A Peer-Reviewed Journal About

MACHINE FEELING

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EDITORIAL

FEELING, FAILURE, FALLACIES

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Feeling

Digital culture has become instrumental for capturing and managing what Raymond Williams would once have called "structures of feeling". The journal issue *A Peer-Reviewed Journal About Machine Feeling* alludes to this, and points to a material analysis of aesthetics and culture, including its technical and social forms, and in the way that this concept was originally employed as an acknowledgment of the importance of the hard to capture dimensions of everyday life. Styles, expressions and sentiments are always in flux, yet Williams, and others after him, have with this term argued that they are grounded in cultural history and specific everyday situations. In developing a critical and analytic understanding we should therefore turn our attention to changes in language, style, aesthetics and those social forms which are active in the present, but not yet fully formed or captured by a conceptual or scientific knowledge framework. Taking their point of departure from Williams, Devika Sharma and Frederik Tygstrup write:

> *We recognise the facts of cultural life once they are established and institutionalised, but we tend to miss those moments when new patterns of experience emerge, when people start to think differently, when new sensibilities arise, when habits swerve. (4)*

This journal issue further explores this line of thinking, and more specifically responds to the current developments in machine learning and the ability of technologies to capture and structure feelings and experiences that are active, in flux, and in the present; for example, in the ways that automated experiences of seeing and reading begin to produce knowledge through the capture of everyday styles, expressions, preferences, sentiments, and so forth – the very means that Williams alludes to.

If, in general, machine learning appears to lack an affective dimension, then in what ways are we to understand its resolute and concerted pursuit of this? What old registers of processing culture and organizing time, space and power does it build on? What potential new sensibilities and structures of feeling may arise in such normalized registers of our habits? What new cultural and social forms and practices emerge in the coming together of machine learning and structures of feeling? In each their own way, the authors in this journal explore these questions.

Failure

To capture moments when new patterns of experience emerge, when people start to think differently, when new sensibilities arise will first and foremost depend on a large set of training data — sound, text, biological data, and more that can be used for image recognition, sentiment analysis and more. At a more general level, these datasets absorb all kinds of social and cultural production; they seek to absorb every moment that people start to think, act, sense, and experience phenomena in new ways.

There is a certain paradox in this. As pointed out by Matteo Pasquinelli, machine learning is a paradigm of intelligence that fails to provide a methodology of failure. What people generally refer to as artificial intelligence and machine learning is merely a statistical mapping of correlations in the dataset. Because of this, machine learning will reduce the least common structures in the dataset, simply in order to reduce calculation costs. Consequently, machine learning is not a sign of cognition, but of compression as a means to efficiency, which on the other side is also a loss of diversity; failure does not exist. In this, he claims, machine learning seems much more aligned with a history of optical lenses who operate by resolutions and diffraction. This is what he calls *statistical cinema*. This problem of generalization or "regression towards the mean" is mathematical but not without political consequences.

Fallacies

What then is the role of researching digital culture and *machine feeling*? On the one hand, to follow Williams and capture the "habits that swerve" seems to be relegated to corporate research institutions that seek to align calculation costs and statistical resolution; institutions that perform the *statistical spectacle* of contemporary digital culture. On the other, could researching machine feeling be regarded as an interrogation of the failures of machine learning; or, even providing a methodology of failure that machine learning otherwise lacks?

This kind of research could take different shapes. For one, it might address the implied inclusions and exclusions that are at play in the politics of research, such as the intersectional *feelings* of race, gender, and class. It might address the emotionalisation of not only politics and a people born to feel (which seems to be intrinsically related to the statistical spectacle), but also of research itself and how it links to subjective patterns of experience. The contributions to the journal resonate with this approach and expose some of the fallacies at work in research processes once feelings are engaged. The subsections of this journal reflect this problem: *making sense* (Iain Emsley, Maike Klein, Irina Raskin); *(un)being* (Maria Dada, Tiara Roxanne, Rebecca Uliasz, Brett Zehner); *feeling generators* (Malthe Stavning Erslev, Michela De Carlo, Carman Ng, Tanja Wiehn); and *seeing things* (Mitra Azar, Daniel Chavez Heras, Tomasz Hollanek, Rosemary Lee, Carleigh Morgan).

There is more than a hint of Williams (and his *cultural materialism*) across these positions in recognition of the ways that certain ideas (such as affect theory and machine learning) achieve hegemonic status. We, as contributors to this journal issue, all *feel/felt* the weight of history and privilege here, not least as the workshop leading to the publication was held at the University of Cambridge where Williams himself once taught. The setting for our (and his) work is clearly an important issue if we take structures of feeling seriously and recognise that the contents of a journal such as this are a consequence of a wider factors that include actual work, social relations, and place of production: "it is a trivial fantasy to suppose that these general and pressing conditions are for long or even at all separable from the immediate and the personal", as Williams puts it (*Culture and Materialism* 222). Herein lies the tension between received forms and lived experience, of structures of feeling.

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We dedicate this issue to the memory of Sascha Pohflepp.

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MAKING SENSE

Iain Emsley

ITERACIES OF FEELING

Abstract

Computational readings of culture allow us to pose new questions or create new cultural forms supporting new forms of critical thinking and reading. Yet the machine may not be able to identify some of the qualities, such as emotion, that might be central to the question raised. Using the Next Rembrandt project as a case study, this paper suggests an approach to consider the medium as the site of meaning making in digital culture and how this affects critical practice using Raymond Williams, David Berry and Jacques Derrida. In the first part, I consider the idea of reading with machines and how this might be considered within the medium. The second part uses iteracy to find meaning in the models and how this might reveal new critical paths through readings of the image. The final part presents a reading of the digital object itself and how these can be used to create a space for meaning to come into being. Through this, the article raises questions about critical techniques for understanding the material object in distant reading methodologies as ongoing research.

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Computational readings of culture allow us to pose new questions or create new cultural forms supporting new forms of critical thinking and reading. Yet the machine may not be able to identify some of the qualities, such as emotion, that might be central to the question raised. The advantages of distant reading, such as scale, may be tempered by a realisation of what may be missing.

Using the Next Rembrandt project as a case study, the aim of this paper is to suggest an approach to consider the medium as the site of meaning making in digital culture and how this affects critical practice. In the first part, I consider the idea of reading with machines and how this might be considered within the medium. The second part uses David Berry's iteracy to find meaning in the models and how this might reveal new critical paths. The third part presents a reading of the digital object itself and how these can be used to create a space for meaning to come into being.

Raymond Williams's structures of feeling suggest a way of beginning to think about this new understanding. I build on this conception that "a cultural hypothesis, actually derived from attempts to understand such elements and their connections in a generation or period, and needing always to be returned, interactively, to such evidence"(133) by situating the elements and connections within a digital reading. Computational reading derives features from the data based on human thought and interpretation of the hypothesis, either in the construction of algorithms or labelling of data. Once identified, the features may then be analysed or combined to create new structures and elements. Qualitative feelings such as emotions become uncertain elements that the quantitative seeks to understand through models. I will suggest that a critical reading of the digital object reveals ways in which the human might be understood and to suggest a critical practice.

This suggests two critical responses that I will explore in this paper. The consideration of structures of feeling requires not only human reading but also technical reading itself using models to understand the digital. Reflecting on Hayles's sense that print is shallow but code is deep, I suggest that this develops cyborg reading, where the "reader necessarily is constructed as a cyborg, spliced into an integrated circuit with one or more intelligent machines" (85), a technique to interpret the medium's discourse. I want to develop this through the way that reading digital culture means reading with machines to understand the data.

I want to develop this reading as an experimental process as well as considering the materiality of computational culture. Berry's iteracy, "the ability to read, write and understand processes" (190), is a key to understanding the artefact and to interact with its relocation of epistemology. This uses both cultural hypotheses and evidence to test how the data is being created, so placing a human meaning into the process. Building on Berry and Fagerjord's call that "culture […] is materialised and fixed in forms specific to material digital culture",(142) I want to think about how the presentation of the final form reveals and hides the metamedium nature of the digital, capable of transforming existing media and creating new media and technologies.

Next Rembrandt

In this section, I want to consider the Next Rembrandt[1] and to think about how it is read with machines. The project was an experiment to create a new picture from a reading of Rembrandt's portraits, shown in Figure 1. The Next Rembrandt is an algorithmically generated image by a partnership of J. Walter

Figure 1: Image of the Next Rembrandt. Photo: J. Walter Thompson Amsterdam.

Thompson Amsterdam, ING, Microsoft, TU Delft and the Mauritshuis. Using high resolution 3-dimensional scans and digital versions of 346 of Rembrandt's portraits, machine learning algorithms identified the key points to be created from 150 Gigabytes of generated graphics. Using a mix of cloud and physical machines, the algorithms were tested and run in parallel. The rendering of the portrait took 500 hours on machines and a 3-dimensional printed picture is created from 148 million pixels. The computational aspects both hide themselves behind and are bound into the impression of paint.

This impression is an imitation made up from a digital reading of the drops of paint and the intentional layering to be recreated in 3-dimensions for the physical portrait. The created form echoes an earlier tradition to present itself as a singular object. A closer reading suggests that Finn's assertion that "code can be magical" (5), where the code is an agent in changing the world and the mind, is at play here. The layered paint sections hint at algorithms used to create them as does the gaze in both editions of the painting. The attempts at authenticity in both digital forms provoke a desire to read it more closely, to understand the entwined cultures, but the machine resists traditional cultural readings to fully tease apart the layers. Authenticity becomes inauthentic, unless it is read with a machine or a machine in mind.

As a digital object, a machine is required to read and render the cultural data through new models of space, location, and artistic models to make it visible to the human. Culture needs to be read through computational remediation. Yet the work appears to capture human aspects, such as emotion. Emotional reactions may have alternative meanings in the technical world. They may be seen as signs of both commercial and personal engagement or a data point in a model to suggest new content or to try to refine models of how to understand humans. Even these emotional points can be limited to a recognised and constrained set of emotions. We need to consider the contexts they exist in. Emotional markers may be read through sentiment analysis or from a reaction on a page by a machine looking for engagement or a commercial opportunity. Or is it learning how to recreate our reality through a numeric system?

Reading with *machines*

We need to read with *machines* to begin accessing this culture and understanding its new forms.

The visual layer invites a human reading of the image and to infer the emotional states represented in the eyes and the wistful mouth. Within the given boundaries, the algorithms create an image using an intensely close reading of colour palettes and shades but can only imitate emotion. A reading of the object as a visualisation provokes questions about how the representation is considered, either as a close reading of the portraits so enhancing a trait that it reads or whether the algorithm has created it?

Having considered using machines to generate and process the data, I want to think about how we might begin to think with the machine and considering how they might generate knowledge. At the very least, we must admit that we need to read with the machine. Born digital culture, like the Next Rembrandt, cannot be read by a human; it requires computational remediation. Such art alters our critical relationship with machines and raising a crucial role for questioning the medium itself as site of cognitive practice through remediation.

