

Towards a Sympoietic Relation with Materials in Interactive Artworks

Nefeli Georgakopoulou,
Dionysios Zamplaras, Sofia Kourkoulakou,
Chu-Yin Chen

INREV Laboratory, Paris 8 University
Paris, France

neveli.valeria@gmail.com ; dzamplaras@gmail.com ; sopheeah.k@gmail.com ;
chu-yin.chen@univ-paris8.fr

Abstract

In this paper we acknowledge the agency of non-human entities and argue against the binaries of subject/object, mind/body, nature/ culture, science/art towards a new materiality. This new vision of the nature of materiality changes the direction of passive matter into a more active one. Technology has given us the opportunity to characterize and analyze material systems not only by their properties, but also by their potentialities. This leads to a sympoietic relation boundary between human-matter-machine interactions. In the context of an interactive artwork, agency should not be considered as inherent for any of the actors. It is emergent, it is the result of the interactions between the elements and the entities located within a mixed reality environment, as much inside the installation—material, devices, objects, sensors, humans—as at its exterior—such as the cultural context and the artist, for example. This new materiality which is based on an “open material” concept is an emergent and co-constitutive process, continuously becoming in, with and through interactions.

Keywords

interactive art, materiality, new materialism, symbiosis, sympoiesis, becoming.

DOI

10.69564/ISEA2023-59-full-Georgakopoulou-et-al-Sympoietic

Introduction

While the modern world still struggles with the polarities of mind/spirit, nature/culture, physical/digital, material /immaterial, many writers and philosophers recently have attempted to challenge this and develop different theoretical approaches with a more holistic understanding of our environment and our planet. Such theories often called "feminist materialism" or "new materialism" and writers such as Donna Haraway, Bruno Latour, Jane Bennett, Karen Barad and Manuel DeLanda tend to adopt the idea of complexity, material action and imply learning ways to coexist respectfully with the world of matter. This means that primacy is not only given to the human actor, but also to the non-human ones. These studies also focus on the interrelations between material agency and social phenomena and help us to imagine an open material that is based on the idea of movement and agentivity; a material capable of behaving in a complex and multidimensional reality in which the relationship between subject and object is fluid. They give us a new definition of human's relationship with matter, one that is closer to a magical vision of the world. This current paradigm shift in the way we think about, conceptualize, and experience human relationships to their surroundings has led to new forms of artistic experimentation and brought new interfaces between humans, machines and materials into light. The goal of this research is to examine and create interactive systems that promote a symbiotic and sympoietic relationship between human-matter-machine interactions (HMMI). Here, we are not interested in creating a virtual alternate of reality but in capturing the mystery of the world around us. The research reported in this contribution deals with fluid materials (natural and intelligent), sound, and light in order to create complex and constantly evolving systems.

Background

Modern science has demonstrated, in theory and experiments, that the atom (matter's fundamental units) is not an indivisible particle, nor the smallest unit of matter. The existence of subatomic particles has been proved when experiments showed that light could behave like a flow of particles (photons), all the while having wave-like properties. Quantum physics, therefore, under an alternative (conceptual) framework reveal new characteristics of matter and raise questions about materiality. Quantum mechanics sometimes go beyond just explaining the basic structure and interaction of molecules and tackles questions relevant

with life, such as the interaction between mind and body, material and immaterial or living and non-living matter. We find out that in the very nature of materiality is an entanglement.¹ Bruno Latour, based on the indistinction of things and people, has formulated a social phenomenon called "Actor-Network Theory" (ANT). ANT refers to and includes both humans and non-humans in the same network. Realities are understood as networks of actors, both people and things.²

In this perspective, there are no a priori distinctions between subjects and objects, nature and culture, man and machine. As Bruno Latour writes, "... it is we, the Westerners, who have lived until now in the strange feeling that we had to separate into two distinct collectives, according to two forms of incommensurable gatherings, the 'things' on one side, the 'persons' on the other."³

Bennett's work also focuses on ideas about the relationship between humans and "things," a relationship she calls "vital materialism." In her book, *Vibrant Matter: A Political Ecology of Things*, she explains that by vitality she means "the capacity of things—edibles, commodities, storms, metals—to act as quasi-agents or forces with trajectories, propensities or tendencies."⁴ Such a relationship between the human and non-human worlds can give rise to the concept of enchantment, which, as Bennett describes it, is a sense of openness to the unusual, the everyday captivating, and can be found in nature, for example, but also in such unexpected places as modern technology.

