

> *Bricolage has elements of robotics in it. It is a reliant central kind of governing entity that is actually producing movement which a lot of robotics is. It uses engineering to sustain a life or life- like living entity. It has elements of science in terms of using modern technology in order to produce not only movement but again a life/life-like living body. And also touching on the point of self- assembly: it is a very hot topic in robotics. Actual hard-core, metal based, engineered robotics. And I believe self- assembly is an element which all life forms of all kinds contain, right down to molecular level. And the way things fitting together...when things moving and producing entities bigger then a singular elements there is an overarching rule-based system where each element knows what the other one is doing, or they are predicting what the other one is doing. So they produced a larger body that is organized in a certain way. This was something we wanted to implement in the Bricolage artwork for a few reasons. Basically because it is something that is heart of life anyway.*
>
> *(Thompson, 2019, Attachment 2).*

The foregoing suggests that the problem of the biobot term is not the incorrectness of the very definition of it in relation to this artwork. A careful approach to its use seems to be dictated by the additional semantic superstructures of it that were pointed out by Erich Berger. The halation and simultaneous utilitarian understanding of technology which possibly became entrenched in the public discourse with robotics could impact a very distinctive idea of a biological robot for general public.

Another topic on the verge of a discussion about the definitions of the automaton and the biobot arises from material, materiality, and properties of biobots in Bricolage. The key characteristics of given biobots alongside the combination of engineering principles for building a structure with such components as hardware and wetware are expected autonomy, ability to move and self-assemble.

Are these characteristics as conditions for creating the life-like living body becoming at the same time new instantiations of simple interactive embodied and autonomous systems that remind of Brook's suggestions for robots? This would relate life-like living bodies in moist media art to life-like living systems in ALife art? Wouldn't that mean that Bricolage biobots would have the potential to be perceived as a new dimension of artistic discussion about the embodied cognition of artificially created technology?

 Certain speculative vein of the discussion about the biorobots as living technology lies in the ethical considerations that are highlighted with Bricolage artwork. For example, in the interview in connection with his artwork, Nathan discusses the role of laboratories and pharmacological corporations as elements of hybrid ecology.

> *These companies are in control of the industry and no one questions that. And here's another of the reasons why we wanted to use the word robotics. "If" in the future, "when" maybe machines are becoming a living in terms of biological machines: are we implicit in our ignorance of these things happening? Are we implicit with machines that are sentient? Are we implicit with slaves are being produced that have no choice?*
> *(Thompson, 2019, Attachment 2).*

The exploitation of biological machines is only one of the many potentially socially significant topics that the authors bring to the discussion of their work. Among other issues bearing the characteristics of environmental thinking, for example, is a conscious approach to the use of materials. The author's approach to the conscious and responsible choice of biomaterials invites the audience to become concerned and aware of the origin of these materials. For example, Nathan is speaking about the choice of liquid silk due to the desire to save the life of silkworms. For comparison, in the traditional silk production silkworms are welded alive in their cocoon before they hatch. This guarantees the integrity of the cocoon and the obtaining of a long unbroken silk thread that is valued in the textile industry. The Bricolage authors say that "silk has a long history coinciding with human control of the natural environment...There is a big connection with how humans have shaped their environments in order to benefit the human endeavor" (Thompson, 2019, Attachment 2). Emphasizing their resistivity to this trend, the Ben-Ary and Thompson also use the

We are not so interested in hyping the work in unethical way. We find the most interesting things happening in conversations outside of the artwork itself. And in order for these conversations to happen, the artwork and the production of the artwork needs to be thorough. We need to be very diligent in the way that we work in order for the artwork to be effective in the ways that we want it to be

(Thompson, 2019, Attachment 2).

synthesized ecological biomaterial as a nutrient medium for cells. This is a conscious effort that allows avoiding both financial dependence on pharmacological companies in this matter and the need to use the unsustainable mass-produced nutrient medium. The last one is predominantly based on fetal calf serum, which is an extracted blood serum from an unborn fetus of a cow that is preliminarily slaughtered for meat or leather. Finally, special attention is paid to the key elements of the art duo's artwork, namely the cells. The authors need to emphasize the fundamental difference between them and artists who use cells of the animals that did not give their consent for this. The duet of Nathan and Guy uses exclusively human cells of people who voluntarily agreed to provide those and who were not significantly affected by the way of the cells extraction. In the cellF project, Guy Ben-Ary's own cells are used. In the Bricolage, a drop of blood from an umbilical cord of a born baby serve as a pleasant postnatal bonus to be used to extract cells. All of these examples as addressed to the public in the artists' presentations are becoming signifiers of artists' inclination to communicate certain messages and questions to their audience about something suggested to be considered hybrid ecology.

The above-described attention to the ethical choice of materials and procedures in artistic work, according to the artists themselves, reveals the potential of art practice as an investigative process that interests authors from the standpoint of individual research and learning. On the other hand, it creates a context for questions formulation from the public's side. It contrasts with the opposed model of creating artworks without its in-depth evaluation and understanding. Developing this thought Nathan emphasizes:

An additional aspect addressed with Bricolage is a common problem in biological arts that in a different way elaborates on the question of actual autonomy of current technologies and future human-technology interaction. It could be explored through a common struggle among bioartists to

create autonomous work in terms of its viability. In the interview, Nathan mentions that he is looking for design solutions that would allow the work to be self-sustain: such that it would not require the constant presence of the artist or his regular checks and manual maintenance of it in the desired state. Nathan insists that the situation in which an artist working with biological matter can leave artwork without control, supervision, and maintenance of its activity and lifelines is rather unique at this stage of biological arts development. In that regard, he speaks of the creation of supportive elements such as a drip-feed mechanism where the media is preheated and then dripped into the dish to be able to make an artwork relatively self-sustaining: "There's nothing like that happening anywhere in the world. So I like the idea of being able to have a biological artwork that I don't have to attend. I set up and leave" (Thompson, 2019, Attachment 2).

Speaking of artistic practice, another topic that the authors strive to bring up in the Bricolage is the "make-believe" phenomenon, which they consider problematic for artistic practices working with a living matter. According to Nathan, many works of the bioart offer the viewer to believe the artist, to rely on the story she or he tells about the creation of the artwork: what the artwork consists of, how it was created and what it does at the moment of direct observation. In this case, the viewer may be deprived of the verification instruments. On the one hand, an important role here is played by the complexity of an artwork requiring specific knowledge in the field of natural sciences, which the audience does not always possess. On the other hand, frequently complex processes are not obvious, visible to the viewer either because of the scale or lifespan of it for example. This is precisely what caused the desire of the authors to create a structure that does not require additional technological mediation and could be observed with a naked eye. In this sense, the authors articulate their claim to biological art. Suggesting their way of ambiguity avoidance artists seek to demonstrate as clearly and transparently as possible their work and bio-matter behavioral modes to the audience. At the same time, they remain the main narrators to explain this very same background of the artwork's senses. Therefore, they are shaping viewers' perceptual prism of understanding those synthetic creatures.

3.3 Enigma of embodied autonomy in the way it's explained to the audience

The fact that the Bricolage project focuses on the materiality and material in conjunction with the concepts of movement and autonomy, as well as in the opposition of the idea of productivity to the very principle of biological life as cognition, can be traced in how the artists communicate it to the

audience. To explore it I studied the websites, blogs, and Instagrams of the authors, and listened to their responses during the presentation of the project at the opening of the exhibition in Helsinki. In this way, I was groping the connections between the key topics of the primary author's interest with their transformation and explanation to the public.

Back in September 2017, in his blog, NATHANJOHNTHOMPSON describes the first steps in the development of his study Movement and interface — possibilities of interfacing human heart cells to artistic robotic bodies supported with the grant from The Australia Council for the Arts since late 2015. Nowadays we know this project as Bricolage. Having previous artistic experience in building analog automatons, as Nathan emphasizes, he strived to take a step "from electronic-based actuation to biological" while focusing on the material and materiality of the artwork, on its movement (NATHANJOHNTHOMPSON, 2017). Therefore, he describes in detail the process of searching and mastering the necessary materials. He mentions the stages of experimenting with progenitor cells later replaced with human's Induced Pluripotent Stem cells, and testing of corals and sea sponges later replaced with aqueous silk. As a result, Nathan learned to seed those in vitro-grown and spontaneously twitching cardiomyocytes into the silk scaffolds of the predesigned shape. The next step was to give individual cells time to aline into a sort of a tissue or a muscle in and on the scaffold to flex and move the body of the silk-structure itself. Several of such self-propelled bio-engineered objects made of heart cells tissue and silk was precisely what Guy described as 7 mm square bio-robotic prototypes (Guy Ben-Ary website, 2019). The authors planned to improve their skills in manipulating the way these actuators move, their size and self-assembly ability to witness the autonomous self-composing artwork, sculpture, robotic entity.

As Thompson (2017) underlines in his blog making the movement visible to the naked eye was a task of primary importance to him in this project. As well as the materiality of the material. This argument he used during the opening of the exhibition to explain why precisely heart muscle cells were chosen. He answered the question from the audience speaking of his interest in the autonomy and materiality of the artwork. Proceeding with an explanation that all skeletal muscles are only responding to external electric stimulations which brings an element of artists' control over them. This control is undesirable for authors since they don't want these bio-robots to simply do what artists want them to do. Cardiac muscle cells do not require external stimulation. Therefore artists expect them to twitch and move freely to allow the material to have as much autonomy as possible. That inevitably leads to the following comment from Ben-Ary: "We can't even get them to work for

an exhibition: they do what they do" (In Vitro Agencies opening, 2019). This comment brings us to the specificity of the situation at the opening of the exhibition. As mentioned earlier, despite the successful previous results in test laboratory conditions at the In Vitro Agencies exhibition, cardiomyocytes did not have enough time to form a solid tissue to perform twitching and flexing of the scaffold in such strength that would be visible without a microscope. Perplexed by the need to examine biobots under a microscope, a visitor asked a question about the real productivity of such an unstable structure. Thus, he voiced perhaps a collective or only my earlier consumeristic demand for obvious usefulness of the technology. Thus, he also provoked artists' objections against this way of thinking. They replied with a set of questions. They were asking why these biobots should be productive at all, why an artwork should be useful, and why living things should be utilitarian. Moreover, Thompson (In Vitro Agencies opening, 2019) emphasized that operating with biological structures is different from working with digital materials. It is almost always somehow different from the previous experience, often unpredictable and sometimes not repeatable. If something is going slightly wrong in working with biological matter, if something dies — it is gone and this is simultaneously the challenge saturated with anxiety, the beauty and a thought-provoking sensation of this kind of artistic practice.

Figure 6 : Printed liquid silk scaffolds from the workshop in Biofilia (Aalto University, Helsinki, spring 2019). Photo from personal archive

Speaking about another material forming biorobots, namely silk, we again encounter two sides of the medal of Nathan and Guy's artistic practice. In his blog, Nathan (2017) openly describes how to hack laboratory equipment to print silk scaffolds with the light on a motorized microscope. His willingness to describe online how to manipulate the property of this device to emit light for photographing samples in the dish to give shape and hardness to silk liquid material is very consonant with the traditions of open-source DIY culture. Adherents of this tradition often strive to liberate a personal approach to technology. They suggest to do it through information sharing and hands-on approach that should reduce the mysterious sensation from the closed system of not flexible in customization fabricated mass product objects and devices. As was clear from the interview with Nathan the reduction of the mystery around the technology is precisely what he is seeking for with his practice. On the other hand in Guy Ben-Ary's website, this very description of the printing silk process is followed by a slightly contradicting video and statement. Ben-Ary provides a video where the screen is divided into two halves. A video with red drops of blood landing on white silk fabric is played on the left half. On the right half, a microscope shot with transformed from blood cardiomyocytes that are compressing the surface of hardened aqueous silk is shown. Ben-Ary accompanies the video with an explanation:

It demonstrates what happens to these materials after applying Biological Alchemy. We believe that the biological sorcery or alchemy that enables the conversion of a drop of blood into a living animated entity is something to explored from a cultural perspective

(Guy Ben-Ary website, 2019).

Thus, he again brings us back to the conversation about the role of media art creatures in the formulation of meanings and possibly myths within the framework of entities' property and manner to articulate science and technology for a wide audience.