Using a machine to write data suggests that it is required to read and remediate it, so using it as part of the interpretation through the models encoded into the process. It may be mediated through visualisation or sonification processes, providing another area that needs to be understood. Instead of reading data, we read presentation models that affect hypothetical models as a strategy of not reading (Clement; Moretti, "Conjectures in World Literature"). This practice accepts that the quantity of information cannot be read at a close level, by humans but that broad patterns can be viewed through machines. In cultural terms, this builds on Moretti's concept that "distance is not an obstacle, but a *specific form of knowledge*: fewer elements, hence a sharper sense of their overall interconnection" (Moretti, *Graphs, Maps, Trees 1*). These abstractions, allowing the reading of patterns over specificities, are digital structures used to support interpretation or remediation. Machine interpretation may also be fuzzy and not show outliers or emerging patterns if they are too slow and long, suggesting that the subtleties of emotion may be aggregated through counts into clusters of readings at the machine level.

Although brought together as one image, the picture is a series of algorithmic observations. Each of these is a specific form of knowledge gained through the distant reading and pieced together through other forms of knowledge. The machine, through its learning algorithms, uses a hypothesis to test its understanding and creates an image. Its understanding of a structure is taken from the evidence, to which the evidence is returned once the process has tested it. I would suggest that this understanding is based in computational materiality.

The project is a close reading of portraits conducted by machines to create a machine-readable data set. The algorithms identify relevant parts of information. The resulting image requires computational remediation to convert the numeric world into a human readable one. In a very real fashion, we can only read the image with a machine. This echoes Adorno and Horkheimer's culture industry that broadcasts and replicates itself, where we rely on technology to create and remediate culture.

Reading *with* machines

We begin to read *with* machines and to understand how both sides form and contribute to digital culture.

By this, I mean that we need to consider not only the interface and how that creates a reality but how we can use any given options or even access to the algorithms to consider the logics at play. Reflecting on the roots of iteracy as iteration, I want to think about how it can be used to repeat a process, perhaps with alterations, to allow the algorithm to be the point of interaction. Through making changes, user meaning can be given to the machine to continue hypothesis testing. When Next Rembrandt was being created, algorithms were repeatedly run in parallel. The repetition of these processes provides a space for the human thought to enter the process and realise the potential of Ramsay's algorithmic criticism (33) to reconceive both the form and criticism's logics in a playful form. Tweaking the parameters and repeating the process not only reveals the process through which the picture is made but also allows humans into the iterative loop and realise the hypothetical nature of the work through experimentation. This site of interaction moves human cognition into the machine so as to embed the concept of thinking with the machine and its models.

The materiality of computation becomes more apparent through these acts. Researchers defined that the resulting person was Caucasian, male, wearing black clothes with a white collar and between thirty and forty. This suggests a machine logic that might recognise the image but requires guidance through wider cultural nuance that might be either difficult to model or statistically insignificant. This is translated into a model or set of constraints. The limitations of the machine's cultural understanding become more visible as does the imposition of human values into the reconstruction algorithms. Taking an active stance in considering how the computational both reads and writes the data reveals not only different meanings but suggests new critical practice.

Using machines raises questions about culture. Are new cultural forms appearing: ones that can be appreciated by both machines and humans? What forms of culture may arise from this? Who owns the created form? Is a new culture industry being created through the use of social media or infrastructure companies to create cultural forms?

I want to take a brief pause to consider the critical theoretical response to this position. At one remove, the process of creating the model of the image reduces the human to a set of constructs, such as average width between the eyes, which is then broadcast to the viewer. The digital can reproduce the image in a variety of forms from the same underlying data and the results of the imperfect structures are encoded in this view. Benjamin's assertion that "reproduction detaches the reproduced object from the domain of tradition" (215) can be operationalised to interrogate the structure in its new tradition.

The newly created digital reading raises questions as to which tradition is being developed. The artist becomes the subject of the work rather than the creator, though he is elided from the public gaze. As well as reading and showing the new structures of feeling, the object itself is not part of Rembrandt's tradition. Aside from the ownership questions, the newly created picture exists within an alternate context. Material questions about whether it can be considered as a work of new media art or data visualisation and what its relation to Rembrandt's oeuvre might be? Is it a creation or an analytical work? Digital reading of the portraits detaches this from the paintings and creates a new tradition through algorithms and processing power.

Infrastructural questions can be raised. One project partner, ING, fund cultural institutions, such as the Rijksmuseum, enabling cultural institutions to remain open. However, it might also be read as patronage. A culture industry arising from the financial ability to support human endeavour and the physical infrastructure. JWT Amsterdam also paid for the physical version of the painting to be created. This provokes further questions about the relationship between digital and physical artistic culture. The digital has the potential for writing, assuming the protected mode is off. An act of execution and change, writing is a permissioned act within computation. The machine owners may grant or deny the permission for non-owners to write any data without a visible infrastructure. As such, the culture shown is one where the non-corporate entity is deemed lower and granted read only permissions.

Patronage can be rethought through the computational. The scale of the data produced by the project as well as the amount of processing power needed to run the facial recognition and rendering processes on such a large digital object suggests that new platforms are required. The infrastructure is provided by Microsoft in this instance. Both of these require financial and computational power so renewing patronage as a computational form. This embeds such providers into the warp and weft of digital culture. Without a return to reading with machines and considering their logics, we return to a transmit only culture. Technical specialisations create the conditions for a read only culture, so projecting their dominance into a cultural sphere. The rendered figure, through its created class and social standing, perhaps points to the role of the creative partners in creating the image.

The face is a construction of models and aggregations rather than being read and interpreted from a sitter. Critical questions remain about whether this project was a safe space to develop and use facial recognition and reconstruction algorithms. This project creates an ethical safe space to reflect on these algorithms within a known set of biases, ones defined in the underlying data set and the parameters given for the reconstruction. I want to raise these as critical issues to be able to interrogate the created image and the assumptions that give it focus.

The born digital image is both remediated into a human readable image and rendered as an artefact that I want to think of as reborn analogue. This latter form, the printed image, continues to challenge the concepts of tradition. Through being made into a physical object, it is placed into a museum setting that the funders support as well as what might be considered an old media cultural setting. The image is also available digitally and can be copied and reproduced. This latter tradition that is represented is one driven by the technological medium as something that can be easily shared at minimal effort. What the physical print elides is that it was printed from the digital file. Generated from the digital file, 'paint' is calculated through machine learning and printed in minor layers. The computational re-presents the paint medium as an abstraction that requires a deep reading to understand the artifice of a natural process. Paint drops become composed rather than accidental. As well as remediating the data into new forms, new tools and conceptual processes are required to understand the materiality of the object and how these fits in with existing traditions.

A consideration of the image involves its methods of creation. From here, we need to extend Hayles's notion of thinking through the network to consider the physical machines, such as printers, and materials involved. The printed image was not only made on a 3-dimensional printer but through layers of printing substrate, though both are controlled by the file made from the image. As well as encouraging us to read in different ways, we need to think about the techne itself and how this supports an epistemological reading.

Iteracy's root as literacy provokes questions of how one might read or listen to the results as abstractions and patterns. The act of interacting with the process embeds a human element in part of it, suggesting that the object being read comes from thinking through a network. Next Rembrandt may be read as an image but to understand it, one needs to consider new practices of reading and meaning making. In many aspects, this is a technically demanding reading. We might feel the sadness and warmth in the sitter's eyes or the slightly worn look derived from the way the light plays on the features and through the layers of paint. I contend that we are inside an interpretational loop, reading the evidence supplied to us from a hypothetical model encoded into the process. The machine uses aggregations of the models and the data to create a new set of data points derived through a model. The underlying algorithms create a numerical reading, themselves bound within what the limitations of the algorithms and the hardware. Its surface is a visualisation, where mappings mediate the numerical data into a new point, which humans perceive as colour at a location. From a human perspective, we note the stylistic similarities, the attention to detail in the style and the emotion in the face. There is a disjunction here between the two readings that reveals the need for conceiving about how this can be critically approached. Read together, these data points begin to suggest the underlying logics, such as the position of light, as we move from a macro- to a microanalysis. With the assumption that we are unaware of the human provided limitations, the reading can interrogate how the machine reads the data to project a model of its understanding.

I want to turn to models as an integral part of these computational structures. McCarty echoes Weizenbaum in considering computational systems as dependent on the models given to them to understand a conception of the world. The use of Artificial Intelligence to create data sets and models raises questions of who is the designer and whose world is being created? The model's structure of an element rests on how the designer or implementer translates and transcodes the element into their work as well as the model's purpose. The model itself requires critical consideration of what is being modelled and what is being presented through the computational.

The use of the machine suggests that the computational materiality needs to be considered for what is being modelled and presented but how and the values that lie within the processes. Weizenbaum's consideration that the "symbolic recreation of [the designer's] world" (18) may be read in two ways. Firstly, the model and its associated processes reflect their purpose and process. Secondly, the medium affects the object through its own limitations and understanding but it shows a need for a critical practice to determine where the model might come from and how it is represented. As the data is being rendered, the model's values are being applied through the processes. The reconstructive stage shows the machine's iteration as it mapped the facial features to proportions until it achieved the final image. Through testing the image, the algorithms are testing themselves. Using this, one might read the intention behind the models that are shown and to understand the two readings available – the numerical and the rendered – and to probe its limitations.

A key point is Williams's issue with the specifics of what constitutes an element in discourse is further problematised through translation and encoding required for the machine to understand them as hypothetical constructs. A new discourse is created from the results, which require reading when it has bene returned to the evidence from whence it came. The underlying computer model both makes and is made from the translation. This alters the location of epistemology from the reading and interpretation to within the computational. A necessary consequence is a potential change of the location of the element's negotiation.

Whilst it may happen as part of wider cultural discourse, it is happening within the algorithms and their models of the world. As discussed, human intervention can help to mould the uncertain elements into an appreciable form through a combination generated from iterate readings.

The digital object as pharmakon

Having considered the image and its consequences for realising the digital, I want to focus on the digital object itself. Having discussed potential ways of making meaning, I want to illuminate the material that reshapes both it- and ourselves as the site of cognitive practice.

I see the pharmakon acting as discourse. Derived from Plato's view that writing "will make them remember things by relying on marks made by others, from outside themselves, not on their inner resources" (69), Derrida suggests that it "acts as both remedy and poison" (Derrida, *Dissemination 73*) and injects itself into discourse. At one level, text provides a discourse that can be read and shared, yet it also removes the ability to query the underlying discourse and remakes it in its own symbols. This imitation of practices suggests that there is a computational cognitive economy where only those who can create the tools to understand the digital object may interpret it. I suggest that by exposing the pharmakon, one can bring different tools to understand it. This suggests an alteration how we think the digital affects writing. Where Plato's writing loses both access to memory and the underlying discourse, the object is central to both as the locus between humans and machine cognitive practices. It both creates and transforms the cultural forms, acting as memory and discourse to express them.

The Next Rembrandt image is a medicine in its form. Without reflection of its materiality, hidden by the (in)authentic surface, it is a poison. Where the textual medium removes access to an oral discourse through remediation, the digital can be remediated into different media though the original language is computational. It can be accessed using tools and with permissions. Understanding that the digital can be presented in different ways, such as a born digital or a printed picture, creates the space for a critical gap to appear. Even using machines and programming languages, one has to acknowledge the translations and transcoding to converse across the layers. Taking Manovich's conception of the metamedium (101-102), critical practice becomes a tool of and about the medium. This practice, as shown above, does not necessarily need to use computational tools to be reflexive but can also be theoretical by bringing the object into a different being. Having suggested that the digital object is a pharmakon, I want to extend the reading through Derrida's différance and the use of play that it reveals.