All of the above thinkers seek to defy and deconstruct the subject/object division that has been imposed by "modern" techno-scientific thinking as a paradigm for how we, as subjects, understand and form the world. What is interesting is that they all try to seek in art a link beyond the modern paradigm, in order to reveal the hidden creative potential of technology. Specifically, Bruno Latour, while deconstructing the subject/object divide, points out that the mind and the world are separated in our modern worldview, giving the former the power to directly control and dissect the latter. On the basis of such a theory, he would try to question this worldview in order to open the path to alternative possibilities by attributing agency to the non-human.

Theoretical framework Living with materials (Symbiosis)

Symbiosis is examined in this research as a system that establishes a dialogue between a human and their environment (materials more precisely). In Greek, there are two different verbs to describe life. Ζω and the old βίω. The difference between the two is that ζω, "live," refers to the act of living in a sense of "spending life" or just existing, while βίω refers to an experience, in the sense of having an intense life. Life was transformed through politics and public life from an existential condition into what Aristotle called bios. Through his work "Homo sacer: sovereign power and bare life," Agamben asserts that "the fundamental categorical pair of western thought and politics is that of bare life/political existence, zoē/bios, exclusion/inclusion. However, nowadays we are moving away from an anthropocentric way of thinking which places human beings at the center of social existence and many thinkers and writers highlight the 'active role of nonhuman materials in public life'.⁵

Making with materials (Sympoiesis)

Poiesis means the activity in which something comes into being that did not exist before. Poiesis derives etymologically from the Greek ποιεῖν, which means "to make." For Haraway, poiesis is always already sympoiesis. In Donna Haraway's view, nothing can really create itself.⁶ Thus, nothing is really autopoietic, but requires other organisms for it to become what it is. This creates a necessity to combine the theory of autopoiesis with a theory called sympoiesis, which relates to collectively produced systems, not autonomous ones. In other words, sympoiesis includes and extends autopoiesis.

Donna Haraway adopts the theory of sympoiesis from Beth Dempster. Beth Dempster (1998) introduced the term "sympoiesis", which was coined by Friedrich Schlegel (1800), as a way to describe systems that lack rigid boundaries. More specifically, these systems "have cooperative synergistic characteristics and must be identified by the continuing interactions among components [...] the systems are evolutionary and have the potential for surprising change."⁷

Following this notion, we see interactive artworks as having a greater focus on relationships rather than on the individual parts from which they are composed.

While such an interactive artwork may begin as an amorphous form with blurred boundaries, it will acquire shape and identity by interacting with others (human and non-human). These interactions can change the direction of the outcome and force reinterpretation of the previous forms from different perspectives. As the shape of such an artwork is in constant change and re-formation, the "life" of such a work is not dependent on any individual entity (agent, whether human or non-human). By contrast, it is distributed between their relations, their exchange, and their flow of energy. Interactive artworks attempt to highlight the fact that we need an "ecosystemic" approach, emphasizing that we must shift our perception of our position in the world as well as our agency. Sympoiesis as a system should be considered alongside environmental, social, and mental ecology through an "ecosophie". Through his collaboration with Deleuze, F. Guattari focused on heterogeneity and difference, articulating agencements and multiplicities to find rhizomatic structures rather than unified and holistic ones.

Likewise, sympoiesis is a term that refers to assemblages which acquire their uniqueness and identity through interactions and the process of becoming in the Deleuzo-Guattarian sense where new "movements" emerge from creative forces.⁸ Therefore, for this research we started with the idea to create a dynamic microcosm that could perform a continuous becoming of form, structure and material narrations.