Outcomes of the research and further considerations

Taking into consideration previous discussion, what kind of ideas can cellF and Bricolage cases lead us to in the theoretical framework of sentient technology conceptualization and hybrid ecology cognition? Primarily, these artworks are a curious epitome and continuation of the discussions regarding the nature of living things, intelligence and cognition. On the one hand, they rediscover these topics in the tradition of researches in ALife and robotics. In this sense, their key contribution comes with the In Vitro Intelligence concept. This category indicates a new round of research that fuses the practice of synthetic biology and the actual organic matter into media technologies. Probably without the conscious desire of the authors of cellF and Bricolage themselves, the idea of IVI problematizes Cartesian duality due to the manner in which it reveals the concepts of embodiment and materiality, behavior and interaction, movement and cognition, autonomy and agency. In this regard, we consider the example of a surrogate performer cellF that, firstly, has a recognizable marker of intelligence in the form of a neural network, and secondly, is capable of interactions with its environment during performances. However, it seems that Bricolage also has an important standing in this discussion. What could be a topic for separate research, is the potential of self-propelling biobots of Bricolage to be analyzed as a peculiar form of In Vitro Intelligence. In the sense of a certain form of the distributed but located bodily intelligence of entities that are autonomous in their behavior as in Simon Penny's descriptions but in vitro.

Secondly, considering cellF and Bricolage as some forms of In Vitro Intelligence, we also stepping into the conversation about the coexistence of the natural and artificial, sharing of the world among human, nonhuman organisms and technology. As Erich Berger (2019, Attachment 3) explains in our interview until recently the distinction between living and non-living, natural and technological was much clearer. Nowadays, when people are manipulating the Earth system on a global scale and with divers technological actuators, things that were biological by nature are not anymore a domain of solely biology. He points out that the concept of nature that was developed during the romantic period is obsolete. Nature, as we thought in previous centuries, was something sublime that existed without our inter positioning and interrogation. As we can also trace from the theoretical frame provided with this paper, humanity now starts to understand that nature is not separated from the human: "culture acts upon nature and nature acts upon culture. They are not independent from each other" (Berger, 2019, Attachment 3). Thus, all of the respondents of my interviews are underlying that since we acknowledge that in our times "technology and nature are coming together to form a

new entity with new qualities" (Berger, 2019, Attachment 3) we need to find the right language and develop a new vocabulary to speak about this new rising formation. In its content, this idea is discussed by theorists in different traditions, where they are using different terms and focusing on different aspects of such a technologically shaped nature. However, while we can find resonating concepts in writings of Latour, Morton, Serres, Ascott, and others mentioned earlier and many more not mentioned in this research, for now, I'm using the term hybrid ecology to refer to the described phenomenon. Due to Erich Berger's explanation of this term as of the temporary word construct that is standing for something that we don't know a better name for yet.

We recognize many theoretical frames to debate about the new techno-ecological formation. However, when it comes to particular examples of actual hands-on experience of immersion into the topic with the practices introduced in cellF and Bricolage, we get an opportunity to speak specifically, not abstractly about matters that worry and excite us here and now. These artworks address the topic of hybrid ecology from different angles. On the one hand, it is related to the production of the artwork in the vein of investigative artistic process grounded in practice. On the other hand, it opens up through the artists' framing of topics and their mediation to the audience. For instance, when we are looking at cellF and Bricolage examples as at Ben-Ary's and Thompson's investigative inquiry and work process, we recognize their preoccupation with the actual materials for their work. Attentive attitude to the origin of materials for an artwork, the moral face of their suppliers and environmental means of obtaining them from donors — are just some of the relevant aspects. Does this particular example offer its version of relationships reconstruction in human-nature interaction within the theory of the Anthropocene? Is this trend developing additionally due to visual and design solutions of the artwork? For instance, in the claimed by Nathan desire to take the artwork far away from the lab aesthetics. The authors have repeatedly insisted that they "want people to feel like maybe it's part of the furniture or maybe it is something that is not out of a lab but part of the world" (Thompson, 2019, Attachment 2). Such an attempt to place the Bricolage as a media art creature, as a moist media artwork into the everyday life: to present a marriage of technology and biology as a household object seems to be a direct illustration of the concept of hybrid ecology. The same goes with the desire to introduce cellF as a collaborator concert performer. Furthermore, the question to be explored more in further researches is how artists of biological works perceive their creative process in this context. What kind of relationship connects them with the living matter of an artwork? Do they perceive finalized artwork as an object or a subject, an alive entity, being, creature? Perhaps they experience sentiments to the most living

components of it — to the biological material (be it animal, plant, algae, bacteria or cell, etc.). Observation of Guy and Nathan's practice suggests that there is no sense in generalizing artistic experiences in this way. In the case of these particular artists, it was a matter of a conscious attitude towards the material and an understanding of its wildlife nature nevertheless approached as a material in the first place. The attitude towards it could be predominantly as to the material — devoid of sentiment to the extent that would allow the artwork to happen. So the fragile organization of the process of cells' growing required the authors' daily preoccupation and care for them. At the same time, in an effort to stimulate the twitching of passive cardiomyocytes, Nathan did not hesitate to use scissors to cut biobots, which in his opinion could activate them, however, inevitably ending the life cycle for some of them. Nevertheless, Ben-Ary and Thompson in their interviews are suggesting that being the donor for own surrogate artwork brings many questions related to personal feelings and agency that are to be revealed in the soon to be published paper of the artistic duo. All and all, likewise the discourse of the hybrid ecology these artworks speaks about the new principles of the perception of something breaded in nature through evolutionary processes in relation to the processes and artifacts that occur with the development of biotechnology in the laboratory settings. In this sense, the materiality of these artworks elaborates on the discussion of the borders between natural and artificial.

Moreover, cellF and Bricolage a training apparatus for the perception of an artwork as an investigative process that is possibly more complicated and complex than the creation of a work that is oriented primarily on the result and finalized look. Indeed, in the latter case, an artwork is considered to be an object, an artifact, the final product. In the cases that are described in this paper the practice and the process are treated as an element of the work of art. Such a process requires a research initiative, continuous learning, and mastering of new technologies as well as collaborations with scientists. Possibly this role implies a tendency to borrow behavioral patterns from scholars and social activists. Possibly it is a marker of a more responsible and conscious approach in art practice from its compliance with the values declared by the finalized outcome and respect for the viewer. At the same time in our cases, artists role is also fused with some demiurgic spirit and the sensation of alchemic practices over the living matter. This is an interesting combination that brings some new conceptual understanding of the role of the contemporary artist that should be explored in more detail in further researches.

When it comes to the mediation of the aforementioned topics to the audience with these artworks all

the artists' roles: the demiurges and sorcerers or activists and researchers seem to be related to the articulation and mediation of the contemporary perception or maybe even mythology about techno-culture. Either we are talking about the narration of the past, description of the present concerns, fears and beliefs or discussion of utopian and dystopic contestable futures, in all these cases cellF and Bricolage as synthetic creatures of media arts serves as a Trojan horses for discussion on various issues that artists consider important and relevant and which mostly relate to the interaction of actors: people, nature, and technologies in the modern world and its potential modifications. Nathan describes this as follows:

> *"That's why I find it so interesting to work with these materials. Because it raises up all those questions and speaks to the future on the directions where it is going and hopefully shapes people's opinions about the way they feel about this technologies. But in a way that's actually displayed so that regular people — people that are not trained in the bio sciences can understand what's happening. Because there's a lot of hype about these things, organ donors, surrogate organs and things like these, that will help people in the future. There's not a lot of conversation, at least for the normal regular person about the social implications, the moral and ethical implications of using this technology. So this is one of the reasons why we use human cells"*
>
> *(Thompson, 2019, Attachment 2)*

It is noteworthy that these discussions are not only broadcasted straight through the artwork itself, but are rather opening to a wide audience through related materials: artist-talks, discussions, introductory materials on the projects' websites, additional exhibition materials, and various documentation footage of the artwork process of creation and exhibition. Discussions triggered by the work are not limited by the horizon of preselected by the authors topics. Some questions are asked by the artists themselves, however, it is also assumed that this work is not limited and may be saturated with other narratives and questions by the audience. An example is my acquaintance with these artworks. After a detailed study of them, I rushed to discuss with its authors those issues that they did not seek to consider. For instance, on my question of whether we can consider the Bricolage and CellF to be examples of carbon-based artificial life artworks artists respond by suggesting the use of the alternative to "artificial" term "synthesized". The point here is not so much in the deep-rooted and well-defined narrow understanding of the term ALife in its association

with the predominantly software components and computer code. To a greater extent, according to the artists, an alternative formulation is needed to emphasize the novelty of the creature being presented. The fact is that these entities do not merely imitate and mimic natural processes, but introduces elements that previously did not exist in our shared environment. One of the examples standing for this perception of the work could be traced in the usage of the DNA origami technology where synthesized DNA is used as a kind of glue to put things that don't normally fit together. It serves the artists' intention to predesign the ways in which biobots can actually bond into the bigger structure.

Looking at the tracks described above we can conclude that cellF and Bricolage artworks are primarily a trigger in the form of a collective image for processes and discussions around the set of topical issues of our time. In other words, this can be formulated as the following question: could synthetic media art creatures stand in a way for the phenomena to conceptualize, explain or illustrate them? Would we consider them as an attempt to imagine how certain phenomena would develop in the future? Would it be reasonable to relate it to a way in which people in the past through mythology and mythological creatures used to explain the world around them? This hypothetical perception of media art creatures as beings that help to explore and explain the technological world and techno culture is suggested on the lineage from the past to the future. Accurately and consonantly with this vision, Nathan warned me that the term "creature" implies some fantastical, imaginary and fictional qualities of the subject: mythological essence of the beast. Originally he was avoiding to connect this sensation with his artwork. For this reason, he preferred the term "entity" to emphasize the opposite intentions of his to create something explicit, comprehensible, visible and real to remove opaqueness and be as transparent as possible. But, as we could see from the above analysis of artist talks, online materials and Q&A sessions, the occasional mystification of the topic is generally unavoidable. Continuing the discussion, I emphasized that all the features that Thompson noted in the term "creature" quite accurately address the many aspects of their work that interest this research. After all, this term correlates not only with the author's intonation but with the public perception as well. In this case, I am the person that gradually get acquainted with moist media arts and has some limited set of knowledge about the field not enough though to claim any expertise in this field. This situation puts me in a unique position where the worlds of the professional community and unprepared curious audience meet. And in this position, I have the opportunity to observe the reactions of the audience: listen to the discussions and questions that were asked by the public during the concerts of cellF or at the opening of the In Vitro Agency

exhibition. The results of my observations bring questions about the transparency and clarity of the biological and technical aspects of the artwork for a viewer. Are biological artworks and bio-technologies becoming understandable to the audience due to the artistic intention to make them such? Or on the contrary, the high level of complexity of artistic processes and scientific research that is aestheticized with artistic means translate the results of the activities of scientists and artists into some kind of conditional incomprehensible and mystical sorcery, alchemy-like activity in the perception of the audience? Do viewers fully understand the nature of the on-going exhibits, or do last ones remain to the general public as creatures: myths of biochemistry, fictional and fantastic beasts of moist media art? Questions related to the audience perception of such media art creatures could be an interesting angle for further academic inquiry.

Summarizing, no matter if we would call these artworks as biobots and surrogate performers or beasts of biological arts, liminal lives or semi-living entities, art chimeras or media arts creatures they would, in any case, shift how we understand and cognize such concepts as life, intelligence, and sentient technologies. They are created to suggest new perceptions, raise questions and open the dialog about the utilitarian understanding of technologies and about the solidarity in the new form of ecology that we are sharing with them. They are doing so while being place in the artistic frame of the exhibition space and concert hall providing the audience with a very specific understanding of the new media art objects. This is unveiling their constraints and limitations from the curatorial perspective of maintenance but at the same time possibly creating certain enigma for a regular visitor, and that is something to be yet explored.

Conclusions

The main conclusion of this study is that one of the reasons for creating synthetic media art beings is an attempt to comprehend the idea of living sentient technology. Such technology is a particular myth of the past and present. The study suggested that through this myth mankind seeks to conceive a technological reality that is acquiring new qualities, which some researchers call hybrid ecology. Synthetic creatures were recognized as elements of this myth. It was illustrated that this characteristic of them as well as the myth of thinking living technology itself, has its prehistory. The study traced the practice of creating fictional beings as a way of comprehending certain phenomena and concepts starting from creatures of ancient beliefs to the appearance of automata and fictional characters resulting from the ideas of Enlightenment. The study recognized a new round of this practice in an attempt to understand and create intelligent and autonomous technologies in cybernetics, AI, ALife and robotics researches. Further, it suggested that with the advent of biotechnology, artists acquire additional tools to work on this problem. It investigated whether biotechnological tools allow to look at the problem from new angles.