As human and machine discourses mix, they reconstruct their own context into new discourse. The ontotheological message of a machine reading data becomes one with the potential for multiple meanings. As the model is read and processed as "a sort of writing" (Derrida, *Of Grammatology* 56), its form is recontextualised, moving from an image through numerical models to become its own grammatology. Realising that the object is made up of these changes recognises the différance, the gap created between the signifier and the signified when the computational elides itself. Although based on a learned aggregate set of elements, like the colouring and the geometries involved, a human reading may infer emotion into Next Rembrandt's eyes or face and realises a human part of the language. Where machine process may be limited in their qualitative meaning making, human readers may recognise the possibilities of the elements that exist as a series of interpretative gaps that expose the potential for new critical readings of the image.

Alternate considerations might be brought to the eye as a form of play. Derrida's consideration of play as a de-centring of meaning within bounds allows critical logics to be reconfigured. The new readings allow for interpretation to take place through experimentation, continuing the suggested move from a digital culture that projects its meaning. Iteracy and play work together with the pharmakon to create new contexts and movements between remedy and poison. Different structures of feeling might be viewed as evidence to be interpreted. Our readings work to remake meaning within the boundaries through combining human and machine meanings. Doing this, we begin to recontextualise the medium as a site of cognitive practice where readings combine and recombine. I want to use reading with machines to think about critical practice beyond the interface and at the level of the medium.

Reading with machines supports methodological changes that are hinted at by Williams. The element's existence and its interpretative possibilities as part of an emerging discourse is problematised through this process. The remediation of the images in different media suggests that the presented evidence is a poisoned reading that is guided by the models of presentation. Translating a feature into a series of technical languages to create a new model and element alters the discourse and its specificities. It is only by looking for the imperfections in the surfaces that we are able to begin a reading that critiques these discourses. By taking part of the presented data, hypotheses can be formulated and tested. Meaning can be interrogated by altering parameters and questions to test the new way of thinking and interpretations, while recognising that the structures of feeling may be made of other structures. The evidence that we are examining for clues is made of other evidence and hypotheses that is generated from the machine.

Conclusion

Using Williams's definition of structures of feeling as cultural hypotheses, this paper argues that they might be seen models of thought that are translated into computational models. The evidence is used to generate new cultural forms that are returned to the evidence that it came from. By understanding these processes as a mix of human and machine discourse, we can think about how to both interpret and interact with them. Iteracy encourages not only a different form of reading but also critical engagement with the underlying discourse, so considering the medium as the site of cognitive practice where discourses mix and create interpretative gaps. The claiming of the computational as a metamedium provokes the need for new practices of making meaning that consider the medium. These theoretical considerations are the subject of ongoing research into the digital object as a core concern in distant reading methodologies.

Rather than seeing the digital mediation of cultural forms as a machine-driven process, I contend that considering them within the medium opens up new forms of critical interpretation and techniques that use the revealed discourse. From this we understand that computational structures of *feeling* become imperfect *structures* of feeling.

Notes

[1] Next Rembrandt, https://www.nextrembrandt.com/.

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Irina Raskin

MACHINE LEARNING AND TECHNOECOLOGICAL CONDITIONS OF SENSING

Abstract

In what way can machine learning be understood as a computational mode of sensing? How does the practice of making sense take place in the context of developing machine learning applications? What assumptions and conflicts are constitutive for that very process of sensing? Bringing case studies from machine learning into conversation with theoretical work primarily by Erich Hörl, Luciana Parisi, Wendy Hui Kyong Chun and Karen Barad, this article reflects on the re-configuration of sense in the course of the expansion of media-technology. It questions how computational expressions become relatable as well as the mechanisms for encapsulating the capacity of sensing for determining purposes.

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Introduction

The expansion of media-technology leads to an extension of the remediation of artifacts and signs. It proliferates the evolvement of machinic programs into relatable environments for sensing. Furthermore, it takes part in a re-configuration of sense and the conceptions of how meaningfulness is constituted. As argued by German philosopher Eric Hörl, under a media-technological condition of sensing, a “technoecological” form of sense-making is disclosed. This emphasizes the operative dimension rather than the representative function of signs as information. Sensing, here, on the one side highlights the interlacing between sensory, cognitive and affective fields within sentience and its significance for intelligibility. On the other side, the term sensing stands for a primarily relational capacity through which boundaries between sense-making entities are enacted. At the same time, media-technological devices become commodified tools for exploiting sensing by encapsulating the capacity of meaningful articulations into a calculated determination of sense (cf. Hörl). Thus, media-technology enables a governing of reality by instrumentalizing sensing for determining purposes.

By taking into consideration a case study of machine learning, this article regards the materialization of information via machine learning as a process of sensing. It focuses thereby on the premises of connectivity and the program’s ability to ‘generalize’ Generalization describes an algorithmic processing, which relies on the abstraction of information by gaining structuring models from data. It points to a transformation of the concept of computation and the epistemology it engenders (cf. Parisi). Further, the article discusses this computational mode of sensing in regards to different concepts of performativity (cf. Chun, Barad). From the perspective of performativity, the critique against an instrumentalization of computational sensing for governing reality cannot be exclusively addressed in regards to its partaking in the determination of sense. Rather, it asks for taking into account the measurements for evaluating and shaping the process of determination. This implies to direct one’s attention towards the apparatuses and its infrastructure that sustains algorithmic sensing, towards questioning how one relates to the expressed sense as well as the accountability of computational sensing.

Sensing

Sensing is feeling and thinking. It is an experience that constitutes surfaces of entities and at the same makes time their boundaries questionable and negotiable. It is a capacity which cannot be isolated. Relations are its very substance. Take for example the very trivial but existential experience of sensing hunger. When I feel hungry, I know that I have to eat. If the hunger just emerges, I might be able to wait for a while. If the sense of hunger is more intense, I might become dizzy, unfocused, moody, not able to hold on to a clear thought. If I wait for too long and let the hunger expand, the first bites might cause sickness rather than delightful relief, even though it is a well-known feeling of swallowing more or less pulpy food. Sometimes I know that I need to eat something, but I am too nervous to feel hungry. Fortunately, I am in a privileged situation, where I have access to resources and it is my decision how I deal with hunger, I can choose when, what and how to eat, I do not suffer from hunger.

Why do I elaborate on the sensation of hunger here? It seems to be a good example for how feeling and thinking, knowledge and perception, cognition and affect intertwine in complex ways; for how the same sense may undergo very different nuances and states; for how this sense is generated by multiple entities on different conglomerating scales; for how organism and its environment are interdependent and make sense of each other; for how an 'automatic' metabolism is a part of me and can as well become a conflict for my 'self'; for how due to reflective or intuitive knowledge I can act upon and modify it, but never fully control it; and for how the word 'hunger' subsumes a wide range of different, singular intensities. Nonetheless, terming this phenomenon with one word enhances a relatability and provides further means for sharing or differentiating an experience. In other words, it is a way to illustrate the inseparability between knowledge and aesthetics, or intelligibility and sensibility that comes into play when I refer to 'sensing'.

Sensing emphasizes a material-semiotic (cf. Haraway 11) understanding of inhabiting the world. Instead of being conditioned by a teleological meaning or a transcendent subject, sensing is determined by the relations of its materialization. This does not imply that meaning becomes obsolete, rather significance is an indispensable aspect of becoming. Everything that is, has to be *meaningful.* Also, the mode of being is decisive for *what* it is, with the consequence that "there is no single world in which all living beings are situated […], there are series of 'worlds-for'" (Thrift 465)[1] that interrelate with each other. To understand sense this way, first, accounts for a non-representative, affective, pre-cognitive or "nonconscious" (Hayles)[2] knowledge that is inherently active within material ontogenesis. Second, the diverse cultural operations for making-sense of the world are at the same time methods for worlding. Artefacts — e.g., ranging from oral narrations, reports, measurements, to audio-visual recordings or drawings, modellings, simulations etc. — may not only bring distinct phenomena into the realm of attention, making them detectable for perception and cognitively knowledgeable, they are also tools for intervening in the process of worlding. The procedures of sense-making are not just means to establish truths about reality or storages for representations of the world, but are rather partaking in processes of individuation. They are interfering in ontogenesis by affecting "spacetimematter's" (Barad) intelligibility and sensibility. This is a crucial, as this approach stresses the power of artefacts engendered by sense-making practices as well as the limits of sensing: reality can neither be fully grasped, understood, perceived in its distinct parts nor as a whole. Though this is not because the means of sensing would have to be improved, made more adequate or sufficient, but because reality will have been already re-shaped by its means of sensing. Thus, reality will have become a different one, once sensing has transformed it. Moreover, from this point of view, sensing's capacity remains particular no matter how ex- or intensive it might become. Borrowing from Karan Barad, sensing can be compared to the practice of agential cuts.

> *[A]gential cuts are at once ontic and semantic. It is only through specific agential intra-actions that the boundaries and properties of "components" of phenomena become determinate and that particular articulations become meaningful. In the absence of specific agential intra-actions, these ontic-semantic boundaries are indeterminate. In short, the apparatus specifies an agential cut that enacts a resolution (within the phenomenon) of the semantic, as well as ontic, indeterminacy. (ibid. 148)*

For Barad distinct entities are primarily conditioned by an "ontic and semantic indeterminacy" so that they cannot be taken for granted but are temporal materializations within a phenomenon. She argues against the assumption that knowledge is produced by an interaction of essentially separable unities and suggests instead that distinctions are the result of "intra-actions" within material agency (cf. ibid. 132-185). So, agential cuts are the generative effect of intra-action processes that transform an onto-epistemological indeterminacy into a temporarily determinate separability. Here, indeterminacy is equated to an immediacy which refuses any direct access. Any form of determination is understood as a process of mediation, constituting itself through in- and exclusion of possible onto-semantic materializations, whereby exclusions are the constitutive matter of indeterminacy's potential (cf. ibid. 179). Though it seems that from this point of view, disentanglement is an absolute impossibility and is transferred into the realms of the unthinkable, it also draws attention to the aspect that detachment inherently partakes in any act of sensing.

Ecologizing

Following Erich Hörl, this understanding of sensing can be described as an "ecologization of thinking" (Hörl 1), feeling and perceiving — a "shift from signifying to technoecological sense." (ibid. 4). Due to the implementation of media-technological devices on one side and the expansion of the concept of ecology which underwent a denaturalization on the other, Hörl states a reconfiguration of the "culture of sense" (ibid.) towards a fundamental relational conception. Within the realms of a technological condition, relations rather than essentially stable and self-contained meaningful relata are the only decisive criteria for rationality, with the effect that "signs are no longer seen primarily as representative but as operative entities" (ibid. 19). A technoecological culture of sense thus stresses that prior to being representations, signs are operators that directly act upon the relations they express.