Becoming with materials & the becoming of form

The compound syn, from σύν ("with, together" of symbiosis, sympoiesis) narrates interdependencies of bodies, materials and things, while "feeling these connections is the principal stuff of becoming-with."⁹ This becoming-with line up with Karen Barad's agential realism, which describes the world, not composed of discrete 'things', but "phenomena-in- their-becoming".¹⁰ By taking into account new materialistic theories, we understand that materials are important in order to explore the potentialities of our world in which we live in and engage with them in a process of becoming something new (worlding⁽¹⁾). As proposed in this research this can be achieved by transforming our symbiotic relationship with the world into a sympoietic one which enables us to look deeper into intertwined human-world relations. Becoming is ongoing and

dynamic and entails material-discursive practices of transitioning from one state to another in space and time.¹¹

The nature of these practices and artworks lies in an effort to communicate with the materials leading to a new materiality which renews contemporary art in a way that the old hylemorphic couple material / form is re-examined. The material is explored as something that not only affects the form and meaning of the artwork, but also dialogs with the viewer. The goal of these artworks is not to give a “magic” wand to the participant to manipulate matter, on the contrary the objective is to “immerse” him in a milieu of energy exchange. Based on Simondon’s concept of milieu which is not primarily a spatial concept but a system of energy transfer between an object or subject and its environment, we approach interactive artworks as the potential for many different kinds of becoming of form. What Simondon wanted and we acquire is to find a theory which encloses both the archetypal and hylomorphic theory through a new approach of information and communication. Simondon found this possibility of unification within the field theory (physical and psychological) and energy states (referring to quanta).¹²

In the 21st century, new interactive materials are being designed whose action extends beyond their physical limits, mixing materials with intangible (digital) information. In the context of the digital revolution, we assign to materials our functions such as memory, intelligence, even emotion, which leads us to a new definition of materiality. For Christine Browaeys: “We have to imagine an open material that is based on the idea of movement, capable of behavior. Thus, Man finds himself immersed in a new materiality in contact with the digital.”¹³

Christine Browaeys, in her book “Materiality in the Digital Age: The Human Connected to Matter” emphasizes that materials and technologies are combined in a symbiosis within the field of Human-Machine interaction where priority is given to improving the performance and behavior of the material. The scientific models we have today to understand the evolution of the world are to be reviewed, leading us to a new understanding of matter overcoming the duality of matter/spirit or matter/form.¹⁴

Digitization and virtualization have tended to disconnect the average person from materiality. They lead us to believe that creating something ‘intelligent’ only means a digital system with software that simulates human intelligence. But a great part of our human intelligence is built with and invested in materials, not digital technology. We have lost interest in the intelligence of

our material world. For that reason, we choose to tackle materiality from the more dynamic side of the material, which can be defined as an active matter wherein the interaction flow between man-material-machine unfolds. These materials are becoming, only over time and in interaction with humans through technology.

Symptotic relations in HMMI The becoming of the Interface

Many theorists, like Nathaniel Stern, reveal the performative aspect of the complex relationship between the material world, the body and technology, in the context of interactive installations.¹⁵ In the same spirit, Karen Barad introduces the notion of intra-action. In Barad’s view, intra-action is a term used to replace ‘interaction,’ because the latter suggests pre-established entities with individual agencies that precede their interaction, while the latter focuses on the participatory action. Intra-action posits agency as emergent. Thus, the idea that beings and entities preexist as individuals with inherent attributes, anterior to their representation, is contested through a performative approach, according to which the entities are being constantly co-constructed through an evolving relationship.¹⁶

When trying to approach the aesthetic experience of the interactive artwork, through the prism of interaction, the various entities are mutually co-constituted, shaping through their complex and ever-changing relations.¹⁷ As entities can be considered for example the artist, the spectator/participant, technology, objects and materials, as well as the cultural context of the presentation. In the case of the interactive installation, it is usually the various interfaces which are in charge of providing the means for these relations to flourish and develop. Thus, the artistic interface makes possible the relation between the body and technology, and through this relation the interface is actualized—in the sense of becoming. The symbiotic and symptotic relations and the effects and events taking place during the meeting of materials, bodies and technology bring the interface and all the entities into being.