Another conclusion of this research is that artists whose work has been examined in detail in this study create such creatures in order to continue dialogue with the public about this myth. With the help of their creations, artists talk about intelligent technologies whose integral element could be an organic matter. CellF addresses this issue through the idea of In Vitro Intelligence. Bricolage can be seen as an attempt to explore the potentials of future sentient technologies through the idea of embodied distributed cognition of simple autonomous systems that together can form a more complex holistic homeostatic system. Both works emphasize the reactivity and interactivity of such systems. As part of this conclusion, this study also recognized the existence of many additional reasons why authors create such works. Some of them were also considered in the text. It is suggested that synthetic creatures may be artists' attempts to comprehend and extend themselves through technology, as in the case with the creation of the surrogate cellF performer. In addition, synthetic artistic beings can be created as message carriers and triggers for discussions with the public about issues that concern artists and audiences. The study describes for example how Bricolage invites to discuss the topic of coexistence of humans, nature, and technology through a discussion of the materiality of the artwork and ethical principles of the artists' practical activities. It was suggested that both works raise some questions about the ways of their presentation and communication to the viewer. In this regard, they are addressing in a broad sense the question of

how regular person could approach technologies and how this might affect the conceptual and physical shaping of hybrid ecology.

The suggested answers to the questions posed by this study are just some of the possible elements of the puzzle. Their verification requires testing on other examples of artworks in which synthetic creatures are present. Therefore, the study does not seek to extrapolate conclusions from particular examples to all examples in the field. However, it offers an analytical model for further research. And suggests another round of questions for further exploration.

Speaking about the course and methods of this research, the following should be noted. Given the degree of novelty of the topic, both for the researcher and in itself, the main challenge of this study was to build a methodological model that could organically evolve with gradual immersion into the topic. The decision to focus on empirical experience, particular case studies, methods of ethnographic and auto-ethnographic data collection and presentation in the text was the only honest way known to the author to conduct research in attempts to minimize deformation of the research presentation. Moreover, this study was considered by the author as a personal interpretation of the collected information that relied on the statements of recognized researchers. In this sense, the selected methods and the obtained results are justified by the dynamics of the study and the novelty of the topic. It must be recognized that the fragmentation of this study into several more focused individual studies could have had a beneficial effect on the depth of consideration of certain questions and the integrity of the text structure. However, such fragmentation is not possible without an understanding of the spectrum of possible directions. In the meantime, this same spectrum was comprehended and formulated based on the results of this research. Therefore further fragmentation should be done in further researches with the help of the outcomes of this study.

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Attachment 1. Transcript of the interview with Guy Ben-Ary. November 2019

Daria: I have a question about your neologism "In Vitro Intelligence" (IVI) in

           opposition to artificial intelligence. Could you unpack a little bit this concept?

Guy: Well, I don't oppose artificial intelligence. Artificial intelligence is a valid field of
           research. It is here to stay and it's quite a widespread and as you know, it's very
           fashionable these days. If you don't have artificial intelligence in your artwork, your
           artwork has no chance to be shown. I just don't think that it fits into what we are
           doing with CellF and other projects that I've done in the past, but also a few projects
           that I'm planning to do in the future.

           Because leaving entities or the emergence of those entities is not dependent on
           algorithms, computers or coded by people. It's biological and it's grown out of real
           neural networks.

           It has a lifespan, it dies, and it works in a totally different way with totally different
           capabilities (that we are not even aware of yet) then artificial intelligence. So I just
           don't think that CellF for instance fits into the AI definition. Nathan and Darren and I
           just finished a chapter for a book about the future of music. But this is where we are
           defining IVI (In Vitro Intelligence) for the first time. And we are working on a paper
           that is actually going to extend it and define it in a more academic kind of way. That
           would be released in February. But I will send you the paper today and you can read
           it. But this is the first time that we are trying to figure out what it is and along with
           another term that I think you may find interesting.

           You call it monsters, or entities, or chimeras, but we are calling it a surrogate
           performer. So surrogate performer is based on the in vitro intelligence. But it's also
           connected psychologically and through agency to the donor of the cells as CellF is
           connected to me. CellF is a surrogate performer. And I'm the donor of it. So what I'm
           saying in this paper and what I'm saying in general is that there's a taxonomic void.
           You know, we have a problem with the taxonomy here. We don't really have the
           language to describe what CellF is. Because if we're using the common terms and
           what people would normally use, they would use the term "artificial intelligence".
           But it's obviously not an artificial intelligence.

           It doesn't fall into this category. Whatever definition you would look at in the world
           of artificial intelligence, it's not that. So what we are saying is that we have a
           taxonomic void. There's some sort of a lack of language to deal with defining what
           CellF or this sort of work is.

           And therefore there's a need to define a new class of intelligence which is in vitro
           intelligence. And in vitro intelligence is those living neural networks that are based
           on living neurons which formed a network, process data and are capable of

controlling robotic bodies. So the potential for intelligence is in those living networks and not in computer algorithm. You know, it can do similar things, like learn and memorize and evolve just like artificial neural networks, but the neural networks and artificial neural networks are totally different.

Daria: In this case do you actually consider those neural networks or the entities that you are creating to be objects or subjects in your projects? Do they have an agency?

Guy: Yes, I think that they do have agency. Especially to the donor itself. But they are independent as well. They have some form of agency, but at the same time their existence and their operation, and the way they work is totally independent from anything. They just work. They just do. The agency has more to do with the source: where did it come from, where did the material come from. But the agency is not dependent on its function. Or its function is not dependent on the agency.

Daria: Therefore, do you consider CellF and Bricolage to be a kind of new life forms on their own?

Guy: Yes, I do. I do. Bricolage is a little bit different because it is not based on IVI. Because there's no form of intelligence as such: the classic kind of form of intelligence where data is processed and there's a process of learning, evolving and emergence. Bricolage has more to do with the inherent properties or characteristics of the material itself, the movement. But I do think that both are some type of neo-life entities.

Daria: Both in Bricolage and CellF as you mention frequently the idea of autonomy is obviously important. And I was wondering why is it so? Why is it so important for you to state this autonomy in them?

Guy: As an artist I didn't really like a lot of works that… There's just so many works around us that are very much dependent on kind of wizardry of programming and is dependent on the skills of the programmer to do this and that. And they control those entities like that. I don't really like where those kind of works, entities or what they are…I don't like when they are kind of play back a set of instructions. In my eyes the work is starting to be interesting when it's autonomous and then you actually let the material perform by itself without any connection or without any relation to the creator or to the artist…actually not the creator, but the artist himself or herself. This is what I like. This is kind of the sort of work that I like. In all my projects (and there's a few that I use neural networks), the one most important thing is the feedback loop. What sort of feedback there is between the entity itself, like CellF, and its collaborator, like the human musicians. Or in MEART it was kind of a feedback loop between the neurons and the robotic arm that was drawing pictures and so on. So these feedback loops or the autonomic kind of properties is where you basically create a framework, you create a world for those entities to live and operate. You just put it there and then they go and do what they do. And I think this is what makes it a little bit more interesting. It comments about the future in a more interesting way. Because what we are doing with those projects is basically we're suggesting contestable futures. We're not saying that this is how it is going to be, but we are saying: "Hey, look at this kind of scenario and look at this kind of story or

narrative". We are asking people to comment about it. And I think that the autonomy property of those entities bring the viewers closer to thinking about the futures in a more informed way.

Daria: Speaking of this losing of control over entities, do you actually validate anyhow the behavior of this entities or your artworks? For instance does they perform in accordance to your expectations? Do you have any expectations at all?

Guy: Well, expectations is a really funny word. You know, my mom has an expectation of me: she wanted me to be a lawyer and she wanted me to make a lot of money and I failed her expectations. I don't have expectations from those entities. But I understand your question and I think that this is where we are putting distinction between science and art, scientists and artists. I wish I could actually collect all the data that CellF has generated in the 21 performances that it did to start analyzing it and start to understand what's happening. I wish that I could do much more experiments so I could see exactly what's happening there. But that's exactly kind of work that scientists do, not really artists. And I think that this is what's interesting about most of my work, which is kind of like that. When the work is happening with those entities performing, there's always two kinds of experiments happening at the same time. One of them is scientific and one of them is cultural. I'm more interested in the cultural experiments. But with MEART and with Silent Barrage at least we had scientists that joined the work and they ran some background experiments on those cultures. And two of them wrote chapters in their PhD that were dedicated to Silent Barrage and dedicated to MEART. So there's a lot of data that was collected and looked at the behavior of those neural networks and what it were doing. I'm very interested in that as well. But I can't do it all. And I chose to focus more on the cultural importance or significance of those works rather than collecting data that would indicate exactly what those entities are doing. An interesting point is that MEART was the first work then we did Silent Barrage. So after MEART, we went to the Steve Potter lab in Georgia Tech and we did a residency there. And just when we got there they were working on a set of really important experiments, which Potter said that those are the most important experiments of their lab. And Steve Potter told us that the ideas or the kind of data, the preliminary data that led them to those experiments that where the most important experiments in their lab back then, that they've published it in a few papers and which was a big thing for them…the preliminary data and the idea for that came from them observing one of the cultures that was controlling MEART during the show that we had in Melbourne. So that shows a very interesting kind of way where the scientists kind of said this is interesting: there's something in the behavior of those cultures or the behavior of those embodiments that actually led us to think about this and that… So I'm not collecting the data but I am interested in it. In some projects scientists worked with us on that. And we had a few kind of incidents where the data that these scientists collected were significant.

Daria: Would you say any improvisations actually happening in the performance of these entities in your works? Do entities improvise?

Guy: Well, the question is: what does it mean to improvise? CellF does things, the neural network is there. It perceives stimulations and it generates controlled data that then is

being converted into sound. So I would say: yes. When you improvise you react to stimulations that you receive without any prior planning and this is exactly how CellF works. So, yes.

Daria: And what about the notion of embodiment? How significant is that for your practice?

Guy: Well that depends on what sort of embodiment you are talking about. Basically when I started to work in 2000, I was quite amazed because I knew nothing about it: that you can grow neurons outside of the body. So I started to work here with a scientist and we grew neurons. Then we took a time lapse photography of it. I could see that the neurons are doing things through videos. Then we started to work with multielectrode arrays material and electrophysiology. It was all interesting, but I understood that without embodiment the work is not going to be interesting. I mean I talked before about the importance of the feedback loop and without the embodiment you don't have the feedback loop or you couldn't create a feedback loop. Embodiment can be in various kind of ways. In MEART it was a robot, in Silent Barrage it was like a landscape of robots and in CellF it is sound. You embody it with sound. So embodiment can take various kinds of shapes and various forms, but it's essential for the work that I do.

Daria: My next question is about the comparison of Bricolage and CellF. Was it an intentional juxtaposing of these two projects in conversation of the traits of life? It seems like you're suggesting to compare this common cultural statements: "movement is life" in Bricolage and Descartes' statement "Cogito ergo sum" — "I think therefore I am" in CellF.

Guy: I don't think that I ever said anything like "I think therefore I am" in the context of CellF. I did not. But as for Bricolage, all my work is about life. It is about looking and exploring various kinds of modes of life. Because through advances in biotechnology we are now witnessing unprecedented amount of new forms of life that are being created in labs. So my work is exploring that. It's exploring the idea of liminal life, life that is not here and not there. It's kind of in between. And it's again looking at the taxonomy of that and trying to get language and discussion that would allow us to deal and to think about those new life forms and get away from the traditional notion of what life is and how life is being created. But this is a thread that goes through all my work. In CellF it was about data as neurons are producing data. You've been in the CellF performance, you know that there you don't see life in front of your eyes. You kind of hear life through the speakers. So there's some sort of remediation of sound. With Bricolage we wanted to take it one step further and to actually get people to see life, to see it with their naked eye, not through the microscope, not with the camera, just look at it. Best way of actually getting that happen is to work with movements because the minute that you see something move, you think it's alive. Even if it's a robot, even if it is mechanical and non-biological: movement equals life. People put a lot of attention to that. The choice of working with cardiomyocytes and getting them to animate bodies that are made from silk is a very clear and very straightforward artistic strategy that allows us to talk about life in that context.

Daria: And in that connection, it's obviously quite hard to work with cells and this kind of technologies in artistic research. What are your reasons to work with this material, why do you choose it?

Guy: I think I already answered it by saying that the focus of my research is life and to work with life you need to work with living systems, with living things. I was always very interested in consciousness. I was very interested in how the brain work. So when I started to work it was very interesting for me to try to deconstruct the brain and try to grow it outside of the body and look at what happens when neural network forms and ask questions about the possibilities of intelligence. The material is very important and the fact that it's alive is very important. And therefore we spend long hours and a lot of time, and it's very painful as you could see in Helsinki. In Solu Space we didn't get what we want and we just showed what we had. Without faking anything, just saying: this is what we have and this is what we show. There was movement, but you couldn't see it with your eyes. So the materiality of the work is very important. Because we feel that it's only by bringing life and only by bringing leaving material into the gallery that you can actually start talking or generating a dialogue with the viewer about those issues that are concerning: the nature of those technologies, what they're doing, the idea of creating life in labs. So the choice of working with the living cells in my work, was very easy for me to make. Otherwise if I didn't, I couldn't do what I do. There's no way that I could.