Additionally, as elaborated by Luciana Parisi, this conceptual shift is accompanied and influenced by the transformation of technological apparatuses as such. According to Parisi, multi-sensorial, algorithmic, automated and networked devices for data processing can no longer be understood as means for communication or tools for transmission, but have to be addressed as machines for prehension[4] that "expose a *nonsensuous* mode of feeling irreducible to the split between the mental and the physical, the rational and the sensible" (*Parisi Technoecologies of Sensation* 182). Besides bringing forward an entanglement between thinking and feeling, concretization and abstraction, technoecological conditions of sensing and sense-making disclose processes immanent to worlding that pass above and below cognitive and sensory perception, thus inherently expanding the realms of sentience and fundamentally modifying its configuration. "Because media no longer mediate (at least not primarily) our senses; rather, they mediate — insofar as 'mediate' is at all still the right term — sentience itself, and they do so in the overwhelming majority of cases *before any occupation 'we' can have through and at the level of our sensory organs."* (Hansen 373)[3] This makes automatized and commodified modes of sensing in forms of mediatechnological devices important instruments for an environmentally acting power that "[operates no longer] through perfectly integrated circuits of communication, but through a new interlocking of distinct milieus of information sensing.“ (Parisi, *Technoecologies of Sensation* 182)

Though the ecological conception of sensing came into matter in the course of an ubiquitously present mediatechnology, and therefore through the infiltration of computation into processes of sense-making, Hörl states that the mathematical way of relating fosters an epistemology and politics that fundamentally opposes the epistemology and politics of relational sensing.

> *It [mathematics] only knows of extensive vectored relations between pre-given terms, terms that always precede the relation, terms that are, but do not become. The "dominance of the mathematical" reterritorialized relations whereas the counter-knowledge of recent anthropological work in particular deterritorializes relations and drives the elaboration of a real relation ecologism. (Hörl 8)*

Hence, for Hörl mathematical procedures are operations that genuinely seal capacities because they pre-determine relations. He argues that

> *"For today, we find ourselves at a very specific point in the history of relationality that brings out the question and the problem of relationality much more radically than ever before: relational technologies and an algorithmic governmentality reduce, regulate, control, even capitalize relations to an enormous extent, and precisely in so doing, become essential to the form of power of Environmentality. […] There is, in other words, a neoliberal-capitalist destruction of the relation [Bezug], a reduction of relations to calculable, rationalizable, exploitable ratios, in the form forcefully wielded by the mathematics of power." (Hörl 8)*

From this point of view, algorithmically, automatized sense-makers in the form of computational media-technology are promoting a rational epistemology, because the methods of calculation are based on pre-determining axioms. Driven by desires induced by cybernetics and capitalism, algorithmic automatization of sensing processes enable new ways of governing reality. Hörl marks a difference between a technoecological culture of sense and a computational sensing carried out by commodified media-technology. In the following section, I want to examine this opposition by roughly exploring the processes of sense-making in a case study of machine learning.

Learning

Though machine learning programs are based on neuro-scientific hypotheses which are implemented into an architecture of algorithmic networks, they have become more than just models for the cognition of living beings. They have become the attempt to transform computation into a field of sentience, to integrate it into the capacity of thinking-feeling, establishing an artificially built, partly automatized, yet not autonomous mode of sensing.

Artificial neural networks are only one of the possible architectures to maintain computational operations that are subsumed under the term machine learning.[5] They are basically up to several millions simultaneously interconnected algorithmic units. Active in different locations, they are used to detect regularities of data. So, they are tools to organize material by extracting information from data without necessarily having a pre-given evaluation system coded to determine what is supposed to be meaningful information. In other words, these programs are supposed to develop 'their own' semantics by processing data. The algorithmic units within artificial neural networks are themselves organized by principals of correlation, recursion and repetition[6]: in a mise en abyme like structure, algorithmic units are layered one after the other in such a way that the output of processed data automatically becomes the input for the next one. It is only a question of hardware resources and programmer's choice how many layers are integrated within one network. The more layers are sequenced, the 'deeper' the machine learns. In the case of programs for detecting features from digital images originating from different contexts, the algorithms gain their sensibility for formal similarities and differences between the images by applying probability calculation on the pixel's appearances.[7] The resulting numeric value is equated with a state of activity or inactivity of the affected cyberneuron towards the processed image.[8] So, when a cyberneuron reacts actively towards images, it is regarded as an expression for the detection of a similar feature or pattern between them and when it reacts inactively, it indicates that the images do not have any meaningful correlations.

In 2018, Google's company DeepMind published the paper O*n the Importance of Single Directions for Generalization* (cf. Morcos). Generalization stands for a "structure-finding network" (Morcos 3), which means that the network is capable to learn a model that structures the processed data. Networks capable to generalize well are more likely to predict regularities for inputs which have not been part of the training set. Hence, their numeric value signals references according to a structuring model.[9] Contrarily, for memorizing networks matching is the measurement for learning as they detect features by recognizing patterns in a one-to-one ratio, i.e. they are able to signal, if data repeats. The researchers test the relation between single directions and a networks ability to generalize. Single direction refers to the phenomenon of 'selective' cyberneurons which caught a lot of attention in a previous experiment: the activity of several cyberneurons is said to express a selectivity that matches with semantic concepts of what the data is supposed to show. For example, there are cyberneurons which with a high probability detect cat faces, others human faces or human silhouettes, while they are being inactive towards other kinds of depictions (cf. Le). Starting from the observation of those "easy to interpret neurons" (Morcos and Barrett), the researches investigate the role of the other "confusing" (ibid.) ones, which so far make up the majority of an algorithmic network, for generalization. For example, in the case of the 'confusing' cyberneuron, it is equally active towards an image of a giraffe, a house and a hamburger and equally inactive towards an image of a dog, a plane and a cat (ibid.).[10] While the in/activity of some cyber-neurons seem to indicate that they are sensible towards data in a meaningful way, the majority of the cyber-neurons make connections between images in a way that is rather puzzling, because their responses to the datasets seem to remain random — the algorithmically conglomerated patterns of information do not make any semantic sense to the human mind. What kind of patterns or features do those images have in common? Is there a 'hidden' sense, a pattern, a relation which cannot be perceived by sensory organs, cannot be conceptualized by cognitive thinking? How to address this lack of comprehension or miscommunication?

By deleting diverse constellations of 'selective' as well as 'confusing' cyberneurons, the researchers tested their influence on the overall performance of the network to generalize (cf. Morcos and Barrett) and concluded the following: First, the 'confusing' or seemingly indecisive cyberneurons are not less important than the 'selective' ones. Second, the cyberneurons that have an 'easy to interpret' selectivity towards previously unknown data (i.e. images that were not part of the data training set) are "more resilient" to deletion than networks that are only 'selective' towards already calculated data (cf. Morcos and Barrett). Thus, the capacity to detect features is not exclusively dependent on the seemingly high degree of selectivity to be found in isolated algorithmic units. The 'confusing' cyberneurons are not malfunctioning. Rather the experiments' results hint towards their significance for the capability of the network to abstract structures or models in data. Thus, it seems that this perceived randomization of data indicated by the 'confusing' cyberneurons is a concomitant of the network's ability to generalize. The researchers asssume "that highly class selective units may actually be *harmful* to network performance" (Morcos 10).

Though the study doesn't resolve the reasons for the observed causality between the 'confusingly' acting cyberneurons and a functioning generalization of machine learning applications, it does make an argument for the acknowledgment of being connected and making connections as a profound principle of acting intelligently. The act of connecting seems to be decisive on many levels: it is crucial for the design of the experimental arrangements as well as the scope within algorithmic processing. The numeric response is regarded as a way of the network to connect with the data and it is simultaneously a way for the researches to connect to the network, namely for assessing what and how the network has learned. Hence, being connected and making connections here coincidences with the generative quality of making sense, disregard whether the numeric response appears to be meaningful in a comprehendible or 'confusing' manner. In this specific case, where the artificial network's capacity to generalize is tested, the practice of collating and abstracting information is inscribed axiomatically into the interconnected structure of probabilistic processing.

The conditioning of the computational mode of sensing via machine learning, which seeks to install an algorithmic capability to generalize, seems to attest to the epistemological shift stated by Parisi:

> *The training of algorithms becomes more similar to an articulation of procedures by means of which algorithms not only learn to think, but above all learn how to gain meaning from the conceptual infrastructure associated with the granularity of data. Learning here coincides with the knowledge of how hypotheses are generated, whose indeterminacy in regards to its results expands the possibilities to extend the search for and from meaningful information." (Parisi,* Das Lernen lernen oder die algorithmische Entdeckung von Information *103)[11]*

Here, what appears to be knowledgeable is not given. The functioning of reasoning is not defined as a reproduction of symbolic information that has been already predetermined to be meaningful. In other words, significance is defined by a speculative process of abstracting similarities out of relational differences that can be found in data. Thus, this marks a transition where the design of machine learning applications is not concerned with what to learn, but "learning how to learn" (Parisi, *Reprogramming Decisionism* 4). Parisi outlines that "[c] ybernetic instrumentality replaces truth as knowledge with the means of knowing, and announces a metaphysical dimension of machine knowledge originating from within its automated functions of learning and prediction." (ibid.) The fact that that DeepMind's researchers favor networks which learn by generalization rather than memorization confirms this epistemological shift. Here, learning as a practice is not about reproducing already known information, but about generating connections as the basis for producing new information. In the face of computational devices that proliferated into archives "saving us from the past, from repetition through repetition" (Chun, *Programmed Visions* 157), educational skills such as learning by heart become less relevant. So, while computers seem to have relieved humans from the burden to train their mind to become a storage for stable knowledge, the computational design works on transforming the computer into a machine that is simultaneously an archive and its registrar.

The case study described above shows that integrating the means of learning how to learn into computational processing is accompanied by the introduction of a technoecological culture of sense into the realms of computation. The cyberneuron's in/activity towards the data is determined in a specific way: Though the regularities to be detected are not pre-inscribed into the program, the very conception of the architecture of the algorithmic network is based on the assumption that to learn means to make connections. Each cyberneuron's in/activity becomes a new speculative information that arises out of the process of connecting what appears to be contingent. Instead of having a pre-given schema that determines the cyberneurons' in/activity, it is this very in/activity that becomes the schema for sensing in a connective infrastructure. Irrespectively of whether the in/activity appears to be 'easy to interpret' or 'confusing', it becomes a mean for operating with and through the data—a mean for un/detecting regularities, for building taxonomies, for organizing and structuring by modeling and thus providing new information.

Yet, at the same time the case study also shows that there are conflicting measures coming into play regarding the evaluation of the cyberneurons' in/activity. The computed numeric values are unavoidably exposed to the comparison with already established taxonomies which function as means to evaluate the 'rightfulness' of the calculated meaning. This is why some of them are regarded to be 'confusing' and others to be 'easy to interpret'. Hence, though the computational processing might exceed a representational culture of sense, it is implemented by the researchers' ascriptions, i.e. their understanding of what a meaningful detection is, serves as an evaluation of the networks' capacity to generalize and this understanding is especially representational. This applies to the 'easy to interpret' cyberneurons' in/activity which matches with semantic concepts of the images' depictions, as well as to the 'confusing' ones, whose in/activity is eventually assessed by their ability to sustain the networks' function. Moreover, images which make up the set of data are put here into the role of representational signifiers. The whole procedure of machine learning here includes various remediations which are not addressed by the researchers. Though the perceived randomization of meaning, which is indicated by the 'confusing' cyberneurons, is a point of interest for researching, it does not become the entrance point for questioning the processes of remediation, assumptions about the detectability of patterns or the premise of connectivity. Instead, it is problematized as well as resolved by the concept of generalization, which at least in this case becomes a method for maintaining a representational order of things—a way of ensuring a general equivalence between signifiers and signified, a general equivalence of meaning between different artifacts and diverse modes of sense-making.

