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Intertwining of the digital and the biological in the artistic practice

Laura Beloff

In the recent two decades, we have witnessed a gradual shift observable in the works of artists working with technology. This shift can be characterized as moving from the digital and virtual realm towards the physical world, and more recently in terms of an inclusion of the biological realm into experiments and artworks that address a wide range of technological developments and their impact on society. Many of the artists working in this field – that is widely titled as art & science – have a background in digital arts. This article traces specifically the emerging inclusion of the biological realm into the technology-based arts as a trajectory towards which the field of digital art appears to be developing.

Considering that readers of this article may have general knowledge about digital and technology-based art as an existing field, the article focuses primarily on the artistic interests involving biological organisms and living matter in combination with technology. The trajectory is introduced through actors and a few milestone events in the Nordic development of new media art and continues with examples of Nordic works, artists and active organizers who are working with a combination of digital and biological matter. The article divides the artistic examples into works that focus on the environment and others that focus on humans as biological organisms. Underlying the article is the author's first-hand experience in the Nordic development of new media art and recent interest in the field, in inclusion of biological matter with digital technology. This development has two historical predecessor fields – one is based on the traditions of art & technology and the other is based on the traditions of landscape art and earth works. The article addresses our evolving understanding of concepts such as real, natural and artificial, as well as biological and technological.

The existing relation between technological and biological in art

Employment of biological and living matter in artworks has a long history in art, and similarly art that incorporates technology. These two categories are typically considered as separate genres. Technology-based art, or new media art, produces works that are based in digital media: interactive installations, network art, physical computing works, wearable technology design, and various others. Art history presents examples of artworks and genres that employ

biological matter, for example environmental art, eco art, land art, and other single experiments. Recently we have seen novel developments that combine biological and living matter with technological approaches and structures. The novel artistic interests are strongly influenced by the developments in technology and the sciences in general. For example, in recent years we have witnessed a speedy advancement of synthetic biology and biotechnology at large, as well there are revived interests in technological development that has its roots in the biological world, including areas such as evolutionary computation, machine learning, and bio-inspired robotics. All these practices from synthetic biology to bio-inspired computation at large have characteristics that are creationist and grounded on approaches in engineering. Comparable approaches are also present in art and design. Ingeborg Reichle has argued that with the recently developed field of bioart, biotechnology has become part of the art world. This has raised many questions about biology being treated as technology and about ethics of manipulating living organisms (Reichle 2014). Both art and science that concern living biological organisms are in some way dealing with manipulation of life – or creation of life from scratch, like the popular synthetic biology slogan claims. One of the differences in their approaches is that the artistic side typically focuses on ethical, critical and philosophical questions concerning this line of work, whereas the scientific approach is typically focused on concrete problem-solving tasks.

Antero Kare and Erkki Kurenniemi are two Finnish examples of art & science pioneers who are good representatives of the earlier generation of practices. Antero Kare is an artist and a pioneer in the field of bioart. He started working with microorganisms in the mid-1980s and conducted investigations on them in various science labs, which he visited as an artist. In his artworks he has used bacteria with specific colors as living paint. Kare's primary interests have focused on 'deep time' that is a concept of geological time, which is visible in his artistic practice and interests. During the recent decades he has also included video, light and media technology as a part of his installations with bacterial growth, however the core of his work is in the biological and geological investigations (Kare 2013).

Erkki Kurenniemi is a Finnish artist, inventor, scientist and techno-visionary, who created several works and experiments that assess the impact of new technologies on the evolution of human beings (Huhtamo [2003] 2011). His body of works from the 1960s and 70s includes experimental short films, various computer graphics, electronic music recordings and theories about the mathematical foundations of harmonies. He also designed and constructed several digital musical instruments in a series called *DIMI*. These experimental works address ideas such as real-time transmission of data and the use of technology as a basis for art practice with a clear relation to cybernetics. These projects anticipated interactive installation and performance art by years, as pointed out by Huhtamo (Ibid.) Some of Kurenniemi's experimental works cross

over to the biological side through their focus and inclusion of a human as a core element, e.g. his interactive musical instruments that were controlled through biofeedback: *Dimi-S* (1972), was based on the electrical conductivity of skin and *Dimi-T* (1973), measured the electrical activity of a brain¹.

Also visible in the examples given above of artists Kare and Kurenniemi is a division of artistic interests that concern biological matter, which are categorized into two main categories: works that focus on a human and works that are focused on the environment (Beloff, Berger & Haapoja 2013). This division is still visible in many of the works produced today, but to a lesser degree. For example, there are works that address climatic and environmental changes caused by human actions, and works that address human existence, adaptation, and survival in the changing environment. These kinds of works address largely the contemporary worldly conditions of humans, their habitat and their actions, and which are often colored with technological practices.