Daria: Speaking about the dialogs with the audience, could you remember any surprising or outstanding reaction from the audience during the course of exhibitions and performances of the projects that we are discussing?

Guy: There's a lot of them. CellF always generated quite a lot of emotions with people. But actually the one story that I'll tell you is from the early days when we did MEART. The neural network was grown in the lab in Atlanta and the robotic body was in Perth in the gallery. So those where not in the same place. The biology was in Atlanta and the robot was in Perth and we used the internet to connect between them. And it was early days of the internet, there was no Skype or Facebook. There was ICQ or Yahoo messenger. To do that we needed to have the PhD students from the NAME of the lab in the lab in Atlanta. We needed him to put the cultures in. And we were talking to him about how he is doing it, when he is doing it, when are we getting the robot going or when the computer crash here or there to restart it. So while the show was on, like from nine to five in Perth, so from nine o'clock to five o'clock at night in Atlanta, he would be in the lab just in case if something happens, if culture didn't work or he would have to change them. At one point I was in the gallery and there were like around 15 people in the gallery. And the robotic arm stopped moving. So I took the computer out. And we had a projection from the lab just to show people what's happening in the lab itself. We had four cameras: one in the incubator, one in the space, one looking at the neurons… anyway… I took a computer out and it all was projected on the wall. I took out Yahoo messenger or ICQ (I'm not sure) and I said: "Hi Alex, are you there? What's happening? The arm is not moving". And after a couple of seconds he came and said: "Oh, I don't know. I'm going to go and check the culture (the neural network) and I'll get back to you soon". And the 15 people were just really interested in this interaction, interested to know why it was not working, what happened to the brain. And in MEART we

called it MEART — a semi-living artist. Because it was drawing. After five minutes, he came back and he wrote one line on the messenger and it was projected on the wall. He said: "MEART's brain is dead. I will replace it to a new one, just wait a second". And he didn't really understand what he did when he did that. But he basically declared in a very dry kind of manner that the artist is dead. And that he's going to bring in a new artist. When you do tissue culture in labs, it's something that happens. It's not a big deal. But in that context…as this brain was drawing for a week and suddenly it died, so people got really, really emotional in the gallery. They didn't know and just started to ask questions. And there was someone who was really close to tears. Because they felt that there was death. Actually it was a very good thing for me because we took advantage to have a little chat with people: to talk about death and about life and try to understand what is MEART and what does it represent symbolically even. And I told them that when they brushed their teeth, they kill more cells than the number of cells that were dead as MEART's brain. But the differences is in that here it was associated with an entity that was operating in this world pursuing some sort of an artistic agenda. And obviously they felt very different about it. So it was a very powerful and very interesting kind of moment.

Daria: Right. But I would say that this is generally a common reaction rather than unexpected one. Right? This is how people usually react, at least from my observations, they usually do associate it with a living creature. In such cases they often showed empathy.

Guy: Absolutely. Yes.

Daria: What would you say about human musicians, the people who are actually performing with the CellF? Was there any feedback from them about the experience of interaction with it?

Guy: We can take the show in Helsinki as an example. It depends who plays. AGF was emotional, excited, interested. She was all over it. And we've been talking about it and she wants to play more. And she did research about it. She was talking to the neurons. And I think that her show and her performance was quite incredible. On the other hand, with the Defunensemble that played in the second day it was different. They are quite incredible, amazing musicians and from talking to Sami (Klemola) after it, I got that he really enjoyed it. He really liked it, but it was a gig for them. Just like any other gig. They came, they played, whether it was great or it wasn't great. They had comments, they had great things to say, they felt that maybe we should change this and that, and we all moved on. So it depends on the person. AGF was really into it. And with the people that we played with in Berlin it was exactly the same. The guitar player put some interviews after where he described CellF as one of the most complex entities that he played with before: an unexpected and weird choices — he called it. Versus the singer that sang with CellF the second day. She came and she did what she did. So yes we did get the musicians who were really into it, very curious about it, they asked questions. They like it, they love it, they hate it — we get all of it.

Daria: Would you say that with this particular project you got the results that you were hoping for? Generally speaking, what were the significant differences from the the original idea?

Guy: Well, I think so. I think CellF is a good piece and I think that people enjoy it or the musicians that play with it. For me, yes, I would say so. But you know I don't actually care what other people think about it. I want people to like it, I want this shows to be successful and I want the musicians to want to play with it, of course.

But what really is interesting for me is the nature of communication or the nature of the relationship that the human and the nonhumans form throughout the performance. How CellF is responding to the stimulation that it's getting and how the humans respond to the music that CellF is generating.

I think that in that sense every show is interesting and every show is great. Yes. I definitely think that CellF is a good…obviously I'm not very objective… but I think that it's a good piece.

Daria: I think so too. But if you would have a chance to start all over again would there be anything that you would want to do differently? From technical perspective or any other perspective.

Guy: There definitely are those. I have lists of things. But those will be the technical little things. Not the main idea in the main framework, how it works and what it does. So we could maybe add some different modules to the synthesizers to get different sort of interactions. Just stuff like that and simplifying a few kinds of processes. But otherwise I think that we are very happy with how it is and I wouldn't really change anything major or substantial.

Daria: After some years of observation of this particular work CellF, would you say that your understanding of this work remained the same or how did it change?

Guy: I don't know. I can't even remember what I thought about it three years ago. This is how it is with this works. It is very dynamic. I meet a lot of really smart people and I read a lot of things that smart people write about my work and I learned from other people, and I started to lose track if it's my idea or someone else idea regarding the reading of the piece.

The way I perceived the piece definitely changed and developed. Three years ago I did not think about the idea of in vitro intelligence. And I did not think about the idea of surrogate performers or the surrogate self. Those are terms that we made up only in the last year because after two years of exhibiting it we realized that we don't have the language to talk about it. I think that is the substantial understanding, substantial realization and substantial element in the discourse that we are trying to generate.

That is going to be the basis for the next work that Natan and myself are going to develop after the Bricolage that unfortunately right now I can't really tell you about.

Daria: In this case my next question will be about the "external brane" as an idea, as the concept, and as your personal perspective and feelings around the idea of growing neural network from your own cells outside of the body. Does it bring any specific feeling about the work?

Guy: It just turns the work to be very personal. Of course my relationship to it is not mechanistic.

But this is again exactly why we coined this term surrogate performer. Because surrogate suggests that I have some sort of a relationship with this living entity. The whole idea of this surrogate performer suggests that there's ideas of agency and ideas of identity, and some sort of a psychological connection between those entities that are IVI networks.

Where they are entities to the donor which in CellF's case is me.

So the first couple of years I was quite mesmerized by it and I didn't really understand it. I needed to have some sort of perspective to understand what sort of relationship you form with those entities that are part of you. Parts of you that are growing outside of your body while demonstrating some degree of autonomous behavior.

And this relationship is what I'm doing now as we speak: I'm working on this paper where I'm trying to think about those relationships that I have with CellF, those IVI neural networks. But trying to translate it into more general terms to look at

what sort of relationship would the donor form with his or her surrogate self.

I think that there's a lot to be said here. I'm still kind of thinking about it. The whole idea of the external brain is a very interesting one and I think that we're just at the beginning of understanding what it means.

Daria: Thank you!

Attachment 2. Transcript of the interview with Nathan Thompson. May 2019

Daria: I was looking for examples of the carbon-based A-life art and I thought of your practice. Aren't your works actually a certain life-form that is being established through representation and simulation as A-life should do but in vitro which therefore introduces the manipulations with an actual living matter? Therefore meeting this broad definition of the A-life art. So What is your opinion? Could we say that CellF and Bricolage are carbon-based Artificial life artworks?81

Nathan: The word artificial? I also like the word synthetic. Because when you're synthesizing something you are actually producing something new. When you use "artificial" it's like you're meaning "something less, something not completely up to original level".

Daria: Therefore are you suggesting that it should be something up to the original level? So it is not about mimicry in any sense?

Nathan: No, no. It was something other than that. It is not really mimicking anything at least in our works. But like you said when we are talking about "artificial" it is loaded with predecessors, I am talking about code and computers and it doesn't necessarily have to be that way. So we don't use the word artificial because of that. But maybe we would like to use the word artificial if people would be more open to the way it is used. In the normal verbal conversation artificial could pass if you have an ability to explain around it. But when using the word in interviews and on paper texts and without giving the opportunity to actually explain what you're doing artificially, it can be taken in a different way. Artificial is ok as long as you have the conversation around what you mean by "artificial".

Daria: Originally you were referring to your Bricolage's microscopic kinetic sculptures as to "microscopic biological robots that eventually have the ability to self-assemble in the space" (…) I believe this "robotic" part was problematized during the exhibition in the Solu Space. But you've underlined that it was used to point out the autonomous nature of the work. So I have a couple of questions in this regard:

1. Have you reconsidered the usage of term "biobot"? In what way?
2. Could you unpack a little bit the idea of Autonomy in Bricolage: how it is reached and why is it important?

Nathan: I think we are moving away from using the term biological robots. Mainly because as was brought up in the conversation in the Solu Space, it directed people in a wrong way and we used it in a very loose sense. But one of the reason why we are using it is because both Guy and I in the past were working with robotics a lot. It just seems natural to have this continuation of our previous work. And it has elements of robotics in it. Its reliant central kind of governing entity that is actually producing movement which a lot of robotics is. It uses engineering to sustain a life or life-like living entity. It has elements of science in terms of using modern technology in order to produce not only movement but again a life/life-like living body. And also touching on the point of self-assembly: it is a very hot topic in robotics. Actual hard-core, metal based, engineered robotics. And I believe self-assembly is an element

which all life forms of all kinds contain, right down to molecular level. And the way things fitting together…when things moving and producing entities bigger then a singular elements there is an overarching rule-based system where each element knows what the other one is doing, or they are predicting what the other one is doing. So they produced a larger body that is organized in a certain way. This was something we wanted to implement in the Bricolage artwork for a few reasons. Basically because it is something that is heart of life anyway. The mechanics behind the work is that there are these multiple little elements that are produced individually. And we wanted for them to have the ability to link up to make something bigger so we could actually easily see them with the naked eye without microscopes or anything like that. So we started to investigate ways where we could make multiple of the same elements and investigate ways in which each element could join up with other similar elements to produce something bigger in organized fashion. And this is where I think we were pointing towards robotics. So it was reasonably easy ??? For us to call this elements robotic entities. I am still thinking whether to use this formulation or not. I am not sure if it is going to evaporate completely but at the moment we are trying to find alternatives. Like I said 'automaton' is a good word. In terms of the self-assembly, we started to use DNA origami: using synthesized DNA and use it as a kind of glue. In a lot of biochemistry they use DNA to put things that don't normally fit together. But that is usually on a molecular, small-size level. We are hoping to use DNA to bond larger elements. These things that we are making are about 5mmX5mm. So there are some issues when you scale up DNA to bond large things. It's not only problems of costs but also problems of contamination. And we have to put it through ???? to sterilize it — that can actually destroy the DNA. So we are looking at way where we can synthesis DNA where you can bond in (?) many different ways. Using a computer programs we can actually predesign the ways in which this programs can actually bond. There is over 60000 ways in which DNA can actually bond together. We are not using all of them of course, but we want to use around 8-10 bounding base pairs so that we have maybe 8 or 10 different ways that elements could be fit together. So if we are using square shape elements, each of the corners will be treated as a DNA glue: one side as a base pair and depending on how I will treat each particular corner they are only bonding with a certain corner of a certain entity. So the basic ideas that if we release multiple entities into the same dish and during the course of the week they will be touching each other, swimming into each other randomly, hitting into each other, and the corners that are meeting are not compatible then they won't stick. But if they are compatible then they will stick, and they will create a permanent bound. So the idea is that with my predesigned structure over the course of the exhibition the shape will eventuate and create a larger automaton in shape that has been predesigned. But we haven't really had much success with the DNA and it's very costly, so we are working on the plan B: using a charged polymers where we can use only one base, like A and B style which is still possible to get quite complex bonding structures out of it and it's also cheaper and faster and less troublesome. So if we don't have any luck with the DNA we can always refer to the polema base pair. But DNA origami is more interesting in terms of complexity where you can control the way they bond. With something that only has one base pair there is less opportunity for you to build a complex structure that you have predesigned. You can still make complex structures, but it's more of a chance event rather than something predesigned.