The materials and the interface are not simply a part of the installation, but rather with the installation and the other entities in a process of being with the others. Phaedra Shanbaum considers that these ideas are reaching towards the concept of Being in the philosophy of Jean Luc Nancy, where “being” cannot be defined outside of “being with.” Rather in a relational conception, “being” is a process of becoming with the others.¹⁸ Thus, all interactions that occur within an interactive

installation are experimental and procedural processes that are produced in conjunction with - and influenced by - the others. The presence of the other entities is a prerequisite for the very notion of interactivity with the artwork to occur, although this by no means signifies the distinction and separation of matter and technology, of the human “Me” and the technological “Other.”¹⁹ A creative meeting of all the entities leads to the sympoietic and symbiotic relations that bring the interactive artwork into being.

The notions of being and becoming are deployed here in order to help us develop a theoretical framework for the analysis of the role of matter/materials and the artistic interface as emergent through the events and the meeting between body and technology. None of those preexist as such, outside of an enactive system—formed by all the participating entities, rather they become inside their complex relation and the sensible experience of matter and technology. Through action, experimentation and the always evolving co-constructed relation, the meeting with matter and the interface is an aesthetic temporal process, initiated by the artist in the moment of the conception and continually rethought through the meeting of bodies, materials and technology.

Agency as a creative sympoietic force

In the context of interactive artistic installations, the relation between human, matter and technology can be partly theorized by the hybridization with and through the various actors. Nevertheless, when designing HMMI, from the moment of its very conception, interactivity is seen through the perspective of communication and agency of matter and technology.

Thus, agency allows us to rethink our interactions with the material and the technological world surrounding us. One of the fathers of informatics and artificial intelligence, Alan Turing, once proposed a test that has been used as a validation tool that would allow us to classify a machine as “thinking”. Nevertheless, for Kate Forbes-Pitt, even though this test consists of an undeniable contribution in the evolution of computers and artificial intelligence, it also provides an enormous contribution in social and cognitive sciences, as well as in machine mediated artistic environments.²⁰

According to such a point of view, the way that this test was conceived and proposed simultaneously provides us with an assessment of how humans perceive and

interact with other human beings and with technology, as well as their expectations and affordances vis-a-vis these interactions. It could even be suggested that we are being more informed about the perceptual capacities of the human actor than about the capacities of the machine itself. Undeniably, during the exchanges between several entities—humans or between humans and non-humans—there is agency. In our research, the exchanges between these entities are represented in the relationship between matter, technology and humans.

For Karen Barad, agency is a matter of interactions, an enactive relationship.²¹ In her theory, agency is conceived as various possibilities of the reconfiguration of the viewer's body, of material and of technology. It cannot be a pre-established attribute of either the subject or the object, a condition that pre-exists in an entity in its conception, outside the context of interactions and relationships. On the contrary, in the case of the interactive artistic installation for example, agency is produced by the choices of the human who, consciously or unconsciously, positions and interacts with the other entities—the artistic interface, the materials, and of course technology.

However, we cannot consider agency as an a priori attribute of the interface, since neither it nor the human can have a “stable existence” outside of a cultural field of exchange.²² On the other hand, the performative nature of the experience of the interactive work makes the interface unstable and this is possibly one of the reasons it opens up the possibility of agency.²³

Nathaniel Stern, for his part, also emphasizes this performative aspect by explaining that the relationship between the body and the interactive work is constitutive, a “performed and emergent emergence”, a process that is constituted “in and with and through” the relations.²⁴

As such, it has been proposed by several theorists that separating human and non-human entities includes the risk of reducing their actual role in a co-constitutive relationship. Indeed, for the study of the interactive artworks, it will be more beneficial to consider their emergence as an encounter between the actions, efforts and effects of specifically located humans, materials and technology.²⁵ This enactive whole composed of efforts, effects, people and matter, operates in the specific cultural context of the work, within which the machine is not an autonomous agent but the precondition for the participation and the study of this set. For Suchman, the problem is less the attribution of agency to technology and more the fact that our language of speaking for agency presumes and imposes a field of autonomous

and discrete entities. As an alternative approach, she suggests that we consider interfaces as entities in the making through their relationship with other entities.²⁶

All the aforementioned thinkers help us to imagine an open material that is based on the idea of movement and agentivity; a material capable of behaving in a complex reality in which the relationship between subject and object, human and non-human, nature and culture, science and art is fluid. They give us a new definition of human's relationship with matter and technology, one that is closer to the enchantment of the material world, which leads us to renew our conception of matter as an agent in the becoming of the artwork.²⁷

Artistic Installations as Case Studies Ferrofluid interaction and the becoming of form

Liquid Matters (2019) ⁽²⁾ is an interactive installation dealing with materials in a playful way; by letting the participant interact via gestures and thus a natural interface, triggering movement of organic matter (ferrofluid particles) in a container liquid display, while this interaction and emergence of forms is reprojected in real time in a large video installation. (Figure 1)



Figure 1. *Liquid Matters*, Ferrofluid Material 2022 ©Respect Copyright.