Expressing

In order to account for a computational sentience in machine learning applications, the processing of numeric values has to be conceived as a performative act. Regardless of whether the in/activity of the cyberneurons is evaluated to be meaningful in a representational way or whether the in/activity is understood from a technoecological point of view accounting for an excess of meaning, it points towards a sensing of data within worlds-for data. Evidently, it is fundamental to consider the in/activity as a mode of sensing in order to be able to relate to and modulate its operability. Though, it is important to notice that the machinic mode of sense-making, the specific computational sensing within the network, derives not only from the program as such or a genuine 'execute-ability' of the algorithms. Rather, an entire apparatus sets structures and conditions potentials for how and what is to be expressed through numeric values — this concerns for example the required material infrastructure, the programming of code, the labeling of data, the digitalization of images, the generation of power, the transmission of electronic signals etc.[12][13] So, a lot of work has to be done by human and non-human labor to ensure a computational sentience and even more work to navigate the machinic expressions of sense into desired directions. To conceive the in/activity of cyberneurons as an enunciation of algorithms alone would result in a misconception comparable to the one Wendy Hui Kyong Chun has worked in her study of the performativity of code: a "conflation of instruction with its product — the reduction of process to command — that grounds the emergence of software as a concrete entity and commodity" (Chun, *On "Sourcery," or Code as Fetish* 303). Drawing upon Judith Butler's understanding of performativity, Chun argues against conceptualizing code as a merely machinic expression:

> *What is crucial here is: first, code that succeeds must be citations — and extremely exact citations at that. There is no room for syntax errors; second, that this iterability precedes the so-called subject (or machine) that is supposedly the source of the code; and third, and most importantly, an entire structure must be in place in order for a command to be executed. This structure is as institutional and political as it is machinic. (ibid. 322)*

Applying Chun's argument to the in/activity of the cyberneurons, computed numeric values cannot just be addressed as expressions of the artificial neural network. One has to take into account the social and political infrastructure, where these materializations are embedded in and which render its capacity of becoming an expression at all. Recurring to Barad's notion of agential cuts, to address the in/activity as a mode of computational sensing implies the following: on the one side, it stresses that the discursive and the material dimensions within what emerges as a machinic expression are inseparably entangled. Thus, every materialization — in this case the cyberneurons' in/activity — is already inherently political and social. On the other side, these materializations are regarded less as the result of assembled human and non-human workforces, but more as events that temporarily (re-)produce the boundaries between human and machinic labor. Moreover, they have the capacity to reformulate the relations that constitute the agents at work. Though Barad's concept of performativity differs to the one of Chun, it too raises attention towards the infrastructure or apparatuses of expressions:

> *In an agential realist account, performativity is understood not as iterative citationality (Butler) but as iterative intra-activity. Intra-actions are agentive, and changes in the apparatuses of bodily production matter for ontological as well as epistemological and ethical reasons: different material-discursive practices produce different material configurations of the world, different difference/diffraction patterns; they do not merely produce different descriptions. Objectivity and agency are bound up with issues of responsibility and accountability. Accountability must be thought in terms of what matters and what is excluded from mattering. (Barad 184)*

From this perspective, even a representational culture of sense cannot just be regarded as means for merely depicting the world, but rather has to be addressed as a specific way of intervening into reality — a specific mode of worlding. In regards to the above described case study of machine learning, a representational logic is applied in particular as a measurement to modulate the expressions in forms of numeric values into desired articulations in order to channel the programs capacity into an instrument for the (re-)production of restrained meanings. Whereas this specific way of re-configuring the process of materialization relies on the account of conceiving the cyberneuron's in/activity as a responding expression, which allows the machine and its apparatuses to become a relatable milieu for sensing. The artificial neural networks are situated in the realms of probabilistic procedures and they are insensible for cultural connotations or the conditions of production that sustain their effectiveness. Nonetheless, they are imbedded in those cultures of sense-making, which shape the arrangements of the program's apparatuses and influence how one relates to the sensing. From this point of view, numeric values cannot just be regarded as signifiers referring to patterns, features or semantic concepts. Rather they are signs for the effectiveness of a complex assembly that weaves a computational mode of sense-making into the realms of sentience by simultaneously implementing a technoecological culture of sense into the machinic infrastructure.

Conclusion

The expanding evolvement of media-technological devices does not only transform concepts of computation but also brings forward a further dimension of the interlacing between sensory, cognitive and affective fields within sentience. The implementation of media-technology introduces new environments for sensing and re-configures modes of sensibility and intelligibility. From this point of view, the reductionist and quantitative characteristics of applied mathematics do not per se encapsulate capacities for sensing. Though computational methods of sensing differ from other ones such as writing, touching, hearing, smelling, thinking, feeling etc., they neither genuinely oppose them in terms of their tendency towards determination of meaning, nor can they be executed exclusively within the realms of computation. As determination is inherently part of any mode of sensing and a condition for un/becoming, it is so to speak an immanent cruelty of worlding. So, a critique against an instrumentalization of sensing for exploitative means cannot just address logics of calculation or capturing, but also has to take into account the apparatuses and their measurements which create and sustain computational procedures for instrumental means. Thus, this does not imply that the problematic of determination as such becomes meaningless. On the contrary, as it highlights that every made connection simultaneously points to a detachment, the determining process asks to be further problematized. Therefore, it directs one's attention to the measurements which are incorporated in sense-making and demands a continuous questioning of what kind of world the determinations make im/possible. It raises the awareness for the ethical dimension within sensing — because each connection goes in hand with separation, learning with unlearning, expression with muteness.

Notes

[1] Thrift is referring here to Jakob von Uexküll's concept of "umwelten".

[2] Hayles coins the term "nonconscious" in order to describe a mode of thinking that traverses cognition, but is not executed consciously. It is an automatically enacted decision for interpretation of information, which is pervasive in life forms as well as technical systems (cf. Hayles).

[3] Translated from the German publication by the author.

[4] The term "prehension" has been suggested by by Alfred North Whitehead. It describes a registering or comprehending mode of existence that is intrinsic to all organic and inorganic forms of perception and thinking (cf. Whitehead 57ff). For the relevance of Whitehead's philosophy for Parisi's thinking see also *Was heißt Medienästhetik?* (44-49).

[5] In his publication on the *Machine Learners: Archaeology of a Data Practice* Adrian Mackenzie gives an overview of the different operations that are assembled under the term 'machine learning'. He examines the consequences machine learning has on forms of knowledge production, critical thought and strategies of power. Notably, by machine learners he "refers both to humans and machines or human-machine relations" (Mackenzie 6) and therefore rather to practice that is situated in specific "accumulations of settings, data and devices" (ibid.).

[6] It is interesting to note that this resembles what Félix Guattari, who himself was influence by cybernetic theory, described as 'machinic': an affective mode of thinking that proliferates non-pre-given, irreversible and singular enunciations, which result into an excess of meaning by assemblies that are organized through recursion and connectivity (e.g. cf. Guattari). At this point it should be also mentioned that Hörl develops the notion of the technoecological culture of sense amongst others in close reference to Guattari's idea of ecology as well as his notion of non-significant heterogenesis of meaning which is apprehended to be machinocentric (cf. Hörl 13-21).

[7] This depiction of how machine learning processing of images is arranged by engineers and how it works on a computational level is quite simplified here. It is to be said that there are different parameters for designing such a program and that there are further aspects such as regulatory measures (e.g. batch normalization) that shape its operability. Nonetheless, for the context of this paper, I want to emphasize the premises of connectivity as well as the attributes of the network's architecture such as correlation, recursion and repetition in regards to their partaking in the configuration of an algorithmic sensing via machine learning.

[8] If it tends towards zero it is regarded as inactive and if tends towards one it is regarded as active.

[9] According to Alpaydin, the network's capability to generalize is the main feature that marks machine learning's capacity to govern information. He states: "This ability of generalization is the basic power of machine learning; it allows going beyond the training instances." (Alpaydin 42)

[10] This example refers to the explanatory graphic provided by the researchers (cf. Morcos and Barret).

[11] Translated from the German publication by the author.

[12] For instance, Andreas Sudmann emphasizes that the reason for the recent popularization and proliferation of machine learning applications is neither primarily to be found in more elaborated algorithms nor the enlargement of data training sets, but the parallel organization of fast GPU- or TPU-chips (cf. Sudmann 63, 69).

[13] See e.g. the work published in the context of *Data & Society* (https://datasociety.net) that provides insightful research on social consequences as well as conditions for mediatechnological industries.

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Maike Klein

ROBOTIC AFFECTIVE ABILITIES

Abstract

Within both popular media and (some) scientific contexts, affective and 'emotional' machines are assumed to already exist. The aim of this paper is to draw attention to some of the key conceptual and theoretical issues raised by the ostensible affectivity. My investigation starts with three robotic encounters: a robot arm, the first (according to media) 'emotional' robot, Pepper, and Mako, a robotic cat. To make sense of affectivity in these encounters, I discuss emotion theoretical implications for affectivity in human-machine-interaction. Which theories have been implemented in the creation of the encountered robots? Being aware that in any given robot, there is no strict implementation of one single emotion theory, I will focus on two commonly used emotion theories: Russell and Mehrabian's Three-Factor Theory of Emotion (the computational models derived from that theory are known as PAD models) and Ekman's Basic Emotion Theory. An alternative way to approach affectivity in artificial systems is the Relational Approach of Damiano et al. which emphasizes human-robot-interaction in social robotics. In considering this alternative I also raise questions about the possibility of affectivity in robot-robot-relations.

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Making sense of encounters with ‘emotional’ robots

At GV Lab in Tokyo, I met a robot arm that was equipped with a PAD emotion program combining the values of pleasure, arousal, and dominance to constitute an emotion that is expressed by a movement. Through interaction via different sensors, the robot executed different behaviors. If, for instance, I entered the robot’s ‘personal space’, as detected by a distance sensor, the robot executed an ‘emotional’ movement, as you can see in the image below:

Figure 1: Robot arm. Source: https://www.youtube.com/watch?v=q1DO4PBSA6M&feature=youtu.be.

I encountered the humanoid robot ‘Pepper’ in a shopping mall: it was standing in the corner, overwhelmed by ordinary noise. In the media, Pepper has been advertised as “the world’s first emotional robot” (Singh). This doesn’t seem very convincing. Most of the time, if there are no technical problems, passers-by did not pay attention to it. It did not seem to me that Pepper has much emotionality that humans typically react to. Perhaps Pepper would have been more interesting if it would have raised its voice or just gone somewhere else to avoid being ignored. Contrary to the robot arm, as you can see in the pictures, Pepper is a humanoid robot that has a face, changes its voice, and so on. Its outer appearance is intended to be cute and to evoke positive emotions.