Daria:	But is there any intention at all to predesign? Because as far as I understood, you can't really predict the way how they will stick together. And my next question was actually also around the way how you want to manipulate over their movements. How you are stimulating movement of entities in the desired direction?
Nathan:	They're not stimulated. The human cardiac muscle cells twitch spontaneously. It's part of the reason why we chose them. They don't need an external source for them to twitch and move. They just need the right elements, which are, you know, 37 degrees and 5% CO_2 and the right kind of food. So at the moment we don't control the way that they move so much. We're just investigating on how they move.
Daria:	Even in terms of giving directions?
Nathan:	Well we'd like to, we'd like to be able to do that, but it's fairly difficult for us to understand at this point of time the design of the structures and how that changes the direction that they're moving. It's an immensely complex intensive, how we are able to seed the silk structures with cardiomyocytes in a way that we align them a certain direction so they twitch in a certain way. So they've been in a certain way and then bend to move in a certain direction in media. There's so many elements there that we still don't have a full understanding of at the moment. We are getting movements, we are getting swimming, but we don't predict. We can't yet predict on which direction and where the movement occurs. it's just a matter of us investigating more, but we're consistently and successfully getting swimming movements. The idea is that we don't want to control so much the direction of movements. We want to have a better understanding on how the actual physical movement of the structure is working in order for it to be more of an aesthetic visible thing. But not so much in the direction where it swims. That's not really of interest so much. The interest for us is to build a larger structure over a period of time in the gallery space. So with multiple visits people can see that the entity is getting larger. The control of the way they bond on together, like I said, with this DNA Origami would be great, so we can predesign the shape that will end up being composed. But we would be just happy at this point at a time to see a larger device being built over a week or two. Irrespective of the actual shape. But we want to be able to quickly see in the next two months or three months the ability to self assemble: whether it's controllable or not is not so important for us at the moment.
Daria:	We'll get back to this idea of being able to see entities with the naked eye because I know this have been very important for this artwork, but I still have just a couple of more technical questions. Could you talk a little bit about the cells' planting on the Silk Patches? Why did you decide to make the scaffold this way? And is there any like more general, is there any symbolical or historical meaning for choosing this material.
Nathan:	Yes, earlier in the piece, we were just looking for materials that we could use as the scaffold. We looked at the deserialized vegetables. We looked at coral, we looked at the sea sponge. And then we discovered silk. Silk is a beautiful product because it's used already in devices inside of patient's ear drums, eyes, heart bumps etc. Silk is used quite a lot as devices inside the medical field. So there's already a lot of research on silk been done. And the reason why it's good is because it doesn't get

rejected by the human body. And we are using human cells, so it's important that the structure, the scaffold is compatible. It's a bio-compatible material. So that was easy to choose silk in that way. Because it already had a lot of history in the medical field. But also it's a rather poetic material in its own, right?

We are yet to really pick upon the cultural and philosophical things about using silk, but it has a long history coinciding with human control of the natural environment. I'm talking about silk worms in the textile industry. All those things. There is a big connection with how humans have shaped their environments in order to benefit the human endeavor. So that's an area where we will possibly go into. A lot of these things are really loaded with a subtext or potential subjects and a lot of them are loaded with cultural and ethical conversations or potential conversations. And we're aware of all of these things and we definitely welcome these conversations. In fact we expect these conversations to be had, but we don't directly answer to these things with the artwork. What we're interested in is actually in giving the platform for people to have the conversation about these things after they've seen the artwork. So after they've experienced the performance, which is important. One of the things that I think a good artwork does is that it leaves the person with more questions that one is curious about to find answers to. What I find a little bit, disappointing with some art works is that they give you the full answer and leave you there, when you walk out and maybe you've learned something, but you don't have any further points of investigation as a person, as an individual. So the artworks just sits by itself and just talk to people in this way. And when people leave and they may have enjoyed the artwork, but the conversation doesn't continue. It just kind of stops. But I think that with Bricolage it has got so many things that are loaded with cultural and ethical and moral things, that we want people to talk about and that we are aware of in making this work. Some of them were yet to be aware of course, but this kind of good when we talk to people about that. They teach us new things. But with the artworks itself when you sit down, we're not giving you any of the answers, which is filling you with the questions. So we used silk because of these loaded things, but also because it was already used in the field. And also it's a very great material to use easily. It's very malleable. Also one of the important things that I've just started to think about the silk, obviously, it's production kills lots of silk worms. Silk worms are boiled to death inside of their cocoons before they hatch out. So the basic plan is that humans have grown silk worms in order to take their homes. And kill the babies before they're born. Because once the baby's break out of their cocoons, the silk fiber is broken. So they need to kill the baby before it breaks out of the cocoon. So they have one long continuous silk fiber. But the silk that we use is liquid, so it's not a one long fiber. It's actually that fiber that serves us as material has been chopped up into millions and millions of minute pieces. And then it is put into a kind of bath and then stripped to the proteins and all these kinds of things. One of the great things that I hope to work towards is towards producing of my own silk where the silk worms are actually born, so they are not killed before the silk has been harvested. And then the silk cocoons that have been hatched can be used to make the aqueous silk. Making aqueous is easy, but it's very time consuming and labor intensive. So whether I end up doing it or not I don't know but it's not too difficult. So that would be ideal. And this is a conversation that will probably come up with when we start showing the artwork. Again this is one side of the argument that we want to talk about is that

textile industry, devices that are used inside of the humans bodies — all these things that are responsible for death of sentient entities. So that's the silk.

Daria: It just fit in so much into what I'm curious next to ask about. I was interested to know how much the social or cultural issues are impacting your works and if you are taking it into consideration when you're coming up with ideas for your artworks. And then like that as the beginning as the opening question. But then I was also curious to understand if you think your work somehow maybe reflecting and portraying the reality or you would rather considered, use them as tools to speak about the future or past and speculate about that for instance? Or is there another approach to this work? What is the way you would put it?

Nathan: I think it's all of it. That's why I find it so interesting to work with these materials. Because it raises up all those questions and speaks to the future on the directions where its going and hopefully shapes people's opinions about the way they feel about this technologies. But in a way that's actually displayed so that regular people — people that are not trained in the bio sciences can understand what's happening. Because there's a lot of hype about these things, organ donors, surrogate organs and things like these, that will help people in the future. There's not a lot of conversation, at least for the normal regular person about the social implications, the moral and ethical implications of using this technology. So this is one of the reasons why we use human cells. A lot of artists use other animal cells. I don't use any other animal cells for the work. The basis of it is that we wanted to be sure that the material of our work has been sourced from entities that have a choice and actually offering these materials. Silk is still one of the things that we have to consider. But the cells that we are using with the IPSc technology it come from a drop of blood, from a umbilical cord of a born baby, so from a mother and a child that are now living. Donated umbilical cord and the blood from that cord has been used to produce stem cells in an induced pluripotent way. So the blood was sourced and then reverse engineered back into stem cells from a human that had the ability to choose whether this was going to happen or not. Some artworks are made (not ours), but some artworks do use materials and cell lines from animals other than human. That obviously haven't given the permission, those haven't had a choice. Not only in terms of cells themselves, but for the media that is used to sustain the life. A lot of the media that is available uses calf serum, which is the serum from an unborn fetus of a cow. So when a cow is slaughtered for meat or leather, if it's a mother that has an unborn fetus, they take the unborn fetus from the dead cow and they extract this blood serum from this fetus and then they use that serum and they sell it as a product to sustain life in the lab. So it's called a fetal calf serum (FCS). It's everywhere. It's used in all labs, all over the world and used in a lot of artworks in biological artworks. We don't use those. We use alternative, synthesized alternatives. And this is a conscious effort. To not only spark conversation for the artwork, but also for us to feel as if our work is more based on an investigative process rather than a work based on sensationalists and ostentatious over-expression of hype of things like this. We are not so interested in hyping the work in unethical way. We find the most interesting things happening in conversations outside of the artwork itself. And in order for these conversations to happen, the artwork and the production of the artwork needs to be thorough. We need to be very diligent in the way that we work in order for the artwork to be

effective in the ways that we want it to be. I think that answered some of your questions.

Daria: I'd like to know more about the protocols that you are using. I believe that you had to create your own protocols and I wants to once again ask, why exactly, you had to do it. Why didn't you use those that are already there?

Nathan: There was a few reasons.We started when I was successful in getting a government grant. I'm not sure how long time ago but maybe three, three — four years ago. It was for a large sum of money, a large for me at that time. And I thought, oh, this is going last me the whole project. But then I realized that it was super expensive using human materials in terms of cardiomyocytes. Online, you can buy them. So when we first started experimenting I bought, a little vial of cardiomyocytes. Cardiomyocytes that have been differentiated that come from stem cells, they've been differentiated through all the stages and they finished as cardiomyocytes. And then these kind of cardiomyocytes you buy in a vial of a million of cardiomyocytes. It's quite a lot of dollars to buy them. I thought: "oh, it's a million cells that will last me a long time". So I bought them and I bought the kit. You can buy a kit to keep them in a media. You can buy a big jar of 500 milliliters. And I thought that I can experiment with this and then do the artwork. But I soon realized that it wasn't the right way to go there because for lots of reasons. One of the reasons was that once the cardiomyocytes have reached the end of the proliferation they don't divide. So a million cells will always be a million cells. They are frozen. So once you defrost them, you have to plait them on a dish and to keep them alive. And they don't differentiate any further and they don't multiply. So you've got a million cells and that's it. So for the media that I bought they don't give you the recipe. It's just a media in a jar. And you pay lots of money for it and it doesn't last that long. I found out that even if you don't use it all it only last like three—four weeks. So just a month and then you have to buy more. But they only sell it in big jars. And I was only using 1/10th of it. So in order to keep my cells living I had to keep buying these big jars of this other manufacturers' media. So it was becoming very expensive. And also I didn't really know any of the process. So in order to save money and learn more about the process, we decided to start from stem cells and then learn how to differentiate from stem cells into twitching cardiomyocytes. It was four years ago, so there was no documentation of people doing it. And of course the big pharmaceutical companies don't give you their secrets because they want you to continue to buy their materials. So they sell you the cardiomyocytes, but they don't tell you 'how', and they don't tell you if it's even possible if they can be frozen or if they can be sustained. They don't even give you the recipe of the media that you buy. So you're in a complete control of these big pharmaceutical companies if you want to only use these frozen cardiomyocytes. So we decided that we, in order to learn more about the material itself, which is very beneficial for the practice, but also to save money, we need to learn how to do it ourselves. So there is now a little bit, but there wasn't any documentation at that time on how to take stem cells and differentiate them into twitching cardiomyocytes. There was little bits of information here, there, everywhere. So we read lots of papers and put four or five different papers together and saw their similarities and then try repeat it: repeat their experiments in our lab using the same materials that they did. But of course each paper is using a different

cell line from a different place. So each cell line is minutely different and we weren't sure if it was going to work. In three years we managed to develop a recipe that got us some success with the cell line that we were using. So this is why we had to develop our own protocol — because there was no one telling us how to do it. But about two years ago or about a year ago, we made a connection with a scientist in Berlin — Sebastian Diecker. We were using his lab when we went to Berlin with CellF. His lab is Germany's main supplier of stem cells or even any kind of cells. They produce lots of cell lines in his lab. So he helped us out a lot with optimizing our protocols. So now we are using his cell lines that are optimized for twitching. And we are using a recipe that he helped us to develop for what we want to do. It improved our process a lot. So he's actually a collaborator on Bricolage now because he helped us so much and he continues to help us. So it started off as a necessity that we needed to learn not only for the artwork itself, but we needed to learn because there was no other opportunity. No one was giving us any information and you know, rightly so, because these companies are huge pharmaceutical companies that have an interest in actually protecting their intelligent property. But that's something that we want to talk about as well. These companies are in control of the industry and no one questions that. And here's another of the reasons why we wanted to use the word robotics. "If" in the future, "when" maybe machines are becoming a living in terms of biological machines: are we implicit in our ignorance of these things happening? Are we implicit with machines that are sentient? Are we implicit with slaves are being produced that have no choice? Even if we sitting at home and we don't know that these things are happening. Is it our ignorance, we're not talking about them, how they actually implicit in this future? So I think one of the reasons why we chose robotics early on was because that's kind of a word that speaks to people a little bit better then 'automaton'. Because basically what we're doing as humans — we are producing slaves. And when those slaves are made of living biological matter, how does it change how we see these machines and how we believe that these is machines. So that's part of the reason why we chose robotics. But aside from that, these machines are being controlled and produced by big companies that are not transparent. They're opaque companies that don't tell you where the cell line is from. They don't tell you how they source that cell line, they don't tell you all the information you need in order to reverse engineer the cell line and don't actually give you the ability to do it yourself in order for you to learn outside of their control. So all of these things we've managed to circumnavigate and circumvent in order to bring an artwork that actually is able to talk about these things effectively.

Daria: This was actually another question of mine in this line of conversation about exploitation of organic matter as not a material but more like a living entity that is supposed to work for our sake. It was interesting how in our conversation the other day you were saying that in the beginning of the project when you've managed to produce the first patch you were very attached to it and you kept it alive for 3 months and only after that you had to stop feeding it. I find it interesting. Are you nowadays considering it more as a working material, what is your particular relation with it?