I call works and practices, which combine technological and biological actors, *techno-organic*. I have previously defined the term in relation to art as the merger of technology and organic matter, which may include humans, non-humans and environment (Beloff 2012). *Techno-organic practices* can be seen referring to developments that increasingly reshape the boundaries between the technological and the biological. This new term allows one to think about single entities that are a conglomerate of biological and technological aspects and actors. For example, Roy Ascott has been a long-term proponent in art of what he calls the *syncretic condition* that “will arise when the two apparently opposed technologies are used in tandem; not simply cross referenced in an academic or analytical way, but brought together in a concerted conjunction of actions” (Ascott 2005).

Similar problematizing between the technological and biological and their shifting borders is present in the chart by Pier Luigi Capucci, which divides art that address the idea of ‘life’ into two main categories: non-carbon realm and carbon-based realm (Capucci 2008). The non-carbon realm includes mainly technological or new media artworks that address ‘life’, such as genetic art that is made on a computer. The carbon-based realm contains various genres of art that include biological matter and wet laboratory techniques in the process. The chart was further developed by the author & co. together with Capucci to include a few recently emerging and re-emerging areas; artificial life, robotics, and synthetic biology (Beloff, Berger & Haapoja 2013).

One of the insights this chart produces is clarity on the fact that an artwork, which incorporates biological matter or addresses ‘biological life’, will always be based on manipulation of living organisms – even in the cases where the work is critical towards manipulation and use of living organisms in art. It is obvious that

¹ http://en.wikipedia.org/wiki/Erkki_Kurenniemi [accessed 22.6.2016]

there is no 'natural' situation in art that deals with life – this kind of life is always under the impact and manipulation of the artist's intentions.

Art that is based on computing and technology is not necessarily directly involved in the manipulation of living organisms. For example, the field of artificial life (A-Life) raised a lot of interests among artists in the late 1980s and throughout the 1990s when the field was evolving within the sciences and technology. The initial quest was not *life-as-we-know-it* but *life-as-it-could-be* (Langton 1996). However, interests in A-life have been gradually fading until recently, as they have emerged again with novel developments in machine learning and AI (artificial intelligence) that employ deep neural networks. One of the continuously present questions within the field has been what constitutes life and artificial life – what characteristics or properties does an artificial entity need to have that one can call it 'alive'? This has earlier divided scientists into two camps – where one is a proponent of the so-called *strong A-Life*, who believe that virtual creatures existing in computer memory and, often represented on the screen, can be genuinely alive. Practitioners of the *weak A-Life* use computer models to express and test theories about living things but do not claim that the models are really alive (Boden 1999).

It is clear that novel forms and concepts will emerge with currently developing *techno-organic practices* in the arts (and in the sciences). For example, the concepts of "natural" and "artificial" require rethinking. Until now, it has been quite easy to recognize a difference between things that are constructed (by humans) and things that are grown (biologically in nature). This is no longer an obvious issue with the development in e.g. synthetic biology, unconventional computing, and material sciences. The perceptual recognition of the difference between 'artificial' and 'natural' is disappearing.

This chapter has presented a short overview of developments that are ongoing in the arts, and which have their point of origin between two art genres; one that employs technology and one that deals with biological matter. The next chapter focuses specifically on the Nordic scene and introduces actors, artists and activities that are part of these developments.

Actors and Activities

One can ask: what is typical in the Nordic scene of artistic practices that are crossing digital art and biological art? The digital art field, also referred to as "new media art," has never been a strongly visible trend in the art scene in the Nordic countries – not at least when one compares it to the Central European scene that already in the 1990s had several festivals and events presenting artworks that used and addressed digital media, as well as having established education in some of the major art universities².