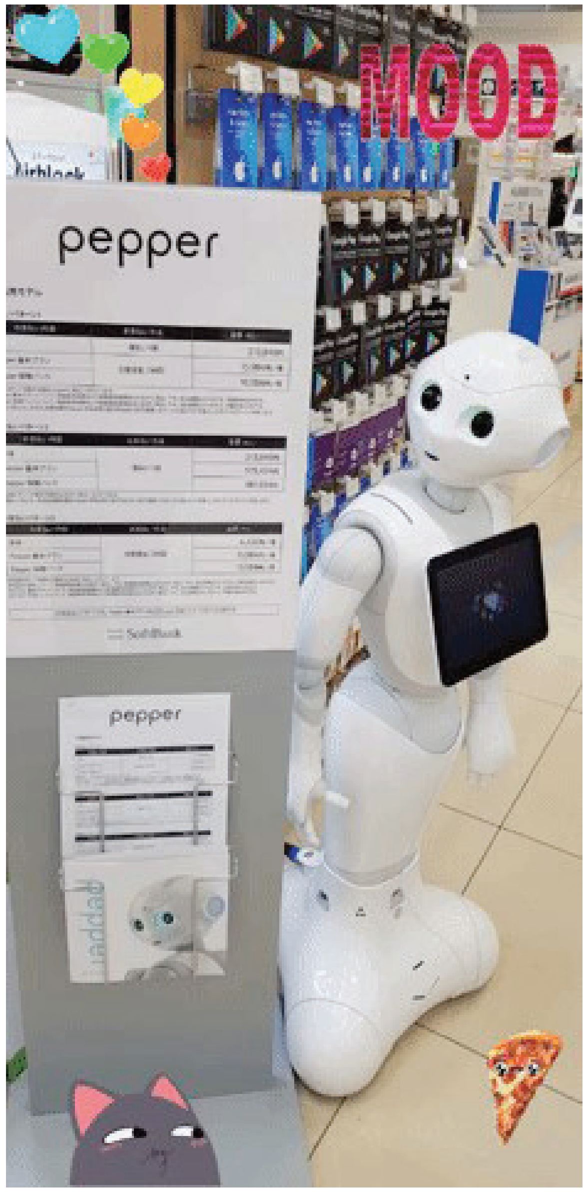

Figure 2: Pepper, emotional robot. Image by author.

Finally, I encountered Mako, the robot cat that I built at GV Lab in order to learn first-hand what machinic affectivity, and building a machine in general is all about. When does the machine start to interact, to be a robot, and to be affective? Mako is an Arduino-based small device equipped with distance and touch sensors for interaction. Moreover, it can express itself: by text through an LED display, by movement through a servo motor, and by noise through a piezo buzzer. It has neither emotion programing running, nor a capacity for changing facial expression.

Thus, it is a very basic robot. Nevertheless, it elicited confusion in humans that were not due to any malfunction. First the display says the neutral but welcoming message “what a nice day”, then if the human approaches, the messages “touch me” and “do not approach” are shown; and if the human touches, the robot expresses a loud piezo beep and the message “go away”.

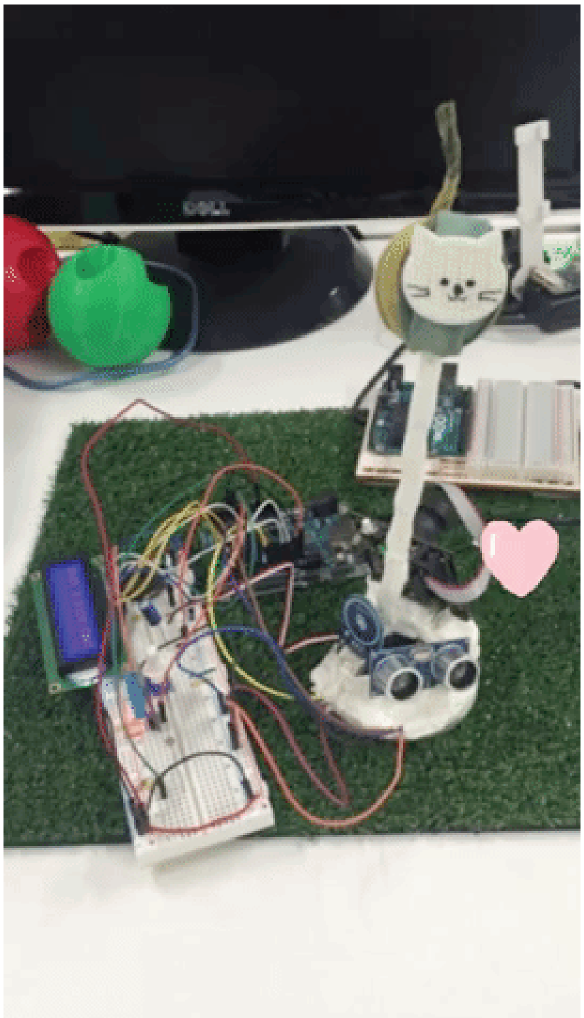

Figure 3: Mako, robotic cat. Image by author.

What was going on in these encounters? Various kinds of affectivity!

Besides everyone’s own feeling of and for affectivity, there exists a variety of definitions for affective phenomena in living beings that one can choose from, making the phenomena hard to grasp. To follow the works of Colombetti, Deonna and Teroni, I use the notion of ‘affectivity’ to subsume phenomena like emotions, feelings, moods, primordial affectivity, sentiments, or affect.

The various definitions of affective phenomena in living beings come with different theoretical frameworks. In philosophy and psychology, these are notably emotion theories, each emphasizing different aspects of emotions. For instance, take the distinction between non-cognitivist and cognitivist emotion theories: When William James writes about emotion, he means the occurring bodily changes and their felt experience. For him, emotions without a bodily component are “cold” mental states (James 189). In contrast to this, Martha Nussbaum claims that emotions are cognitive “judgments of value” and the possibly occurring bodily changes are just their byproduct through physically imitating the cognitive processes (Nussbaum 194). These theories exemplify antagonisms and exclusions: Nussbaum’s theory is far from an embodied perspective and excludes animals and children up to a certain age. ‘James’ theory’ (or the ‘James-Lange theory’ that was later developed) would possibly be difficult to apply on systems that do not have bodies of flesh and blood. This example emphasizes that there is no uncontroversial definition of emotion or affective phenomena in living beings. In other disciplines, affective phenomena in artificial systems have been studied extensively (e. g. Suchman, Picard, Dautenhahn et al., Marsella et al., Boden).

When we look at robots and engineered applications, we often find emotions – machines modeled over emotional expressions, emotions evoked in humans through human-machine-interaction, and even emotional robots. Due to the lack of consensus regarding the definition of emotion, from an emotion-theoretical perspective, the theoretical basis of machinic emotional abilities has to be based on a working definition. For several years now, in disciplines like Affective Computing and Social Robotics, computer scientists and roboticists have applied (mostly psychological) emotion theories (e. g. Ekman and Friesen, Russell and Mehrabian), and taken emotion theories as a foundation of their programming and engineering (e. g. Bennett and Šabanović, Rincon-Ardila et al.). With no clear definition of what an emotion is, however, it is difficult to choose which theoretical framework to take and how to translate the (more or less) wordy theories into numbers. Besides, although there are many different theories of emotion and affectivity, most emotional programs and machines depend on just a few theories that are limited in describing emotions in general. Thus, what is this thing called emotion that in the end comes out of the machines?

In this paper, I reflect upon the emotion theoretical implications to affectivity in human-machine-interaction, having an academic background in practice-oriented philosophy and a practice in creatively exploring technology. I will briefly introduce two of the commonly used emotion theories that here shape the emotion theoretical discourse from the Western tradition: Russell and Mehrabian's Three-Factor Theory of Emotion (the computational models derived from that theory are known as PAD models) and Ekman's Basic Emotion Theory. My goal in this text is not to provide an exhaustive overview or detailed analyses of either emotion theories/models or artificial systems that include affective abilities. Rather, my goal is to raise questions and initiate discussion about the application of emotion theory to robots and the complexities of assessing the ostensible affectivity of robots.

During the three encounters I described above, I was confronted with three different ways of modeling affective abilities into machines: internal, external, and relational (Damiano et al. 8). As shown in the chart below, each way of modeling comprises several features I experienced during my encounters with the robots.

<table>
<tr><th>Perceivable / external</th><th>Invisible / internal</th><th>From the relation</th></tr>
<tr><td>Face (Pepper, Mako)</td><td rowspan="5">Program that serves as a regulation mechanism (PAD emotion model in the robot arm, Pepper depending on the program that is running)</td><td rowspan="2">Reciprocal affective interaction (Pepper smiles and I smile back)</td></tr>
<tr><td>Sound (Mako: piezo, Pepper: voice)</td></tr>
<tr><td>Blinking light (robot arm, Pepper)</td><td rowspan="3">Human affective interaction on a meta-level (I am amused when the cat robot exhibits contradictory behavior, I am happy when my guess for the "emotion" of the robot arm is the same word as what is displayed on the screen, and I am heavily annoyed when I hear Pepper's voice</td></tr>
<tr><td>Words, pictures (Mako: display, Pepper: tablet)</td></tr>
<tr><td>Movement (all three of them)</td></tr>
<tr><td>Basis: Ekman's Basic Emotion Theory (BET)</td><td>Basis: Russell's and Mehrabian's Three-Factor Theory of Emotion (PAD)</td><td>Can be explained through the relational approach with examples from Human-Robot-Interaction</td></tr>
</table>

Emotion theories as bases for emotion models

If the outer appearance of a machine includes emotional features, for instance displayed emotions, or emotion recognition technology, the work of Ekman and his colleagues is typically used as the theoretical basis (e. g. Bennett and Šabanović). In 1976, Ekman and Friesen provided a system to divide facial movements into "action units", which can be a movement of one or more muscles (and one muscle can be part of more than one action unit). Ekman, Friesen and their colleagues isolated each muscle movement in their own faces and observed video recordings and photographs in order to make sure that every facial expression consisting of one or more action units is unique. They called the resulting catalogue of facial expressions 'Facial Action Coding System' (FACS). Moreover, Ekman continued the ideas of Darwin with his work on basic emotions: over many years and several studies, he identified six basic emotions (happiness, surprise, fear, anger, disgust, contempt) that are expressed by unique facial expressions. According to Ekman's studies, humans from various cultural backgrounds can equally identify "at least five" of these six emotions (Ekman 551).

If a machine includes non-visible emotional features like regulative mechanisms that consider the environmental input through sensors and human-machine-interaction or internal changes, such as changes in temperature or the former emotional state, the Three-Factor Theory of Emotion is often used as the theoretical basis (e. g. Rincon Ardila et al.). This theory is sometimes better known as 'Pleasure-Arousal-Dominance' (or PAD). For Russell and Mehrabian, emotions can be captured and described in terms of pleasure, arousal, and dominance. Depending on the numerical value of each of the three dimensions, they form or explain a different emotion. The statistical methods used and the resulting significance of the theory is a topic open for further discussion. This theory, however, has been further developed in various ways since 1977, with Russell's 'Core Affect Theory' as its most popular contemporary spin-off. Today, PAD is still popular when equipping robots and virtual characters with emotions. For this, the PAD values are mapped as vectors in a three-dimensional space. Thus, an emotion program can be coded and added to the robot's other programs in the operating system. Depending on external or internal stimuli, for instance through incoming data from an ultrasonic distance sensor, the robot's emotion changes internally and produces, depending on its physical features, an emotional behavior as outcome (e.g. Rincon Ardila et al.).