Nathan: The one that you're talking about that I was attached to: those weren't my cells. Those were the cells that I bought from the company. But I was attached to those for a few reasons. Of course, when you first see these thing moving and have this

feeling: "wow, this is something I've made, you know, this is my little baby and that feeling doesn't go away. But I wanted to keep it alive as long as possible for a few reasons. Of course I was attached to it, but also I had so much invested in it in terms of money and time. And at that stage I didn't have a trajectory on where I was going with the next thing. I needed to keep it alive in order to learn more about it, but I couldn't learn more about them because I didn't know how it was living, I didn't know how it was working. I didn't have any knowledge at that stage about anything really. So I wanted to try hard as possible to keep it alive in order to continue investigating in how to use the material. I'm still attached to the little babies that I make.But it's more of investigative kind of curiosity. I think the trade off actually using these materials in the research to produce this final artwork outweighs the cost of disposing of the research materials along the way. Now let's go back a little. The cells that I'm using are coming from blood. The blood plasma cells reverse engineered and gone back to stem cells. Then from those stem cells I've directed them to go twitching heart cells. When they're plated on to a silk body they are align and synchronized to produce a lifelike movement. In a controlled environment that I've built and that can be turned off at any time. At this point in time I'm hoping that the artwork, when it's presented, will raise the same questions of concerns that I'm having while I'm working on the research. But hopefully in a more amplified way. Also in a more broad sense with the amount of people that will see it. So I set aside my feelings forwards for the hope that people that experience the artwork have feelings four it.

Daria: Going back to the topic of elimination of mediation of the artwork and making the process visible with the naked eye. I think it fits also into what you're talking about now. Why did you find this important for the work?

Nathan: Over the last 20 years Bioart (which I hate the word term), biological artworks have been displayed with the main operand of the artists is that the audience members trust the artist to show work that is doing what the artist says because we're living with. Because the artwork is using a material that cannot be seen with the naked eye (artworks in terms of previous biological artworks). Two things can happen. You're using technology to amplify things so people can observe or experience them or you're leaving the material at its normal scale. And I'm offering it up in a gallery space to audience members to believe that that's actually what's happening without actually seeing it, or hearing it, or feeling it. And whether it's true or not, whether the artist had done the work or not, or whether it's alive or not is not really easy to see or experience or to check. It's difficult to check. I've always thought that that's a little bit of a disappointment, not only for me as a person that goes to see these art works, but also the disappointment as for the whole art form. Because it creates some doubt. Unfortunately we know that a lot. I wouldn't say all and it's difficult to say how many, but a lot of biological artworks are not doing the things that they are said that they are. They're displayed in a way that is not telling the truth. And perhaps I can see that because I'm working in the same field and I have a little bit more of an understanding how these things need to be done. But I'm sure these people in the general public would have the same feelings of disappointment and the same feelings of distrust about these works. And it's not good for the industry and it's not good for the artwork as a whole because an artwork is supposed to be trusted to spark lively

conversations. And if the audience, for example, feels as though the artist has not been truthful or the artist has not done all one can do to do the best practice, then, it's a missed opportunity. And it creates uneasy feeling that continues. So with this art work, I wanted to eliminate all these uneasy questions and feelings but of course when you want to do that it creates a whole new world of anxiety. Because as you saw it's incredibly difficult to do what we want to do. And there are things that pop up unexpectedly that can make the artwork fail. But nevertheless, I think it's important that we work hard to produce an artwork that is not mediated by technology. Well it is mediated through technology with the minimal amount and the audience members are able to experience the work as integral as possible to eradicate all of these feelings, but also to get them closer to the material itself. When you look down a microscope in the lab it is still kind of a little bit disconnecting, although it's really great to look down a microscope. There is this kind of disconnect. It feels like you and the material is distant. Also when you're looking down the microscope you're in your own world. There's no one else viewing the same things that you are. What we've found is that we, in situations where we can see the twitching cells in the dish with other people next to us both feeling the same thing at the same time — it's much more of a visceral experience. When I decided that I wanted it visible to the naked eye, it meant that the person that's observing the work is as closely as possible connected to the material itself. So there's no screens, there are no cameras, there's no monocular microscope things. And also I want to take it very far away from the lab kind of aesthetic. You know, I want people to feel like maybe it's part of the furniture or maybe it's something that's not out of a lab but part of the world.

Daria: My followup question is about the design actually. On one hand from the perspective of supporting system to sustain the life, like more technical aspects of it. And on the other hand also from the perspective experience creation for the audience. What are the milestones of this two aspects of Bricolage's design? Why did you choose to make it exactly the way you did? Are you planing to stay with the same design for the future versions of Bricolage?

Nathan: The prototype at Solu was in that orientation for a few reasons. Let's start from the beginning. That wasn't the original design and that wasn't planned for the final designed to be anything like you saw in Solu. When Eric (Erich Berger — curator of the Solu space) invited us to come, we told him early that we don't have the artwork made yet, and there's still so many things that we need to investigate, but we can show a prototype. And the original idea for the final artwork was something that hangs off a wall. That is a round kind of a dome-shaped thing that's staged at shoulder height so people can see it from all different angles. And that was going to be made of very organic materials. Not metal or not shiny metal, but lots of clay and maybe some leather. I don't know, maybe not leather. But we didn't have enough time to do any of that. And of course it's very costly. So in order to show what we did at the Solu, I had to make a prototype as fast as possible for as cheap as possible. But still sticking more or less true to what we wanted: absence of technological mediation on the digital side of things. And the environment had to be sustainable for life and that needed to be visible to a large proportion of the population. So really the only thing that I could think of in the three weeks that I had was to build something that hangs above your head. Also that the petri dishes on the inside of the incubator

are above viewing platform and you look up into it and you're able to see the entities. As you found out, the heating elements were too close to the dishes and they dried out the dishes. But here in the lab when we had those dishes in the incubator and we didn't feed them and we could have them living in a normal incubator for a week. So that was the plan: to have it in a space living above your head without me having to feed it for seven days. That was the plan, but it didn't happen. But one of the good things was that I learned a lot from building that prototype. A lot. And it has helped me to think more about how I am going to make a final piece. And I kind of like the idea of it sitting above your head. So we may have a show of the final piece next year in January. So I have to start making it soon. I think it will be hanging over the head. For a lot of reasons. I don't want it to be sitting on the floor because there is a lot of artworks that kind of sitting on the floor, almost all installation works are sitting on the floor. I want it to be easy to be freighted around the world. It needs to be broken up into smaller pieces that are easily transportable. It needs to be simple to set up and with minimal work on the gallery space. So those sides of things are pointing towards, for me at least, towards something that sits above the head that's kind of in a circular formation, like a round donut shape. I like the idea of creating an uncomfortable feeling for people to see the work. There's a number of ways you could read into that, but I like the idea of someone not being able to stand there for a long period of time. We did find out which was a happy accident that the lower you go, the shorter you are, you actually see it better because of the optics. So you're actually seeing it better if you've got a regular eyesight. So that was something that I was happy to find out. And the materials are going to be a clay. Cause Arki, my wife is a potter and we just installed a kiln in our house. So we're going to make a kind of a big clay donut.

Daria: Would the interaction remain similar? People would approach it and could observe it from the bottom, right?

Nathan: I think so, yes. The way that it turned in Solu, the way that it was installed was not very well thought out. Well, it was thought out, but it didn't work so well. So I'm going to use different sensors that actually have a proximity sensor. So it will be for each one individually: when someone's underneath it will turn on instantaneously and go off when they leave. I think it's going to be in similar orientation, but it has to be easily transportable. And also thinking about having it to sustain life for months rather than weeks. So I want to be able to work on some kind of drip-feed mechanism where the media is preheated and then dripped into the dish. So I can set it up and leave the country for like two months and the work will still survive. That kind of idea. There's nothing like that happening anywhere in the world. So I like the idea of being able to have a biological artwork that I don't have to attend. I set up and leave. That'd be great.

Daria: Something obvious we discussed and experienced in Solu is that it is very challenging to work with cells and relevant technologies in artistic research. It is probably always a quiet complicated things. Why do you find it beneficial for yourself and your practice to work specifically with this materials and technics?

Nathan: Because there's so many things to learn on so many levels. There's things to learn in terms of being able to produce the work. There's things to learn about how to display

the work. There's things to learn about how to sustain and there's things to learn about the material itself and the ramifications of using it as an artwork. And there's things to learn about the material itself and the ramifications it has on human endeavor. So all of these things are about learning and I like learning. I like using materials that I don't know anything about. I liked being a little bit cheeky and using things in ways they're not supposed to be used. And it's something that is very new that it's difficult to find information about. So in a way no one can tell me that I'm doing something wrong. So like for example, if you go to art school and you want to study painting and your teacher there is going to tell you that you shouldn't paint like that, you've got to paint like this. Or you go to design school and design teachers tell you that you can't make the mobile phone like that, but have to do it like this. So the material itself gives you so much opportunity and potential to do so many things. Those things that I haven't done before, haven't been able to do before. Also I've found myself in a really unique situation where I'm living very close to this lab here. And this lab is associated with SymbioticA. And SymbioticA is one of the only places in the world that allows artists to work alongside scientists. And when I discovered that SymbioticA existed I decided that I should invest some time into learning more about the biological arts. Because not a lot of people get the opportunity. I think I have a lot of things that I can investigate and question by being here. And also because it's really fun. It's really fun to work with life. So to manipulate life and work with life is fun in a way that I can question things and learn and I'm always stimulated that I can get up in the morning and have a job to do. I think I can really learn new things. That's what I mean by fun, because I want to always continue learning new things. I find it boring doing the same thing all the time or at least doing something somebody else has done before. I'm not really interested in going over somebody else's catalog. I want to see if I can do stuff that is new.

Daria: I have more questions around this topic of the notion of the creature. I was curious if you even consider your artworks like CellF and Bricolage to be some kind of creatures in the way how the artworks are done and when they are ready? Whether we are already having this self-assembled sculpture or this entity that is playing the music. Do you think they could be treated as beings in a way?

Nathan: Yes, but I wouldn't use the word creature.

Daria: Entity?

Nathan: Entity — yes. It's fine using the word creature of course, but I wouldn't use it. Because for me it has in it an inkling towards something that goes towards a direction that I'm not really so fond of going towards. The term 'creature' at least in English is associated with the mythological beasts, with fantasy, associated with unreal things or dreams or fictional characters. If other people call our works creatures, that's fine. But I wouldn't use the term because the things that we are making are real. I want to instill in the fact that people when they see the work, they are actually seeing the work and they're actually seeing something is real. So I don't want to create any doubts. I want to reduce the amount of doubts. Through using the right materials, through using the right method of displaying and removing any opaqueness and trying to be as transparent as possible. Whatever question arises I'm

happy to answer. So by using the word creature I think like I said, it would start to bring in some kinds of mythical.., something that's unreal. At least in my understanding of the word. So I would use 'entity' because the entity is more connected with present living objects rather than creature — meaning historical, fantastical or mythical.

Daria: Well, that's interesting you're saying that because it's good to know that I managed to translate exactly the idea. Because what I'm having in my mind is that this new media entities they could stand a little bit for the cultural phenomena. And kind of explain them or illustrate them. Or try to imagine how some cultural phenomena would develop in the future. And you can actually trace how that somehow reminds you of the way how people in the past through mythology and mythological creatures used to try to explain the world around them. And that's what I thought about this digital media artworks. Media creatures as beings for explanation of the technological world and techno culture, maybe the 21st century in a way for our society.

Nathan: It's a great angle and it's something I haven't thought about. It's true. I wonder if we are talking about when the myths are made, historically when people are creating stories for example, are they creating stories about things that are happening right now or are they creating stories that happened in the past? So when a a myth is produced, when a myth is born is that telling a story or create it about something that is happening at the present? Can you think of historical precedent of a creature that was created previously or created now or anything. Because maybe that's why the word creature has this feeling of mythology is because the word is used a lot because of the things that are happening in the past. But of course, as you said, the reasons why all these things are made is actually to talk about certain issues. But I wonder if these myths are born in the present day or whether they're talking about things in the past? Wonder if there's some kind of way that you can introduce some prefix. It is prefixed that you put in front of a word to actually make it do something different? I wonder if there's a prefix that you can put in front of creature to actually say that there's something that's happening now or in the future. Like keep the word creature, but actually ad some kind of prefix. That's interesting.

Daria: Were the CellF or Bricolage inspired by any cultural, mythological examples, something parallel from the past? Another reason to ask it is connected to the way how Guy Ben-Ary is frequently referring in his talks to Frankenstein, which is also like the cultural creature in certain ways.