² E.g. Academy in Köln established a degree program in 1990. link - <http://www.khm.de/en/study/media-and-fine-art-degree/>

Digital art in the Nordic scene in the 1990s

In the Nordic region, there have been several attempts and events that could be described as milestones in the efforts of trying to introduce and establish new media art and which ought to be mentioned in order to give justice to these efforts. Such were for example ISEA in 1995 and 2004 in Helsinki; Outoäly-exhibition in Kiasma in 1999 curated by Erkki Huhtamo³; establishment of the Interactive Institute in Sweden that strongly supported experimental digital art and design during its early years⁴; Gallery Otso in Espoo occasionally exhibiting new media art under the leadership of Päivi Talasmaa; Avanto-festival together with small galleries (Muu Gallery, Huuto Gallery and Mediatheque) exhibited sound-related digital art installations during the time of the festival⁵; and a few single exhibitions during the recent decade such as Digitally Yours in Ars Nova museum in Turku in 2007⁶. One important factor was also the establishment of the Pixelache festival and association that is still active today⁷. Also, a surprisingly early actor on the scene was Rauma Art Museum with their yearly Electronic Art Week event⁸ that has been left almost unnoticed by the main art scene. Looking through the list of participants in Rauma, it reveals surprisingly many well-known figures who today are active and influential international artists. This list of activities is not complete and the given examples are mainly from Finland; one can assume that there are comparative lists of similar events within other Nordic countries.

From a practitioner's perspective (in Finland) – in general, during the 1990s the overall situation in the Nordic region of new media and digital art was quite scattered and not much continuity was established that could have supported artists' initiatives or their education in the field. This situation resulted in many young artists going abroad for education, or pursuing their digital art interests in countries that had more enthusiasm for the field. This obviously didn't help the situation in the North in establishing a good basis for the field.

Especially one specific feature in the development of the Nordic field of new media and digital art is worthy of pointing out. While in Central Europe the field has been dominated by men, in the Nordic countries – specifically in Finland and Norway – there have been remarkably many females involved in the developing

³ <http://valvomo.fi/?portfolio=kiasma-outo-aly>

⁴ <https://www.tii.se/>

⁵ <http://www.avantofestival.com/?ln=en>

⁶ <http://www.aboavetusarsnova.fi/fi/nayttelyt/digitally-yours>

⁷ <http://pixelache.ac/>

⁸ In the 1980s the Rauma Art hall began presenting media art by organizing yearly one week of video screenings, which was called Electronic Art Week (Sähköisen Taiteen Viikko). This event was extended in 1992 by inclusion of other thematic exhibitions presenting computer-based and electronic art works. The last exhibitions in this series were organized in 1997 and 1999.
http://www.raumantaidemuseo.fi/suomi/nayttelyt_sahko.html

and experimental visual art field⁹. However, from a critical viewpoint – even if this was the case in the 1990s and early 2000s – the women in the arts working with technology have often been marginalized in the main art scene in the Nordic countries and considered exceptions in the technological art field. This does not mean that they would have not been successful internationally but that they have been lacking recognition in their own country. In general, it took quite a long time in Finland before digital artists were gaining mainstream recognition. In 2010 for the first time a digital arts practitioner was suggested for Ars Fennica prize in Finland – since then the candidates for the prize from the field of digital arts have included Charles Sandison, Mika Taanila, Pink Twins: Juha & Vesa Vehviläinen and Terike Haapoja¹⁰.

Activities and actors crossing digital and biological.

My focus in this chapter is not digital art per se and its trajectory in the North during the last few decades, but to give an overview of the current situation with a specific focus on actors that have shifted or extended their focus from digital media and technology to include biological matter¹¹.

In the Nordic region the growing interests in the inclusion of biological matter alongside the technological, are visible in the activities of small grass-roots organizations that arrange workshops and various events for artists and bio-hackers. The most active ones today include the Finnish Bioart Society - Finland, i/o/lab in Stavanger - Norway, Biologigaragen in Copenhagen - Denmark and BioNyfiken in Stockholm - Sweden¹². In addition to these small organizations, there has recently been a growing interest by universities' art and humanities departments to develop educational activities that address these novel trajectories. The emergence of artistic works that use digital technology in combination with organic matter is gradually growing. Also the author's long-term practice, which spans from focus on humans and technology to focus on nature/environment and technology, is a Nordic example of artistic work in the field (a couple of the author's works are described later in the article). To make obvious the connections between digital art and the current tendencies in art & science and bioart in the Nordic scene, one should mention that many of the artists and organizers who are active in these novel developments have a previous practice or interest in digital art.

⁹ In Finland the previous decades of media art include for example: Marikki Hakola, Marita Liulia, Eija-Liisa Ahtila, Pia Tikka, Laura Beloff (the author), Minna Tarkka, Hanna Haaslahti, Minna Långström, Mari Keski-Korsu, Merja Puustinen, Mia Mäkelä, among many many others. In Norway the list includes: Kirstin Berggaust, Marianne Selsjord, Vibeke Jensen, Amanda Steggel, Maja Urstad, Jana Videren, Hege Tapio, Ellen Roed, Maja Ratkje in music, among many others. And, of course, one should not forget the electronic art pioneer from Iceland, Steina Vasulka.