The ferrofluid drops, organic and fluid as they are, flowing around, are controlled by the participant via a leap motion device. Thus, *LiquidMatters*, suggests a sympoietic artificial organism between human (experiencer), non-human matter (ferrofluids) and machine (Arduino controller and leap motion sensor, filed under computer vision). This simple combination of ferrofluid and magnet coupled with computer vision and real time interaction, becomes a complex system of a sympoietic node towards a material other. The organic form is co-created as a response to the feedback human—machine loop, but in this case, the machine is organic

pixel forms: they come in contrast with the regular pixels, thus confusing us on their nature; are they living creatures or maybe simulated ones?

In *LiquidMatters* installation (Figure 2), ferrofluid behavior is controlled by many technical factors, such as the distance between magnets, the power and the number of magnets and ferro particles itself, as well as the density of the container liquid. Ferrofluid movement is controlled by an Arduino device that translates the visitors' input gestures and hand movements to electromagnetic trajectories in the x and y axis. *LiquidMatters* is a fragile in nature experiment: if the particles don't interact, they sit still in their container liquid. As soon as our attention and gestures are captured new forms emerge, like a game of life of swarm ferro-particles. The significance of this 'augmented-diminished' reality experience is referring to the economy of attention between visitor and ferrofluids and in the sympoiesis of an entangled medium which *becomes* the artwork.

Through the force of a magnetic field ferrofluid becomes alive, complex in its behavior. By seeing this liquid as a material with intelligence, we activate and animate it. Digital technology allows us to see it as a responsive system where we are not simply imposing our will upon the environment but letting it reveal certain kinds of properties or possibilities through its constant fluidity. When dealing with matter in such a way, the agency of humans, machines and that of the materials unite, co-create and make visible the superimposition between the realms of a machine, human expression, and of matter itself. Instead of using digital processes or coding to generate forms, we used natural dynamic forces such as magnetism, gravity, and chemical reactions.



Figure 2. *Liquid Matters* interactive installation, Laval RectoVRso Gallery, 2019 © Respect Copyright.

Seeing through touch: Handprints as proof of sympoietic interfaces

VitRails (2018) is a mixed reality interactive installation, on the mediterranean refugee crisis. The multi-sensorial interactive installation uses a black thermochromic surface as an interface and a VR headset (Figure 3.). The visitor wears the headset, and is asked to touch the black surface presented as a window frame (Figure 4). The thermochromic behavior of the surface's material allows a temporary color change on the black surface, making the black transparent for a few seconds, and this, by touching, thus transmitting heat to the surface, using our hands. As soon as the surface changes its temperature by touching, a virtual landscape appears in the headset. Computer vision coupled with this behavioral object, the thermochromic paint, are the interface of this installation and allow visitors to enter the Virtual Reality world. Visitors can see through their handprints, by touching the surface. Once achieving access to the virtual world through his traces, he or she has only a few seconds to explore the events revealed on the other side. The cracks will start to disappear quickly, while the color of the painting returns to its original state.



Figure 3. VitRails, detail; view from the VR display, Laval RectoVRso Gallery, 2018 © ©Respect Copyright.



Figure 4. VitRails interactive installation, Laval RectoVRso Gallery, 2018 © Respect Copyright.

Archaeological evidence brings to light how our ancestors, since the hunter-gatherer period have been using different techniques involving materials in order to communicate a story, inventing languages, tools and techniques to pass on information. The Caves of Hands in Argentina (Figure 5), is named after the findings of mural stencils dating back to 7300 BC.