Nathan: I would say no, there's not. There's lots of artworks and artists using historical references. But I don't think that we are doing it with Bricolage. Frankensteinian points were pointed because last year was the anniversary of Mary Shelley's Frankenstein. But also it wasn't the basis of the work, but actually once we started making the work, the similarities with Frankenstein monster, were very apparent. Putting things from different areas, different parts, and mashing them together to make something new is what really recognized the word in French: bricolage means to put together things from different places to make something new. Bricolage has a reference to DIY kind of culture historically. But in terms of any historical myths other than Frankenstein I don't think I have any interest in doing that. What I am

interested in is actually trying to flesh out more about the history of silk and how that works with Bricolage. I haven't found much yet, but I think there's definitely something there. I know a lot of artists do it and I know that Guy has done it and perhaps it's something that we should think about a bit more. But I just haven't thought really about the references to the past. I just haven't really considered it much. But I will with the silk as I said. Do you think it's important for an artwork to actually reference?

Daria: I think it really depends on your own practice and your own approach. And if it just doesn't fit into how you construct these things, then it doesn't have any need to be forced. So it's more important for media arts historians' perspective to try to trace this connections because then you have this lineage. There is a continuum, there should be a continuation and it's quite archetypical. And then it is also helpful in finding patterns, repetitions, differences in different cultures time-wise and territory-wise. Because then you can kind of analyze the cultural aspects of human beings. But for artistic practices I think it really depends on your approach.
But can I ask you a couple more questions regarding design choices? Could you remind me what was serving as the inspiration for the visual and sound design of CellF?

Nathan: So many things. Both Guy and I set almost for four months trying to flesh out how we want to do it. You know, I'd sit with him, I'd sketch and then I'd go home and I'd do more sketching and then I'd come back and then we talk more. And you know, it went on and on for months and months and months. But what came out of it was that we realized that we're really similar in our (cause this was the first project that I worked with Guy) so we realized that we were very similar in our upbringings, similar in what we're interested in, similar in so many ways. And it basically came down to our influences and in terms of the music styles that we liked and also the artworks in the past that we liked. So there is an Italian futurist called Luigi Russolo, who in the 1920s made these noise machines and they are these boxes just with these big horns on them. And they produce sound. He was basically the first noise artist. So he was a real big influence in terms of the aesthetic of sound for the CellF. The aesthetics of the piece were inspired by Russolo's machines as well, but the dictating factors of actually how the CellF functions is more evident in its final form, than in aesthetic influences. So, first of all, it had to be a working lab, so it had to have an incubator, … sterile hood working environment around the back so we could feed the cells and it has to contain all the things we need to keep everything alive, as well as the interface for connecting the neurons to the module synth and the module synth itself. So it needed to be rather large to have all these things, but it needed to also be demountable so it could be packed away and reasonably sized even though it is still quite big. It needed to work in a gallery space as well as a live stage environment. It needed to be able to stand on its own. So it didn't need any support. It needed that people would be able to walk around. It needed to be imposing. So it needed to have a feeling of imposing on them. So it would actually feels like it's actually overbearing. We came up with all of these things after months and months of talking. Speaking of the the shape of it. What's actually happening in a molecular level…and it's indicative of that. So what's happening in the molecular level is that we're taking these minute millivolts from the neurons and we're amplifying these millivolts to

larger volts. These voltages are send through a modular synthesizers and then out through speakers. So inherently the electrical signal from neuron to speaker still has parts of this same voltage and translated and mediated. So there's a direct link from neuron to the speaker. The idea of the CellF being a jamming semi-living musician plays a role in its aesthetic stands as well. So what's happening is that the neurons are producing voltage. It is going through the synth and then from synth it is going to the speakers thus producing the sound. And then this sound is heard by human musician. And the human musician is producing a sound and that sound is put back into the neurons as stimulation. So it's like a feedback loop (*important additional explanation with gestures to be seen in addition to text: video recording at 1:40:20h). More or less like a feedback where you have a microphone and you have a speaker and you put the microphone in front of the speaker and there's feedback. So this form is really what's happening in CellF. So we have the neurons. The neurons producing a voltage. The voltages are going out through the interface and then the signals are amplified and then producing sounds. It's a feedback machine. The shape that you see is indicative. It's not actually a sound producing body: speakers are around the space. But I chose this shape because it's kind of indicative of what's happening. But also it harks back to sound lab aesthetics from the 50s and the 60s where it all made from metal, gray and black machines: speakers were huge, huge drivers that we used for live events and military purposes, all of these things. So that was the driving force for the aesthetics apart from it having to be able to be broken down and unscrewed box together. So each element can be taken out and then put over another one. They're all kind of packed down in a way that's as easy as possible. So it's half indicative of what's happening in a molecular level, half harking back to historical references. And the third half: it's actually a necessity to contain all of the things needed for supporting the artwork itself.

Daria: How about the specifics of the sound itself? I imagine it's still quite predesigned in a certain way. Like the way how synthesizers sound.

Nathan: Yes and no. Daren who you may have met — he is the musical side of the projects. He works with the human musicians to produce the performance. He works with the modular synthesizer. So you probably saw, or you may already have an understanding that the synthesizer in CellF is made of certain modules and these modules. And this modules are all independent and the only way they can communicate with each other is through a patch cable. So you patch the cable from the outside. So there is human's decision — Darren's decision to make a certain connection with one module to the other. And it is not audio, but it's the voltage that goes through that cable. So these each individual module that you see has the language that is voltage. So the only way they function is through the voltage. They produce sound, but the way they talk to each other is through voltage. So the voltage goes from one to the other through these patch cables. And there are choices: choices made by Darren in order for what modules are connected to what modules. But the instance of the original voltage source is the neurons. So he's just routing the voltage. Basically that's what he's doing. But he's making aesthetic decisions on the sound as well. So there is, like I said, some control of his placed over the palette of sound that is heard, but there is also a lot of control ceded to the neurons themselves and their erratic, chaotic behavior. So when we say that there've aesthetic decisions been made

— yes there have, but there is also a lot of decisions that are made by the neurons themselves, which is important for the work. And also more or less the use of modular synthesizers with neurons is very poignant. Because they communicate in the same way really. Neurons communicate through voltage with other neurons. They make connections with other neurons that sometimes work and sometimes don't. Some connections to other neurons are weighted stronger than others. Some don't happen at all. And the way the modular synthesizers are patched and programmed is similar. So there's a lot of control given up with the performance of CellF. And it's important for human musician that the CellF plays with to understands that the machine, robot or entity basically does what it wants. If it's not sounding nice to our human ears, it doesn't make any difference to the neurons if it sounds nice or not. There is a lot of thought put into it before the performance by Darren and the musicians to actually try and control it. But it doesn't always happen. Sometimes the human musicians get frustrated by not being able to control it. Which is good too, which is great. I like watching the human musicians stress out because they can't control CellF.

Attachment 3. Transcript of the interview with Erich Berger. May 2019

Daria: As we discussed earlier, I'm having plenty of assumptions grounded in observation that were collected during last two years during the master's program. And I was hoping that with your opinion we can try to dissect some of them in order to analyze certain patterns around technologies, and tendencies that preoccupies artistic and new media world generally speaking. I'd need that for a better understanding of these topics to investigate them as a kind of a framework for my research.And generally speaking, you know, that I'm looking at new media art creatures, which for now I'm defining as media artworks, which are embodying or seeking to represent or create the living entity in any form regardless of the specificity of medium. And I'm trying to conceptualize them to distinguish their primary features and properties in relation to creatures purpose like social, cultural, ecological reasons to exist etc. So there are certain concepts which I find interlaced with this topic and I believe that you should have much more clear and more complex understanding of the current state of this concepts. Because those are directly related to your curatorial practice. And those topics are generally discussed in the Bioart society, like in the papers and in the Field notes and generally in the discursive realm that you're immersed in.So I'd like to ask you about those. We can just begin with for instance, the hybrid ecology concept. First of all I'm interested in the way how Hybrid Matters symposium addressed the topic. I was curious if there was some kind of coherent, collective shared understanding of hybrid ecologies as the concept and its position in arts and science domain. And if so, what was that? If not, could you describe the main oppositions?

Erich:

So the hybrid ecology was somehow the conceptual umbrella for Hybrid Matters and to define that term is not too easy also because it is actually not a term to last. It is somehow a term which is temporary standing for something that we don't have a name yet. A couple of years ago, let's say, the distinction between the living and the non-living or the natural and the technological was somehow quite clear. It was very easy to grasp. At least intuitively, let's say. But this distinction between the living and nonliving or artificial and natural, all this kind of binary in which we set up, that eroded quite quickly. When on the one hand we realized that humans as a species are able to manipulate the earth system on the global scale.

Like in the Anthropocene: human impact through technology. And on the other hand when the biological became technological, well basically when biology was not a domain of biology anymore itself. Where you basically have nowadays biological creatures, but they are basically technological in nature because they were designed or they can be designed. So this concept of nature, what we have been

happily indulging in over the last 200 years didn't work anymore. Because it only looked at the biological side of our environment and as the technological became in its massiveness in human massiveness environmental you cannot talk about nature like that anymore. It doesn't exist anymore. There's no spot on this planet which is not touched by human activity.

So for a lack of having a name for how to call this convergence between technology and environment or technology and ecology we named it hybrid ecology. Meaning exactly these two things, these ideas which we are previously thought separately: like technology and nature coming together to form a new entity with new qualities. And giving this name 'hybrid ecology' for not having a better name for that very moment. But also willingly temporarily so that we actually are able to find out what is that actually what we are experiencing and seeing here. When I say that the environment becomes technological, that technology becomes increasingly environmental I mean that really technology is a hyper object. It is something which is basically everywhere has an impact on this planet. That can be through infrastructure, that can be through computer networks, that can be through communication media, that could be through unintentional consequences like pollution. So all these together form basically new agency which have a say in our environment and so a part of our ecology.

So hybrid ecology in a sentence basically investigated the conversions between ecology and technology and its intentional and unintentional consequences. Is this somehow answering the hybrid ecology question?

Daria: Generally speaking, yes. But could you try to maybe describe the key features of hybrid ecology at the moment? Like if you would try to put it in some categories.

Erich: Well, an ecology is some sort of a network of agents which interact with each other. They are interdependent. And in a traditional ecology these would all be biological actors. Like for example, if you look into a pond or if you look into a lake then the ecology there is very well defined. There are microbes there are some algae and they're crustaceans and fish and maybe amphibians. And then there is the water which they have in common.

And then there is some interaction with the outside and that build somehow this kind of environment where these creatures in interdependency live from each other. And in the hybrid

ecology additionally to this biological environment also comes the technological environment. So in a hybrid ecology, you could have gene manipulated crops, you could have synthetic biology organisms, both are basically synthetic, both are kind of technological. You can have robots like a self-driving car or drones, communication infrastructure and why that is part of the ecology is through the mechanisms of energy and of materiality. And then of course also through the impact they have themselves when they act upon the place.

For example: Denmark windmills. So the material for the windmills to function are these magnets, which are mined in China, which whether we have somewhere in the Mongolian desert which kind of spills out all kinds of poisons into the environment when the material is mined. But then this material is brought to Denmark it is turned into windmills which generate this "clean power" — I hope you get the sarcasm. And then enable life here, for example, in the city. So hybrid ecology is not necessarily only something which is happening in one location. The connections in a hybrid ecology can be because of telepresence or because of global market, they can be anywhere.

An interesting video for you to watch maybe would be the Liam Young "City everywhere". We talk about the hybrid ecology. He talks about it as a city. Artists are investigating this convergence from many different perspectives. And they find also very different words and concepts for it. And that also emphasizes different aspects of this convergence. So I'm not saying that we are the only ones who have been working on that. Some other people have been also working on that and they found their own language and their own way of navigating through this emergence of something here.

Daria: So when you're saying "we" that would refer mostly to the Bioart society generally speaking?

Erich: The people who were working then together in Hybrid Matters. You'll find that all very well documented on the Hybrid Matters website. It was a Nordic network project, which was led by the Bioart society. And then there was the IT — university Copenhagen. That was Laura. There was the Malmo university. That was back then Kristina Lindstrom. And there were three exhibition places which were: Kunsthall Grenland/NO, Nikolaj Kunsthal/DK and Forum Box/FI.

Bioart society basically gave the umbrella and the others basically were working then on their own kind of research, or

project, or exhibitions under this umbrella. And they Hybrid Matters conference in Helsinki was basically summarizing it.

Daria:

This approaches you were just describing regarding the interconnectivity between windmills' pieces that are originally coming from China etc. It fits a lot into the media archaeological and geological thinking paradigm. I can recall this moment when in Solu you were saying that the binary of artificial and natural doesn't work anymore. And as far as I remember it came in the discussion about ecological thinking and a colonial thinking through this like media archaeological prism. So maybe now you could unpack a little bit the ecological thinking concept.

Erich:

Why I was referring to this binaries that do not work anymore is exactly because of what I said before. Because what we believed belonged to the domain of the natural is created by tools which we think of in the domain of the artificial. Like for example, making new organisms. Just last week, maybe you have seen the article about this completely synthetic E. coli bacteria, which was created.