¹⁰ <http://www.arsfennica.fi/ehdokkaat.html>

¹¹ This also elaborates on the author's own interests that have developed over the last decade in this direction.

¹² <http://bioartsociety.fi/> ; <http://iolab.no/> ; <http://biologigaragen.org/> ; <http://www.bionyfiken.se/>

The starting situation of early developments in new media and digital arts was quite different in comparison to the current development in the field of art & science, when considered with a wide perspective. Specifically in Finland and Norway, the digital art field was gradually throughout the late 1990's and 2000's attracting enough interest to create more formalized structures that enabled active individuals to pursue initiatives¹³. Today these same existing infrastructures and previously learned experiences function as models for the new developments that engage with the merger of technological and biological realms¹⁴. It is evident that the development of new emerging art fields in the Nordic countries is dependent on groups of active individuals, who initiate new topics and activities, and also further develop them as formalized structures, such as small art organizations, eligible for state art funding.

This shows that the model, which has been previously developed for supporting digital and media art initiatives, has proved to be a functioning one and therefore it has been adapted for new initiatives. However, this does not mean that it is easy to find funding and establish support for these kinds of experimental activities, which are often left outside of mainstream art. Without enthusiastic and active individuals who have the energy year after year to submit funding applications and pursue organizational activities the scene would not exist.

One of the well-established and visible actors, which from its beginning has focused on the art & science field, is the Finnish Bioart Society. The Society was established in 2008 with a purpose to develop bioart in Finland, e.g. through organizing an artist residency program at Kilpisjärvi Biological Station of the University of Helsinki (Berger & Beloff 2014). During recent years, the Finnish Bioart Society has grown to become a well-functioning and influential Nordic actor in the international art & science scene. The Society leads activities on many different levels, from international collaborations funded by the European Commission and Nordic Cultural Fund to organizing art & science workshops for professional artists and students (e.g. in collaboration with Aalto University), curating exhibitions, organizing artists for residency in Kilpisjärvi, and presenting the Society and its interests in invited lectures¹⁵. However, in spite of its clear impact for developments and visibility in the Nordic and international scene, the Society still functions today with a minimal yearly budget.

¹³ These actors are among others: Pixelache and M-cult in Finland, and TEKS, Atelje Nord, I/O Lab, BEK and especially PNEK that supported the structural organization of the field in Norway. Recently new initiatives in the field of digital arts have been established – e.g. KRUKS in Finland.

¹⁴ Examples of the widened interest towards bioart and art & science by former digital art associations are e.g. Norwegian I/O lab in Stavanger with its Article-festival, Pixel-festival in Bergen, Metamorphosis Biennale organized by TEKS in Trondheim, as well as Pixelache in Finland having several collaborations with the Finnish Bioart Society.

¹⁵ Examples of projects by the Finnish Bioart Society: Collaboration with Environmental Research Unit in the University of Helsinki resulting in the Prima Materia exhibition 2013, Field_Notes laboratory in Kilpisjärvi in 2011, 2013, 2015, 2017 (forthcoming), Making_Life educational workshop series on synthetic biology in 2014-15, Hybrid_Matters – a Nordic collaboration project 2015-16, and an exhibition in Oulu Art Museum 2017 (forthcoming at the time of writing this article). <http://bioartsociety.fi/>

One of the core focuses of the Society has been an interest in the biological, or 'natural', environment, which could be described as the following: how the environment and our perception of it are impacted by today's scientific and technological development and by human desire to manipulate other organisms. The Society's focus on environments has been affirmed by its tight connection to Kilpisjärvi Biological Station (Beloff, Berger & Haapoja 2013). This environmental interest does not refer to traditional land-art or environmental-art practices but is focused on technology driven investigations concerning environments and their organisms, such as activities in a laboratory setting with technological tools, working with biotechnology methods, as well as using digital media to investigate environment on site – such as video, sound, GPS-tracking, drones, and environmental sensors.

The Danish actor in the field is the Biologigaragen, which was established in 2010. It has a different focus in comparison to the Finnish Bioart Society, which is primarily focusing on artistic practices. The Biologigaragen is an example of DIY-bio and citizen science activism, however, with strong connections to the cultural scene¹⁶. Biologigaragen and its activities make a good example of crossover activities between hackers, biologists, artists, cultural workers, and citizen science activists in the Nordic region. It is worth noting that this Copenhagen-based initiative is sharing its physical space with hackers' lab Labitat, which supports hackers and tinkers in their initiatives in DIY-technology developments and digital fabrication¹⁷. Labitat is a part of a well-known international phenomenon of establishing hackers' labs, and similarly Biologigaragen belongs to a network of DIY-bio developers and activists, which typically focuses on open source development between biology and electronics¹⁸.