Cave paintings are symbiotic and sympoietic artworks. Symbiotic because of the relationship of different micro-organisms (bacteria and fungi) that coproduce a process of continuous "restoration" while etching the pictures deeper into rock ⁽³⁾. and sympoietic because this chemical "metabolism" refills the contours and vividness of colors/traces that were left by humans thousand years ago.



Figure 5. Hands at the *Cuevas de las Manos* upon *Río Pinturas*, in Argentina. Picture taken in 2005 © Creative Commons

VitRails installation, uses the metaphor of negative and positive human handprints/traces, taken from the Cave of Hands, to the material virtual other, entangling stories through a techno-anthropological gaze of the world via Virtual Reality technology, computer vision, real time simulation, photogrammetry and the thermochromic

paint. In this case, a cybernetic machine is created, involving human, material and technology in order to entangle stories of the Anthropocene, becoming the *Capitalocene* or the Cthulhucene as named by D. Haraway.²⁸ In this new materialism, the gaze shifts its focus from the human, toward informational or data flux and digital landscapes, and this new paradigm is thoroughly explained by Katherin Hayles, in *How we Became Posthuman*: "How information lost its body, that is, how it came to be conceptualized as an entity separate from the material forms in which it is thought to be embedded."²⁹ As Hayles writes, a critical practice that ignores materiality, or that reduces it to a narrow range of engagements, cuts itself off from the exuberant possibilities of all the unpredictable things that happen when we as embodied creatures interact with the rich physicality of the world.

In the cybernetics era, information has lost its body not to be disembodied, but to be embodied differently, to include non-human artificial and natural environments and by redefining the boundaries of nature itself. By creating a feedback loop, this interactive behavior emerges by actively touching the thermochromatic surface, creating negative space. Using a camera, the negative space creates a virtual magical portal. A portal to another reality. Multisensorial virtuality creates the magical plausible illusion of being in this alter world, co-creating with the material and the virtual, in an endless sympoietic feedback cycle. As Norah Campbell points out many *theorists have noticed a splicing of direct and tactile human perception of reality with another reality, one that is mediated and technical; producing a new reality that negotiates the individual's knowledge of the universe in diverse and complex ways.*³⁰

In contrast to many immersive virtual reality artworks, which privilege the sense of vision and usually completely neglect other senses, in VitRails, the participant is invited to be in constant contact with the physical world around him in order to sense and perceive the virtual. In the virtual world, a parallel story is emerging. By touching the thermochromic surface the visitor creates traces of his palms, which allow him via computer vision to briefly explore fragments of another reality through a virtual window, allowing fragmented view to the 3D scenographic elements and interact with them in real time, recreated by the use of photogrammetry, real time simulation, and 3D design in the VR environment.

This experimental artistic research includes human computer interaction with intelligent materials: technical artifacts that act/react as if conscious agents, able to decide on an output behavior, given a specific input.

This does not come as a surprise, as all cybernetic environments are controlled by object-oriented coding languages.

As Gilbert Simondon elegantly describes technical objects: "It is difficult to define technical objects by their belonging to a technical species; the species are easy to distinguish summarily, for practical use [...], but this is an illusory specificity, because no fixed structure corresponds to a defined use."³¹ This paper, aimed to explore the blurring boundaries of smart materials as interfaces, on experimental artistic practices in order to propose a symbiotic relation between intelligent objects, human and technology, to form what is called "the Artwork".

Conclusion

In this paper we introduced human-matter-machine interaction as a concept that questions the symbiotic and sympoietic relationship that emerges when experiencing interactive artworks with intelligent materials. Through HMMI, a new definition of human's relationship with matter stems from the entanglement of the participating actors that forms complex co-constitutive and evolving systems, defying cartesian dualities and attempting to capture some of the mystery and the magic of our surroundings.

These two artworks attempted to draw sensitive relationships with the material world around us through specific "becomings." These installations were born from experimentation on possible symbiosis and sympoiesis between humans, the material world and technology, while trying to provoke unpredictable interactions that lead to more sensory relationships.

These artworks are using such techno-scientific advancements as a way to make spectators question their relationships with the physical environment. Therefore, our focus was on how we experience our physical environment now that the digitized world has altered our perception.