A we have seen, in robotics-influenced emotion research, the external/social/expressive (see the BET example) and internal/individual/regulative aspects of emotion (see the PAD example) are distinct. Damiano et al. discuss this critically. External emotional features are often referred to as simulations of emotions, whereas an internal emotion generating mechanism (as in emotion models) would lead to genuine emotions. Therefore, these two distinct ways of creating affective abilities have also been rated as true/ eal vs. false/fake emotions (Damiano et al. 8). According to these verbal distinctions, it seems preferable to have regulative emotion mechanisms rather than visible emotional expressions — but why? Because this could provide a real-world-correlate to our imagination?

As Damiano and Dumouchel point out, this way of thinking is deeply Cartesian and exclusive (Damiano and Dumouchel 6). The phenomenon of emotion is split up into a Cartesian construct that is related to one matter, either 'body' or 'soul', which reflects modeling on the 'outside' or 'inside'. Besides, the binary distinctions are in some cases not comprehensible (e.g. the true/false rating: how can an attempt to model affective abilities into artificial systems be 'true' or 'false'?) and seem to be misleading. How could we tell which human emotion is real or fake, if we go beyond evolutionary or basic emotions that are necessary for survival? What if we look at 'higher' or social emotions? In these cases, we could possibly measure whether the person smiling at us is smiling with a Duchenne smile – or possibly, we cannot detect anything in the emotions of others and have to trust on what the person reports verbally about their emotion. Emotions can surely be 'artificial' also in humans (Stephan 310) in the sense of true/ eal vs. false/fake.

Moreover, the distinction between external and internal affective features of a robot goes against understanding it as an integral agent. Of course, the possible behavior range of robots is much less extensive than the human behavioral range, but at least in the intended interaction, the robot is an integral agent within its individual limits.

With an approach that focuses on interaction and relation between interacting systems, Damiano et al. suggest one way to make the binary distinctions between external and internal emotional features obsolete. At the same time, they do not exclude mechanical systems of a certain complexity from the possibility of having emotions. According to Damiano et al., interacting agents do not simply exchange

> *information about their supposedly pre-defined and individual emotional states, [they rather] mutually define— co-determine — their emotions during their ongoing interactions. […] [This view] requires us to abandon the traditional philosophical understanding of emotions as events that are individually, internally, and thus covertly generated, and that then we can expressively communicate to others — i.e., the very conception of emotions which legitimates robotics to distinguish between the internal and the external aspects of emotions and empathy (Damiano et al. 8).*

They call this approach a "relational conception of emotions".

In this theory, affective phenomena can emerge from a relation that includes living beings or social robots, everyone and everything that is no (mere) tool and capable of interaction. This could happen in an interaction with Mako, the robot arm, or Pepper, depending on the properties of the relation between the robot and the interacting agent. Thus, if we imagine a human-robot interaction involving one human being and one robot, we have to think about three aspects of affectivity: What is going on affectively in the human during the interaction with the robot? What is going on affectively in the robot during the interaction with the human? What is emerging affectively from the relation and what does this do to the respective interaction partner? This holds also for interactions of (two or more) living beings and interactions of living beings and non-living entities. What about a robot-robot relation?

Affectivity in a robot-robot relation

A good example for both thinking machines as more than mere tools and machinic affectivity among machines is the installation *Nintendogs* of the artist Fabian Kühfuß. His installation captures perfectly the fascination (coming from science fiction) and absurdity (coming from scientific reality) of the question of whether a robot can have genuine emotions that go beyond sharp definitions or are more than the intended outcome of a relation. The artist combines a Nintendo DS console that runs the game *Nintendogs* with a motorized device that moves the console so that a pencil can touch the virtual dogs.

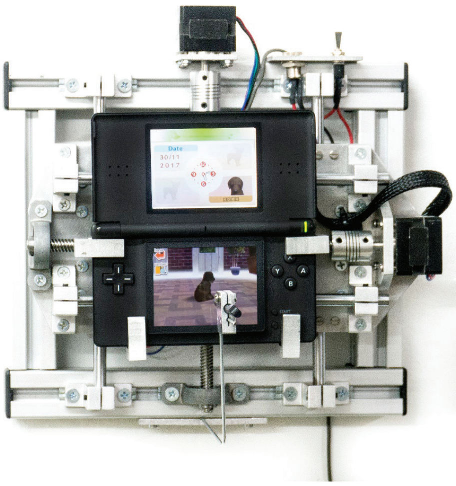

Figure 4: Fabian Kühfuß, *Nintendogs* (2017). Courtesy of the artist.

The purpose of this game is to raise and educate a baby pet dog. One of the possible actions is to stroke the dog, usually an affective action between two living beings. In his installation, Kühfuß transfers this action into a robot-robot-relation. This work raises at least two questions: 'Can machines have leisure activities, too?' and 'What is machinic affectivity?'.

For the virtual dog, it does not make any difference who or what strokes it. For the motorized device, it makes no difference what it touches with the attached touch-pen. In both cases, the result is the same: the dog is stroked, the touch-pen touches. For playing the whole game, however, the machine would need more features that enable it to execute all the other necessary steps. Does the stroked virtual dog 'feel' good within its affective spectrum? Intuition is, however, that the human interpretation adds the specific affectively loaded meaning to this scenario.

What can this example tell us from a relational point of view? There clearly is an interaction between two machines. Plus, there is a human observer that does not take part in the interaction. Is there, however, something affective going on between the Nintendo DS and the touch-pen device? Affective in the sense typically applied to living beings? Affective in the sense of other possibly affective entities? Moreover, who or what is feeling something in this relation? Is this even important, as we cannot always see or detect what other human beings feel or if they are able to feel an emotion at all?

In any case, in the *Nintendogs* example, tasks and goals have been fulfilled successfully. The touch-pen device fulfilled its task to touch the display where it could perceive the puppy (thus, it stroked). The puppy displayed the behavior the game designers and programmers intended for the case after having been stroked. The human observer enjoyed and interpreted the artwork.

Affectivity ≠ affectivity

There is obviously an affective difference between artificial systems and humans. The difference becomes, for instance, evident in the spontaneity and goal-orientation of the interacting agents and their emotion range that still clearly separates machinic affective abilities from those of living beings. There is something interesting about confusing behavior, reacting not as expected, not creating the 'perfect', goal-oriented, faultlessly designed user experience. It creates some other kind of relation where humans need to engage in another way because they are somehow challenged. Moreover, there is something interesting (and relieving) about not being useful, not having to be useful, not needing to serve a certain purpose, not being instrumentalized, like machines always are, because they are built to serve as tools, even if social robots have an ambiguous status (Damiano and Dumouchel 2, 3).

Moreover, in these examples, my own reactions to the robot's affective abilities were, besides some aspects of a reciprocal relation, more like meta-reactions to the machinic affective abilities. For instance, if Mako tells me "Go away!" after having told me to approach, I think this is rather funny. Besides, it is not boring (at least the first time you try the robot out), because it reacts not as expected and does not fulfill any higher purpose (that we, maybe, expect in a machine). If Mako was a human being, I would be irritated, confused, or even concerned. So was the woman who tried Mako out during a lab visit – she was irritated and confused by Mako's behavior.

However, if we aim to facilitate understanding and cooperation between roboticists, computer scientists, psychologists, and the humanities, we should be open to adding definitions and theories from technological fields to the many (imperfect) emotion theories we already debate in philosophy, psychology, and other disciplines. If we want to understand the work roboticists and computer scientists are doing, and if we aim to collaborate in reflecting and developing mechanical affective abilities, we should accept the emotion definitions, theories, and models from other disciplines, like computer science and (social) robotics, as specific emotion theories that are possibly able to explain emotions with their specific limits (all emotion theories have these limits, they are simply different for each and every theory). This means, we should include them as equal candidates for emotion theories that potentially explain emotions within living beings, too. This will help us to avoid problems such as those that occurred when psychologists found the emotion theories of their computer scientist collaborators too old-fashioned (Broekens 8). We should keep in mind here that if the aim is to model affective abilities in artificial systems, there are limited possibilities of translating the wordy theories into a relatively simple and at the same time more complex model and finally into numbers. If we, however, accept that there can be adequate emotion definitions that may not fully hold for a human being (as well as that emotion definitions made for humans may not hold for other kinds of systems or even children – as we have seen in the brief distinction between cognitivist and non-cognitivist emotion theories), we can claim for logical reasons that a 'genuine' emotion comes out of an artificial system if an emotion theory is translated and modelled into that system and if there is an outcome that results from the emotional program. With this view, we would at the same time avoid 'speciesism'. As already indicated, machinic emotions may be very different from emotions of other systems – but not only from those. As there are many different artificial systems and different emotion theories that are used to model their emotions, many different behaviors and mechanisms can be understood as emotions.

It's all about imagination

No matter which theory is used to model affective abilities in artificial systems, in many cases there will be human beings interacting with these systems. For instance, robots with emotional abilities are used for therapeutic settings with autistic children. Among others, Cabibihan et al. provide evidence that autistic children prefer to interact emotionally with robots and that this can help to facilitate the interaction with other humans, too.

One of the main goals of equipping artificial systems with affective abilities is to facilitate human-machine-interaction. This can be very useful in industrial settings where the worker is obliged to work with a robot that is very boring or that the worker does not understand very intuitively. In such cases, the amelioration of working conditions is possible. Another possibility of human-robot-interaction is found within a capitalist context. For instance, especially in Japan but sometimes also in Europe, and as already briefly described in one encounter above, the robot Pepper can be spotted in sales or customer service environments, for instance in shopping malls, airports, and karaoke bars.

The crucial point in all of these machinic varieties and human-machine-encounters is imagination. According to a study of Heider and Simmel, even the simplest shapes are already anthropo- or at least bio-morphized (Heider and Simmel 246). Humans ascribe intentions to the simplest moving forms even though they know that they do not have them. Moreover, humans attribute affectivity to simple shapes (de Rooij et al. 2). With a more complex design, the possible ways of bio- or anthropo-morphizing a thing increase in scope. The human expectations of this technology rise and the moment of deception becomes longer and more dense. The 'uncanny valley' graph shows various intensities of anthropomorphism (Mori 99). It is highly controversial for at least two reasons: 1) There is much empirical evidence for and against it that cannot be true at the same time (e. g. Misselhorn; Bartneck and Ishiguro); and 2) It implies a strong normative dimension that holds the 'healthy body' as the ultimate ideal. Nevertheless, the uncanny valley is used (almost?) always as a reference in (social) robotics research and the modelling of artificial agents, avatars, or movie characters.