Other Nordic organizational actors or initiatives, which deal with biological and/or technological arts, are for example Kunsthall Porsgrunn in Norway with their art & technology exhibition series; Biofilia laboratory in Aalto University in Helsinki that offers educational activities within the field of biological arts; the Oulu region of Finland that has currently opened a regional artist position dedicated to bioart; Pixelache, an organization in Helsinki that has been arranging an international yearly festival with a focus on electronic art and subcultures since 2002; Click Festival in Denmark that has had a sub-theme on art & technology, and in the last two years achieved a growing interest in biological arts with their bioart panels and exhibits. This lists just a few examples that are currently active, among various others.

It is not easy to pinpoint the significantly Nordic aspects in the developing art practices between technology and biology in comparison to the global scene.

¹⁶ <http://biologigaragen.org/about>
<https://www.facebook.com/Biologigaragen-388438941323081/?fref=ts>

¹⁷ <https://labitat.dk/>

¹⁸ Well-known actors in the European DIY-bio scene: e.g. Hackteria and Waag Society
http://hackteria.org/wiki/Main_Page <https://www.waag.org/en>

It may be easier to see the connections to biological matter than to technology through the Nordic cultures' tight relation to nature, which is present for example in various Nordic mythologies. Also, environmental arts have had a strong presence in the Nordic region (e.g. Hakuri 2014; Fortune 2014). In a sense, one can argue that dealing with the environment and biological matter is almost a presumable direction for Nordic art, even when it is appearing as a component of art dealing with technological matter.

One interesting socio-political question concerning this developing field in the near future that will need to be addressed is: When increasing amounts of artists are educated in the art & science field, but the majority of museums and galleries ignore exhibiting this kind of experimental art that involves technology and biology, where will these artists exhibit their art, and how will they be able to continue their practice? The following two sections focus on introducing a selection of artists and works where the connections between the biological and the digital realm become explicit.

Environment – digital

The previously stated claim that art, which involves environment, biological matter and nature is almost a presumable direction in Nordic art scene can be followed with a question: What is *nature* for us today? One plausible initiator for the increased interests in scientific research by artists could be the involvement of science and technology in forming the role of nature in our contemporary society. Science has become a primary tool to perceive, domesticate and also to reconstruct nature, often from a perspective that turns nature into a rational study or resource for economic gain. In recent years, the sciences have developed engineering methods that propose possibilities to construct a completely new kind of nature, for example through developments in biotechnology and specifically of synthetic biology. The novel possibilities for human-designed nature are based on comparable thinking processes that are present in other technology-based design disciplines, such as engineering. Today's technology-driven thinking model is penetrating the biological realm concerning living organisms.

What kind of nature is present in the art of Nordic artists working with digital and biological media? The following section presents works by Finnish artists whose works address the environment and/or include biological matter with digital components.

The project *Tracing* (2015) by artist and naturalist Antti Tenetz investigates presence and impact of animals through their tracks, movements and actions in their environment¹⁹. The artist has especially focused on migrating trout-species and a male wolf, both of which are tracked with technological means, such as underwater and aerial cameras, GPS (General Positioning System) and drones.

¹⁹ http://www.tenetz.com/JALESTAA/index_eng.html

Tenetz describes this work as a search for new aesthetics that could expand our perception of nature and time. Interesting in this project is the emergence of a novel hybrid-animal, which is a combination of a wild biologically evolved organism, which is free in nature, and GPS technology that connects the animal to a global-scale technological infrastructure – to the satellites. This set up draws us a very different kind of image of a wild animal than what we used to think of a few decades ago. In addition to the idea of nature, what this work produces is definitely not the traditional and still common Nordic idea of nature that stands for purity, wildlife, and in a sense also for innocence.

Artist Johanna Rotko has worked with Yeastograms, which is a technique developed within DIY-bio activities²⁰. Her project *Yeastograms – Vanishing Images* (2015), is based on biological matter but creates a reference point to traditional photographic techniques. Rotko's images, light sensitive, living organisms are substituting the traditional photographic chemicals²¹. The produced images, which are based on yeast cells that are provided the necessary light and nutrition conditions, are visible only temporarily before life and growth takes over. Although the work does not precisely utilize digital technology, it references both the history of technology and forces of life in the biological realm (Rotko 2015).