Questioning the role of each entity participating in the becoming of the artwork, whether human or not, the notions of agency and emergence are recurrent in our theoretical framework. When studying interactive artworks, especially through the perspective of experience, their emergence can be considered as the entanglement of humans, materials and technology. The

situated action inside this enactive whole gives rise to the artistic interface as an open materiality, challenging our relationship with our surroundings.

Acknowledgements

Research for this paper has been supported by AIAC, INREV research group, Paris 8 University and EnsadLab Spatial Media research group, PSL University.

(1) Worlding' refers to the co-operative way of 'world-making' according to Donna Haraway.

(2) Liquid Matters, interactive installation by continuum collective, as presented at RectoVRso Gallery in Laval, during Laval Virtual Summit.

(3) Mihnea Mircan, Introduction-Allegory of the Cave Painting, Mousse Publishing, Milan, 2015

References

- 1 Karen Barad, *Meeting the Universe Halfway: Quantum Physics and the Entanglement of Matter and Meaning*, Durham, N.C., London, Duke University Press, 2007.
- 2 Bruno Latour, *Reassembling the Social: An Introduction to Actor-Network-Theory*, Oxford, OUP Oxford, 2005, 2.
- 3 Bruno Latour, *Politiques de La Nature : Comment Faire Entrer Les Sciences En Démocratie*, Verlag, Paris: Découverte, 2004, 66–67.
- 4 Jane Bennett, *Vibrant Matter: A Political Ecology of Things*, Durham, Duke University Press, 2010, 8.
- 5 Jane Bennett, *Vibrant Matter: A Political Ecology of Things*, 2.
- 6 Donna Haraway, *Staying with the Trouble: Making Kin in the Chthulucene*, Durham (N.C.), London: Duke University Press, 2016.
- 7 Donna Haraway, *Staying with the Trouble: Making Kin in the Chthulucene*, 58.
- 8 Rosi Braidotti, "Discontinuous Becomings. Deleuze on the Becoming-Woman of Philosophy," *Journal of the British Society for Phenomenology* 24, no. 1, January 1993, 44.
- 9 Stephen Abblitt, "Composite Lives: Making-with Our Multispecies Kin (Imagine!)," *A/B: Auto/Biography Studies* 34, no. 3, September 2, 2019, p.507–18, doi:.
- 10 Karen Barad, *Meeting the Universe Halfway: Quantum Physics and the Entanglement of Matter and Meaning*
- 11 Karen Barad, *Meeting the Universe Halfway: Quantum Physics and the Entanglement of Matter and Meaning*, 142.
- 12 Gilbert Simondon, *L'individu et Sa Genèse Physico-Biologique*, Editions Jérôme Millon, 1995.
- 13 Christine Browaeys, *La Matérialité À l'Ère Digitale : L'humain Connecté À La Matière*, Saint-Martin-D'hères, Presses Universitaires De Grenoble, 2019, 13.

14 Christine Browaeys, *La Matérialité À l'Ère Digitale : L'humain Connecté À La Matière*, 104.

15 Nathaniel Stern, *Interactive Art and Embodiment*, Gylphi Limited, 2013.

16 Karen Barad, *Meeting the Universe Halfway: Quantum Physics and the Entanglement of Matter and Meaning*, 84

17 Karen Barad, *Meeting the Universe Halfway: Quantum Physics and the Entanglement of Matter and Meaning*, 37.

18 Phaedra Shanbaum, *The Digital Interface and New Media Art Installations*, Routledge, 2019, 44.

19 ibid

20 Kate Forbes-Pitt, *The Assumption of Agency Theory*, Routledge, 2011, 2.

21 Karen Barad, *Meeting the Universe Halfway: Quantum Physics and the Entanglement of Matter and Meaning*, 235.

22 Karen Barad, *Meeting the Universe Halfway: Quantum Physics and the Entanglement of Matter and Meaning*, 213.

23 Phaedra Shanbaum, *Media Art Installations*, Routledge, 2019, 59.

24 Nathaniel Stern, *Interactive Art and Embodiment*, 62.

25 Lucille Alice Suchman, *Human-Machine Reconfigurations: Plans and Situated Actions*, Cambridge: Cambridge Univ. Pr, 2009, 280.