So the bacteria is actually quite a complex organism. Let me quickly remember. Basically they were putting together a genome for a minimal version of the E. coli bacteria. Those scientists were basically cutting everything away, which they thought was not necessary to live. And it lived. And they were basically not only cutting it away. They were actually putting it together. They put those parts together, which they thought that are necessary for the bacteria. So it's basically not that they use the bacteria and cut with scissors away, but they basically assembled the bacteria completely from smaller parts.

Daria:

What was the purpose of cutting it in the first place? I don't really understand, to be honest. They assemble it from the parts of the same bacteria?

Erich:

No, they synthesized the DNA and put it together and then they put it basically into an empty shell. And all the sudden we have something like bacteria which we normally believe is in the category of nature, of the natural, but it was completely synthesized. It's completely artificial. And this is why those two pairs do not hold any more: because you cannot use them to distinguish in such a hybrid ecology.

Daria:

I also believe that Laura Beloff suggesting something similar when she's comparing technological and biological and speaking about 'techno-organic' as her own term, trying to

discuss the blurring border between something that is created by nature and something that is established artificially. I guess this is the same thing, right? At least it is the same pattern of thinking.

Erich: It comes from the same awareness that something is different, that something is new and that the words and the language we are using is no longer applicable to that. So it's just a search for language and this is why you find also these different terms. Like techno-organic or hybrid, or hybrid ecology, or city everywhere. They all basically point towards this one symptom that these words, this language we have been using to talk about us to talk about nature, to talk about biology, to talk about technology that we need new language to formulate what has changed.

Daria: And I guess that was the reason that from this perspective, you were somehow against this approach of mine that I actually borrowed from K.Haylles research when I was suggesting to categorize a creatures based on their medium: like hardware, software or wetware as their medium.

Erich:Yes.

I also have another dichotomy, bias terms that seem to be fitting to discuss with you. Can you trace this parallel between distinction of culture and nature concept?

Erich: Yes, I think that that also points to the same problem. Because 'nature' concept as we still use it as a concept which comes from the romantic period. And it is also interestingly a concept specifically in the Nordic countries, which was literally painted into being. So the painters of the national romantic era they have been painting what we now understand as nature when we look outside. And one thing what they actually tried to capture is the sublime. The sublime back then was a new aesthetic category. And it was said that this sublime is this feeling of smallness, of greatness, of mightiness, of maybe melancholia and kind of aloneness when you encounter certain natural phenomenon like the ocean. Maybe you remember these paintings of Caspar David Friedrich. Where you basically have this tiny figure, you don't see the face when it looks out into the ocean. Or you see the mountain scape. And somehow the art world or the painters were quiet envious, you could even say. Envious that nature has such a power over men that it can give such a feeling.

Part of this national romanticism is basically to try to capture this feeling and to be able through art to generate such a

feeling of humbleness and of mightiness. And because nature was able to do that, they painted nature, this is why the nature was the topic…or those spots. Back then it was probably not even called nature, I don't know. But anyway, since then we have an idea that there is this kind of mighty spot, this mighty landscapes, where I just feel small part of it. Through that they (those spots) were separated from humans, at least this is how I see it. All the sudden there were humans and there was nature. There was culture and there was nature. There had been this separation. What else happened with the separation is an idea that there is always somewhere nature where I can go and also a lack of awareness that this nature which is not part of me is actually the basis of my living, the basis of my survival.

And now we come to the Anthropocene. Where basically in everyday life we understand and learn that this division of nature and culture, of nature and human is actually self-harming. That actually the impact of humans onto nature is so big, or can be so big that it actually is self-harming. So nature —culture basically is another way to say those things are not separate. They are not independent from each other. Culture acts upon nature and nature acts upon culture.

Daria: Also I was curious how would you then suggest to understand bioart nowadays? Because it's quite a complex term and I do know that it's quite problematic one. It's even that Bioart society is trying to reduce the usage of it as far as I understood. So I'm trying to understand 'why?'. Where exactly is the problem with this term and how is it possible to communicate something that have been called bioarts in a different way? How can we name it in a different way?

Erich: Originally bioart was an art practice where artists used living biological material as a medium for their art. And so they went into laboratories or made their artist studios into laboratories so that they could work with those, with life as a medium. And it was specifically towards biotechnology. But the question of life is bigger than the question of biotechnology. Especially considering that there is an intentional manipulation of biology through biotechnology for example. But there is also the unintentional manipulation of biology or of life through human impact. For example, climate change is a manipulation of biology. Or other human activity, what is discussed under the Anthropocene. So bioart with its definition of its origin is laboratory art. Which at some point maybe didn't fully capture the scope of what is happening to biology, what is happening with life. And so people, and also us — we are expanding the question towards environmental questions and how basically

technology impact the biology in the environment. Because that can be also on the one hand through the preachers-witchers fantasies in the laboratory and then come into the environment. But that can be also basically through unintentional manipulations like climate change. So we just wanted to kind of look in parallel, in all of those ways we implicate life.

And the word for that…the Australians, SymbioticA is using for that 'biological art'. There is this small difference between it and bioart which also reminds very strongly of biotech. A 'biological' opens up quite a wider horizon and it's more inclusive.

Daria: Also in the course of this conversation. Once you've mentioned that you are not really happy anymore with the updated chart about bioart domains, chart based on Capucci's original categorization that you have introduced in the Field notes.

Erich: No, I probably said that one would need to look into it again now. Because so many things happened since 2013. But I didn't do that. So I don't know what would need to be updated. I couldn't say you that at the moment.

Daria: That was the question: I was curious to know how, in your opinion that should be changed, what should be changed in it?

Erich: I don't know, maybe it is still up to date because I believe that we put quite a lot of things which have been to be expected already into. So maybe, maybe it's totally fine.

Daria: I wasn't digging into all aspects of it to be honest. But there was one thing that I found questionable for myself and was hoping that you could unpack it. That was the position of artificial life. So artificial life art as far as I am aware is commonly considered to be an art practice grounded in computation. So it is positioned in the non-carbon based realm and it is quite like that this specific chart. It touches on the the edge…but nowadays it is somehow overlapping also I think with the biological carbon-based realm, isn't it?

Erich: Let me have a look because otherwise I cannot answer to that.

Daria: Sure, the reason I'm saying that is because I was looking into how a-life artists and a life-practitioners are conceptualizing the fields and they're talking also on other means of production. Something that would mimic or represent or would stand for leaving. And it doesn't necessarily have to be a simulations through codes. It could be something that

basically incorporates carbon based realm let's say. And I was actually looking at Nathan's and Guy's practice as something that could be an example of a carbon based a-life research.

Erich:
Wait a second. I want to open this chart before, but I know what you mean. The thing is that when you read about artificial life in kind of in the media archeology or media history, then artificial life was always software based. And that's why it's basically mostly here outside, but then it goes into robotics. Exactly. Because of that what you also said. Like there are these experiments and these experiments they can either be mechanical. I think that the chart should be not so much read as negotiated. So you need to think with the chart. And for example, this bio-robotic experiments of Guy and Nathan, that could definitely be in that kind of artificial life robotics bio realm.

Another thing in chart that artificial life is only touching synthetic biology, but that could actually go that they could have an intersection as well. Because we have now these protocell research and we actually did this book before protocell research became also more prominent. That is basically chemical life. So it's basically a certain form of chemistry, which is trying to recreate a life like properties. For example, these artists-scientists work with droplets. So you have a Petri dish with a certain liquid with a certain chemistry, and then you put a droplet into this and they start to react. There comes a chemical reaction and the agency of this droplet has lifelike properties. For example it forms a cell, it can divide, it can move in a certain direction. It even could solve the problem. For example it could solve a labyrinth. And so there would be certainly some things which could be probably now made a little bit differently. But then what was your question also: with Guy we basically said that it actually makes sense. But it could be that Guy could be also in this realm of bio robotics. Which does not need to go into artificial life at all. I think how artificial life is actually meant here is how it is known as a software art practice or software science. And from this perspective, one needs to look at it because otherwise the chart would fall apart.

Daria:
Why would you place Guy's and Nathan's practice as bio-robotics? I think it was also something that you questioned yourself during one of the talks when they were using the term biobot and they were basically trying to refer to the property of autonomy, trying to underline that this let's say biological kinetic sculpture would be autonomous in a certain way. But then you also question bio robotic term.

Erich:	What I wanted to say was actually that bio-robotics would be just one little aspect of how you could name it when you look at it. But it's so much more. And also it was a very utility way to look at it: through an application. And I think that this experiment is so in the beginning that if you frame it already now as first of all a bio-robotics, which is something very kind of concrete and basically already as a utility, then you may be forbid yourself that this is able to develop into something completely different. Because at the moment it's only cells on aqueous silk, nothing more. But because it's only that, it has all the potentials which are in this materialized gesture and one of the potentials could be bio-robotics. But there could be also many other potentials. That was actually what I was trying to do: to kind of open it up a little bit more instead of narrowing it down.
Daria:	That's interesting because we yesterday, discussed it with Nathan and I think what you said really had an impact on them, but I think they also read it in a way that I did earlier, at least Nathan. Saying that maybe it's not the best term to describe it more from the perspective of giving the wrong impression to the audience.
Erich:	Yes. Because when you tell the audience this is bio-robotics, what they see is basically a robot. Then at some point that is something which is doing something for somebody and repeating it until it kind of cannot do it anymore. And there is much more in that.
Daria:	So just to clarify, I'm curious about your opinion. Could you say that CellF and Bricolage are something that I'm calling here 'media arts creatures'? Would you call them like that?
Erich:	Yes, probably the way you mean it. Why not? But honestly I don't find the term very sticky. Because for me this is some kind of infantilization. So the combination of media art and creature implies for me some cuteness. You know what I mean? Also probably because of the history of creatures in the media. Like you will find a lot of digital creatures for example. And knowing that it draws my mind away and it gives this infantilization forwards to the works you are kind of addressing with it.
Daria:	I understand. The reason I'm using this term is because I'm having a little bit different understanding of the connections. Because I try also to introduce a little bit this angle of the mystification and mythology that creatures are carrying as phenomena. When we think about creatures in cultural perspective, especially in the past and in pop culture or some

historical context, it's always about some kind of beasts that either having some magical properties or are created in an artificial way with some sorcery or it has this special meaning for a particular culture. And what I'm trying to suggest with this term in media arts context is that this thing that artists are doing nowadays they are somehow could be perceived by the public as biology and technology involving some enigma, like it used to be with alchemy. And both artistic and scientific world are becoming more complex and more complicated to understand for a public. So in culture it's becoming some kind of a new sorcery: all these synthetic biology things and all this genetic manipulations that are there.

Maybe they are kind of some new urban myths, which on one hand being very much rooted in the history of cognition through the mythological tradition. And it seemed to be popularized in this way through industry and pop culture sources, like even the literature. And on the other hand, they're bringing this big concerns with their obscurity and representation of all those topics we just discussed. Where utopian and dystopian scenarios of the future meet. And it just somehow speaks about our society and suggesting new understanding of things that are coming ahead. And this is why I'm using the term like that. Because in my opinion, it's like somehow connected and then it gives this notion of connection with the creatures of the past. And I'm trying to see if it actually valid to look at it like that.

And that is why I'm also trying to understand what are the concepts like Anthropocene and ecological thinking nowadays are. To see how they're related to this perception. If this creatures can stand for something, if they're actually representing something about the culture or they're talking about the future, or they're talking about the past, or do they have any kind of purpose. So this is a kind of a frame that I'm investigating, though recently I'm learning that it's probably not the very common one. I can see that the term bothers almost everyone whom I'm talking with if I use it without further explanation. What do you think about it? Does it make any sense in your opinion?

Erich: What you now talked about, I know very little about that. If you are able to make that claim and can basically show that this is what the creature was always about, then I'm sure it's valid. But if this is something you were kind of making up yourself, then I would be a little bit careful if this is wishful thinking. Because if you wish to declare that the creature would have this role in society, then this is not enough. Because some way you need to explain what this creature is

and why you were choosing it. You need to build the foundation for that in your thesis.

But I understand what you are after and I think that is interesting. Like what is the significance in those kinds of works and do they also hold what the promise is? Because big claims are made also often.

And for example about Hybrid Matters. I said before, that it's a temporary word. I think we were also using the notion of thought vehicle, something which is carrying the thought over a certain distance. As an experimental vehicle, as a probe, which you basically send out until you see what is coming back. I think that you are describing something like this… I see with the creature something which is the carrier of the thought. And then you basically see how it is developing. Does it hold the question when you look at it again? Or maybe it did not work out or can you amend the vehicle and continue to work with it? Did it lose energy on the way? But that's just a different metaphor for maybe the same thing with what you mean.

Daria: Thank you so much for this conversation!