Artist Terike Haapoja's work *Dialogue* (2008) creates a connection between a human and trees through the human activity of whistling and breathing²². The exhibition set up includes live trees, sensors, sound, and light. The work enables an audible dialogue between breathing and the plants' photosynthesis process. When visitors breathe out they release carbon dioxide into the atmosphere, which photosynthetic organisms can fix and then release oxygen as a by-product. When the visitor whistles to the trees, they respond by whistling back. The interaction between species becomes physical as they are considered in the work to belong to the same metabolic system. In another project titled *Carbon Tree*, Haapoja has collaborated with researchers from the Department of Forest Sciences at the University of Helsinki²³. This online project presents a real time carbon flow of a tree as an animation. The actual living tree, whose actions are measured, is located at Hyytiälä Forestry Field Station. We see the real-time representation of this tree online, diffused into a stream of data.

My own work *The Condition* 2016 (a collaboration with J. Jørgensen)²⁴ also deals with trees, but in this work the trees are already modified – they are cloned Christmas trees, which are currently being researched and developed in Denmark (Beloff & Jørgensen 2016). In the work *The Condition*, the trees are manipulated further by placing them into continuously rotating boxes that form

²⁰ <http://pavillon35.polycinease.com/category/recipes/>

²¹ <http://www.johannarotko.com/>

²² <http://www.terikehaapoja.net/dialogue/>

²³ <http://www.carbontree.fi/>

²⁴ <http://hybridmatters.net/posts/the-condition-cloned-christmas-trees>

a micro-gravity environment. In other words, the trees live in gravitational conditions, which clearly differ from our normal terrestrial gravity. The varying direction and speed of the 12 boxes rotating are based on downloaded data from a satellite that observes space weather conditions. This data is downloaded every few minutes and through the use of intelligent self-organizing methods the data is organized for the set of boxes, which can be observed by visitors as different speeds. In this way, the set of trees is treated as one entity, as a kind of a forest, instead of individual trees in individual rotating boxes. The work creates a living condition for the biological organisms, in which the environment is based on digital control and technological manipulation. In the work, the Christmas tree is presented as a post-natural organism that is both biological and cultural, selected based on aesthetic criteria and manipulated for economic gain. The work points to how biotechnology is deeply tied to our capitalistic consumer culture.

In another work I play with the replacement of technology with biological organisms. In a manner comparable to Johanna Rotko's use of biological organisms as the photographic medium, in the *Fly Printer* project (2014-16) fruit flies are treated as a printing apparatus. They are fed with specially prepared food that is mixed with ink – flies are free to print on the paper that is placed underneath their spherical transparent habitat. In the latest version of the work *Fly Printer – Extended* (2016) (a collaboration with Malena Klaus) the setup is extended with an artificial intelligence component that is observing the images printed by flies and interpreting for us what it recognizes through the use of convolutional neural network learning. Both of these described works address and investigate the connections between humans, non-humans and artificial intelligence from an artistic perspective.

An example with a slightly different approach to the environment that neither uses nor addresses living biological matter in the work, but which deals with our planet's environment as a large-scale phenomenon, is Finland-based artist Erich Berger's *Polsprung* (2012)²⁵. The focus of this technological installation is the topic of reversal of the earth's magnetic poles, which has been proven by scientists to have happened in our geological past, and which can be expected to happen again leading e.g. to increased gamma radiation. This might potentially destroy our technological infrastructures as well as increase biological mutations. As a visitor of the *Polsprung* installation, one can hear and feel the actual fluctuations of the earth's magnetic fields in real-time. Berger describes this experience as 'radical witnessing'²⁶.

Human – digital

²⁵ <http://randomseed.org/web/polsprung.html>

²⁶ Personal communication between the author and Erich Berger in April 2016.

One can argue that the central perspective in these works that address the environment is a human one. They are created from the human perspective and typically for human audiences. Similarly it is even more obviously the focus of works that concretely address humans and the human body. The intertwining of biological and technological matter includes not only environmental aspects and non-human organisms, but also a human + technology merger.

This is an area in which we have seen a growing interest by artists in especially the areas of human manipulation and human enhancement. This enthusiasm may be partly due to advancements in medical and life sciences, but it has also been impacted by the continuously decreasing size of technological devices and components.

In this article, human enhancement is primarily referring to enhancements that are not physical and permanent, and which are achieved via use of digital technology. Experimental practices addressing human enhancement in the arts often propose concepts that go beyond 'the repair of the body' phase that is common in medical science and focuses on repairing the body to its so-called normal state.