26 Lucille Alice Suchman, *Human-Machine Reconfigurations: Plans and Situated Actions*, 263.

27 Jane Bennett, *The Enchantment of Modern Life : Attachments, Crossings, and Ethics*.

28 Donna Haraway, "Anthropocene, Capitalocene, Plantationocene, Chthulucene: Making Kin," *Environmental Humanities* 6, no. 1, 2015, 159–65.

29 N Katherine Hayles, *How We Became Posthuman Virtual Bodies in Cybernetics, Literature, and Informatics*, Chicago: The University Of Chicago Press, 2008, 17.

30 Norah Campbell, "The Technological Gaze in Advertising," *Irish Marketing Review* 19, January 2008.

31 Gilbert Simondon, Cécile Malaspina, John Rogove, *On the Mode of Existence of Technical Objects*, Minneapolis, Mn: Univocal Publishing, Minneapolis, Minn, 2017, 11.

Bibliography

Stephen Abblitt, "Composite Lives: Making-with Our Multispecies Kin (Imagine!)." *A/B: Auto/Biography Studies* 34, no. 3, September 2, 2019, p.507–18, doi:10.1080/08989575.2019.1664132.

Autor: Bruno Latour, *Politiques de La Nature : Comment Faire Entrer Les Sciences En Démocratie*, Verlag, Paris, Découverte, 2004.

Karen Barad, *Meeting the Universe Halfway: Quantum Physics and the Entanglement of Matter and Meaning*, Durham, N.C., London, Duke University Press, 2007.

Karen Barad, "Posthumanist Performativity: Toward an Understanding of How Matter Comes to Matter." *Signs: Journal of Women in Culture and Society* 28, no. 3, March 2003, 801–31, doi:10.1086/345321.

Jane Bennett, *The Enchantment of Modern Life: Attachments, Crossings, and Ethics*. Princeton, N.J., Princeton University Press, 2001.

Jane Bennett, *Vibrant Matter: A Political Ecology of Things*, Durham, Duke University Press, 2010.

Rosi Braidotti, "Discontinuous Becomings. Deleuze on the Becoming-Woman of Philosophy", *Journal of the British Society for Phenomenology* 24, no. 1, January 1993, 44. doi:10.1080/00071773.1993.11644270.

Christine Browaëys, *La Matérialité À l'Ère Digitale : L'humain Connecté À La Matière*, Saint-Martin-D'hères: Presses Universitaires De Grenoble, 2019.

Norah Campbell, "The Technological Gaze in Advertising", *Irish Marketing Review* 19, January 2008.

Monica J. Casper, "Reframing and Grounding Nonhuman Agency." *American Behavioral Scientist* 37, no. 6, May 1994, 839-56. doi:10.1177/0002764294037006009.

Kate Forbes-Pitt, *The Assumption of Agency Theory*, Routledge, 2011.

Donna Haraway, "Anthropocene, Capitalocene, Plantationocene, Chthulucene: Making Kin", *Environmental Humanities* 6, no. 1, 2015, 159-65. doi:10.1215/22011919-3615934.

Donna Haraway, *Staying with the Trouble: Making Kin in the Chthulucene*. Durham (N.C.), London, Duke University Press, 2016.

Bruno Latour, *Reassembling the Social: An Introduction to Actor-Network-Theory*, Oxford, OUP Oxford, 2005.

Lucille Alice Suchman, *Human-Machine Reconfigurations: Plans and Situated Actions*, Cambridge, Cambridge Univ. Pr, 2009.

N Katherine Hayles, *How We Became Posthuman Virtual Bodies in Cybernetics, Literature, and Informatics*, Chicago: The University Of Chicago Press, 2008.

Phaedra Shanbaum, *The Digital Interface and New Media Art Installations*, Routledge, 2019.

Gilbert Simondon, *L'individu et Sa Genèse Physico-Biologique*, Editions Jérôme Millon, 1995.

Gilbert Simondon, Cécile Malaspina, John Rogove, *On the Mode of Existence of Technical Objects*, Minneapolis, Mn: Univocal Publishing, Minneapolis, Minn, 2017.

Nathaniel Stern, *Interactive Art and Embodiment*, Gylphi Limited, 2013.