One of the best-known international artists working in this area is Stelarc from Australia, who has a long-term practice in human enhancement through technology. Stelarc has focused on extending the capacities and overcoming the physiological limitations of a body, which is visible in many of his projects²⁷. When looking at his projects, one can understand the claim made by cybernetics that the boundaries of a human are constructed rather than biologically determined. In Stelarc's performative practice he is merged with cybernetic machines that transform his body's functions and abilities (Clark 2003).

In comparison to artists working with the environment there are not many Nordic artists that work on human enhancement through technological means or who generally address the topic of human manipulation. The following introduces a few works by Nordic artists who have addressed the biological human body with digital or biotechnology.

My personal artistic practice has evolved from a long-term interest in the topic of human enhancement and human interweaving with technological infrastructures (such as networks), towards investigations concerning the environment and its technological enhancement. These investigations are centered on the human-nature relationship, which is strongly rooted in culture in the Nordic context and typically considered as natural, primary and almost sacred. In Finland for example, nature is seen as a protector, as well as there exists an unwritten belief among Finns that they (Finns) have a stronger nature relationship in comparison to people from central Europe or other places. However, the increase in modification of biological organisms by humans and

²⁷ <http://stelarc.org> [accessed 21.5.2016]

simultaneous modification, or enhancement²⁸, of ourselves with technology is today impacting and even reconstructing our relationship with nature. Based on these developments my artistic research asks: when both the human and his/her environment are technologically manipulated and enhanced, how does that affect the existing understanding of the *human-nature* relationship? This hypothesis has driven most of the artistic research and works by the author in recent years, typically incorporating technological with biological components as an inherent part of the works²⁹. In some of the works, a human presence is built in as a required component in the form of a carrier of networked wearable artifacts, whereas other works are speculating on concrete and novel technology-based possibilities to connect with our environment. Many of my works address our desire to control nature and they question the way technology enforces this desire.

The work *Appendix* (2011) is a networked tail designed for a human being³⁰. This technological device is constructed for challenging the traditional perception of the human body, its borders, and desire for control. The *Appendix* tail is connected through a network to predefined environmental events. These connections are chosen with the intention of having no self-evident or easily interpretable meaning for the user. The tail becomes a part of the user's physical body, but the user has no control over the movements of the tail. The tail moves based on data streams received via network from environmental events; the horizontal movement is determined by the real-time movement of the Helsinki city tram number 3, and the vertical movements are triggered by the real-time wave height of the Baltic Sea. In the work *Appendix*, the real-time technology provides a foundation for the novel human body part and faculty. With this work, the author wanted to experiment with *techno-organic connections*, which merge the user's biological body and the physical environment via the use of technology into a single entity.

Norwegian artist and organizer Hege Tapio has created a work titled *Human Fuel* (2016), which proposes the human body's excess fat as a material resource for a production of biofuel³¹. In the project, she went through an invasive liposuction procedure to get body fat that was further manipulated to make a usable biofuel, which could potentially be used as fuel for a car. The work points to the way we manipulate our biological bodies with technological means and questions the underlying motives for this kind of manipulation, as well as our morals and ethics for manipulating other non-human species. Even if this work does not directly address digital technology, it addresses the blurring borders between the biological and the technological, also concerning acceptable

²⁸ Human enhancement referenced as: <http://plato.stanford.edu/entries/enhancement/>

²⁹ The author has defined this kind of human existence as the Hybronaut (Beloff 2012). A selection of works is available at <http://www.realitydisfunction.org>

³⁰ <http://realitydisfunction.org/appendix/>

³¹ <http://tapio.no/wp/humanfuel/>

procedures for our own bodies. The development of biotechnology is bridging the gap between biology and digital technology with an increased speed.

Another Norwegian artist and researcher, Stahl Stenslie, has created a series of works since the 1990s that focus on enhanced experiences for the human body³². His early projects *cyberSM* and *Inter_Skin* (1993-94) experimented with virtual environments and computer controlled interfaces for 'touching' another human across distance. These projects included connected wearable bodysuits that made one's physical body a living interface for input and output. In a way, in these works a biological human being is seen as a cybernetic organism that is controlled by digital technology (Inkinen 1999).

The Finnish collective Brains On Art crosses the arts and the sciences in their approach. Their work focuses on utilizing human brain functions as the base for their artistic experiments³³. For example, the *Poet's helm* (2014) generates poems out of the user's brainwaves that are measured by the worn helmet in real-time. The poems are printed on a small piece of paper. In a performance-based work titled *The Suit* (2014), the performer is equipped with galvanic vestibular stimulation electrodes, which are triggered based on the stock market data. The performer, who is standing on a bench in a public space, will lose his balance based on the fluctuations of the Helsinki stock market index. Both of these works point to issues of control concerning biological organisms (humans) and technology. In the *Poet's helm*, the helmet, as a biological human faculty or "a brain" is connected to a technological machine that produces the end product, whereas in *The Suit* technology takes over the control of the biological body through manipulation of the performer's sense of balance.

The art works described in the previous two sections refer to a new kind of hybrid ecology that includes technological and biological actors, which have merged to form a new entity. Within these works, a new perception is emerging concerning technology, but also biology. From them it becomes utterly clear that the idea of nature is not what it used to be.

It is also important to ask when we refer to the concept of nature what kind of nature are we talking about? With what kind of mindset we manipulate biological matter? And what role technological development has in this?

Conclusion: affiliation with the *real*

The chapter has built a trajectory from development of the Nordic digital art scene to the currently growing interests in the intertwining of digital technology and biological matter through introduction of several Nordic artists and actors in the field. These experimental and novel practices, which deal with technology and the sciences, have seen in recent years an increasing attention from the wider context of the contemporary arts. But can we pinpoint characteristics or

³² <https://stensliehome.wordpress.com/category/works/>

³³ <https://brainsonart.wordpress.com> [accessed 20.7.2016] The art expert in the group is Kasper Mäki-Reinikka.

inherent properties that are commonly shared among these kinds of works that potentially differ from other, more traditional, approaches to art?

One interesting characteristic of these kinds of works as described above is their affiliation with the *real* – with living organisms and planetary phenomena. For example, Johanna Rotko's Yeastograms use living bacteria and its inherent biological functions by exposing the bacteria with specific light conditions that enable it either to flourish or not to survive, similarly as can happen in uncontrolled situations, or in the 'wild' nature. The author's work *The Condition* connects to the real in two levels – with a network connection to the data received from a space weather satellite and with use of living plants in the installation. Erich Berger's work *Polsprung* makes palpable the *real* on-going planetary-scale reversal of the earth's magnetic poles. Also, a speculative work such as Hege Tapio's *Human Fuel*, which is based on biotechnological processes, has its base in the real world – liposuction being a commonly used procedure in the cosmetic industry, with the waste product used in the work – body fat – retrieved from living organisms.

These exemplary artworks no longer simulate nor create representations of the world. They deal with the actual *real*. They use existing living organisms and earthly conditions as the base for the work, which are presented, investigated, and manipulated in order to point to defined issues and create experiences for the audience that have their grounding in our biological and physical world. In comparison to the wider contemporary art field, this kind of art intervenes with *real* life in the world and with living conditions in a much stronger sense than other, more traditional, art forms.

It is interesting that this aspect of the *real* is obviously prominent in these kinds of works at this time when we are experiencing an increase in blurring of borders of reality, for example through technology-based extensions such as augmented reality that combines digital technology with our physical world³⁴. This blurring of the concept and our perception of *what is real* is possibly underlying the emergence of works that aim at intertwining tightly with our comprehensible physical world. In a situation in which our *reality* seems to drift ever further away from our reach, we are looking for traces and areas where things are connected to "the most *real*." One of these areas seems to be the biological world and connecting with other living organisms.

³⁴ For example, in July 2016 a new game was published, Pokemon Go, where players run around in the physical world to catch Pokemons which appear on their mobile phone screens. This game seems to be the first commercially successful one, however it is not the first game of its kind that combines physical location with mobile technology. A predecessor from art & design for this kind of development is a project FLIRT by Dunne & Raby (1998-00) which developed games for mobile phones: "*The Lost Cat* is a virtual creature that lives and roams within Helsinki's cellular network occasionally jumping onto people's mobile screens. It appears at certain places in the city at certain times and if you regularly pass those places it even starts to follow you. But like a real cat, it's very independent and easily distracted, moving on and finding new people to love." <http://www.dunneandraby.co.uk/content/projects/72/0> [accessed 15.7.2016]

The possibilities for manipulation of biological matter via technological methods, and also vice versa, will increase in the near future. But what kinds of divisions between *biological* and *technological*, between *real*, *non-real* and *artificial* and between *human intelligence* and *other intelligences* will form in the future? The artists discussed here have already addressed this question and opened up the field for experimentation, as well as they are pointing to many ethical and moral questions that these practices bring along.

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