Thus, as human beings have the tendency to anthropomorphize, they will likely compare the outcoming emotional reactions to human emotional reactions. Furthermore, depending on e.g. the personality or information and / or education about artificial systems, human beings may have a completely different understanding of affectivity in general, and of what artificial systems are capable of. Apart from the scientific discourse, the main sources of information about this topic are, besides one's own affectivity, media and science fiction stories that sometimes tend to converge with each other. Herbrechter suggests a new media genre resulting from the convergence of fiction and facts: "Science Faction" (Herbrechter 101). As a result, one urgent question is how to separate unrealistic ideas of machinic affective abilities from what is actually happening in science to finally break with the perceived mysteriousness of artificial systems due largely to human imagination (Sharkey and Sharkey 12, 18).

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(UN)BEING

Brett Zehner

MACHINES OF SUBJECTION: NOTES ON A TACTICAL APPROACH TO ARTIFICIAL INTELLIGENCE

Abstract

As the big data revolution ramps up, we are drawn to online platforms that modulate political identity far removed from so-called liberal politics (Cheney-Lippold 2011, 165). There are two ends to the extreme. We have seen the return of white supremacists on supposedly democratic networks while on the 'back end' of computational culture, algorithms de-subjectify users for proprietary gain. In the broad sense here, subjectivity is an individual's relation to themselves. However, machine learning occupies a powerful position within the logics of capital by shifting the site of identification into a digital sphere (165). With the widespread use of machine learning practices, abduction creates an overall "sensibility to change and alter events" (Mackenzie 2013, 402). By abstracting concrete social practices into dta vectors, machine learners measure, forecast and modulate human behaviors. Put simply, machine learners have become some of the most potent social inscription devices today. It is within this context that my dissertation asks — how does the recent ubiquity of machine learning affect how we wield political subjectivity?

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> *As humans feed affect, thought, and sociality into algorithms, algorithms feed back into what used to be called subjectivity. This shift is what has given way to a post-representational politics adrift within information space.*
> — *Hito Steyerl*

1. Machines of subjection

For the past two decades, fields of knowledge-production that utilize statistics have adopted machine learning as their primary mode of operation (Mackenzie, “Programming Subjects” 434). Due to the advances of computational technology, machines can now be programmed to find patterns in large datasets. ‘Machine learners’[1] recursively use patterns to infer correlations, essentially hailing new performative judgments on the world. Adrian Mackenzie goes so far as to claim that we now live within a *regime of predictivity* characterized by computational practices that rely less on verification than inference and abductive reasoning. With the widespread use of machine learning practices, abduction creates an overall “sensibility to change and alter events” (402). By abstracting concrete social practices into data vectors, machine learners measure, forecast and thus modulate human behaviors by essentially scripting performatives. Put simply, machine learners have become some of the most potent social inscription devices today. It is within this context that I ask – how does the recent ubiquity of machine learning affect the production of subjectivity?

As the big data revolution ramps up, much attention has been drawn to online platforms that modulate political identities “situated at a distance from traditional liberal politics and removed from civil discourse” (Cheney-Lippold 165). On two ends of the extreme, we have seen the rise of white supremacists propagating through networks that segregate public opinions. Yet, on the ‘back end’ of computational culture, machine learning algorithms de-subjectify human users for proprietary gain. Capitalism doesn’t care if you’re a fascist, a passivist, or even a bot; so long as it can extract behavioral information from your actions to be packaged and resold by its advertisers. As Cheney-Lippold points out, machine learning shifts the site of identification into the “measurable, digital sphere” (165). Between the front-end user interface, and the back-end logics of computation — machine learners are embedded within the powerful contradictions of capitalist logics.

Amidst this seeming contradiction, the concept of subjectivity may be an unhelpful category. ‘Enlightenment Man,’ the Cartesian subject divided between mind and body, the rationalist ‘view from nowhere’ — these eurocentric notions of subjectivity are founded on the measuring functions of coloniality and the technological organization of capital brought to bear on the individual.[2] Still, technological imaginaries have also been mobilized to trouble hegemonic notions of subjectivity. Donna Haraway’s feminist subjects, for instance, dethrone the “god-tricks” of scientific rationalism through situated technopolitical practices (Haraway, 1988). The notion of technological subjection, or perhaps more accurately, the notion of de-subjectivization, occupies a set of complex problems that garner closer attention.

Now emerging scholarship at the intersection of identity and machine learning has opened new pathways of research in digital cultural studies. Healy and Fourcade observe that the state used to be the only apparatus with the technological power to track its subjects. However, this is no longer the case (Fourcade and Healy). The recent ability for machine learners to track online users' digital footprints, or their "data exhaust," marks an important moment for what Shoshona Zuboff calls surveillance capitalism. Every action a user performs on a digital system is considered a signal to be analyzed, packaged, and subsequently fed back into the system. The quantity of user data is much more important than quality. As long as an action online can be converted into data, it can be utilized in predictive behavioral models. Zuboff explains that no online action is too trivial to be aggregated, repackaged, and sold again (79). "Facebook likes, Google searches, emails, texts, photos, songs, geo-location, communication patterns" are all considered lucrative data to marketing firms and myriad other companies (79). Though let's be clear. Surveillance capital is not merely a social media concern. The algorithmic bias of machine learners stems from a long line of quantitative racism and surveillance (Browne). The targeting of the poorest members of society continues, only now it operates through various forms of data surveillance and predatory credit scoring (Fourcade and Healy 31). Zuboff argues that technique supplants authority, and that "discipline and control produce a certain knowledge of human behavior independent of consent" (81). In this extractive logic, we see an *impersonal* form of subjection at the heart of surveillance capital. New forms of power emerge alienating persons "from their own behavior while producing new markets of behavioral prediction and modification" (75).

The liberal idea of the rational decision-maker then seems to unravel as a locus of power relations. In *The Control Revolution*, historian of technology James Beniger describes the automation of decision theory in the 1930s. "Any decision tree of finite length can be duplicated by a finite automaton, thereby equating the question of decidability with that of computability" (64). It was the automation of decision theory that set the stage for the first machine learning program to be utilized for economic and military planning by the RAND Corporation in 1955. Tung-Hui Hu advances this historical analysis by mapping the topography of power relations within 'cloud computing' where decisions are distributed across networked assemblages. He argues that borders seem to be out of date conceptions at the foundation of the sovereign subject (14). The Tiqqun collective in their cybernetic hypothesis posit that traditional class divisions and social conflict no longer cut through the middle of society, but through the middle of each of us. What is troubling is that the production of subjectivity seems to be no longer about creating "people of substance" but of turning each person into a "fleshless envelope, the best possible conductor of social communication" (18). And most recently, in the Trump era, Luciana Parisi links the de-personalization of machine learning systems to the rise of post-truth politics. Here indeterminacy and the unknown "push automated cognition beyond knowledge-based systems" ("Reprogramming Decisionism" 10). What we ultimately find within the political subjection (and de-subjectivation) of machine learners is a brutal instrumentalism based more on mechanical functions than on ideological content.

Now, despite considering machine learning's effect on social identity,[3] the above scholarship on machine learning has left open an opportunity for rigorous scholarly attention to de-subjectivation. For instance, John Cheney-Lippold asks: "What does the banality of competing for a job interview using machine learning to predict future friendships say about subject formation" (8)? This line of questioning still focuses on subjection at the level of performatives and self-awareness. This limited viewpoint imagines the subject merely as a 'user' who is always already ideologically ‘hailed.’ Even though data analysis seems to aggregate our most intimate habits, surveillance remains automated and deeply impersonal as it bypasses individuated modes of subjectivity and signifying semiotics. Both digital media studies, if focusing merely on identification through computational performatives, is limited in offering any new insights into the forces at play in our present moment.

I argue that the acceleration of predictive techniques and impersonal forms of control require a more robust consideration of de-subjection. Along these lines, tactical machine learning would have two goals. First, the goal would be to update theories of subjection, and de-subjection, for the proliferation of machine learning devices with a keen attention to practices that bypass classical definitions of the subject. And second, to provide an analysis of social practices externalized into the technologies of machine learning. We must describe and experiment with certain tactical media concepts that undergird machine learning today – scenario planning, training, and prediction.

2. A tactical media approach to machine learners

Methodologically, a tactical media approach to machine learning must be situated within the perspectives of media philosophy as well as the practice of media arts. The legacy of tactical media (and its forebears in 1960’s intermedia, conceptual, and performance art practices) informs much of my project combining the fields of digital media with performance studies. For instance, tactical media was outlined in the late 1990s by David Garcia and Geert Lovink as a set of practices engaging technology as always being wrapped up in power relations. The activist ethos of tactical media has been mobilized in various registers by Rita Raley, The Critical Art Ensemble, and Beatriz da Costa. In each case, performance is considered a mediating process that enacts technological apparatuses. Each usage of the term *tactical media* is dependent upon the specific set of technopolitical relations that the practitioners hope to intervene within. In the case of Beatriz da Costa and Kavita Philip, their tactical *biopolitics* replaces the term ‘media’ out of a consideration of specific technoscientific forms of knowledge production modulating the possibilities of life (da Costa and Philip). Jussi Parikka, in a similar manner, mobilizes a geological imaginary to intervene within extractive environmental politics and digital culture. In this vein of mapping a specific set of technopolitical relations, the title of this essay mobilizes tactical media in the service of exploring the temporal regimes of machine learners. The title also borrows directly from Saidiya Hartman’s *Scenes of Subjection*. I hope to expand on scenographic modes of subjection by drawing on the cybernetic imaginary to elucidate forms of technological de-subjection at the heart of identity politics. My initial hypothesis is that through so-called new media regimes, old forms of subjection mutate through the new technopolitical conditions that arise. I look to unearth the technologies of subjection as they traffic through the digital sphere.

To provide insight into the processes of de-subjection I rely on two threads of critical theory. The first mode of critical theory that I utilize comes from post-autonomist marxism and its theories of signification and subjection within the late capitalist technosphere. I find it useful to consider the performative statements and decision architectures of machine learners via the philosophy of language found in the work of Michel Foucault, and

Félix Guattari. Especially useful is Foucault's concept of the dispositif — the structural yet mutable union between institutions, subjectivity, and discourse. He defines the dispositif as an autonomous technique which exists "on the other side of juridical and political structures of representation" (Foucault 40). The dispositif is a mechanism of capture, both material and discursive, which directly manages the experience of everyday life.

Guattari further identities two dispositifs of power that operate in a contradictory manner. On the one hand, we face systems of social subjection. Social subjection categorizes us with assigned identities — it gives us a gender, a race, a profession — a position of symbolic representation. However, the production of an individuated subject is also coupled with a different process that proceeds though desubjectivization. Guattari defines this process as *machinic enslavement* which dismantles the individuated subject, consciousness, and representations, acting on both pre-personal and supra-individual levels. In machinic enslavement, the individual is no longer instituted as an "economic subject" or a "citizen." She is instead considered "a gear, a cog, a component in financial and various other institutional assemblages" (ctd. in Lazzarato, *Signs and Machines* 25). For instance – advertising focus groups stopped using questionnaires long ago in favor of measuring biometric response to stimuli such as taste tests or eye tracking. Capitalism is so successful because it operates heterogeneously at the intersection of social subjection and machinic enslavement. We are all caught in a double bind between performative individuation and the dissolution into our dividual parts, unknown to ourselves. Guattari's critique (which I extend to the analysis of machine learners) is of critical theories that deal only with language and/or recognition while ignoring de-subjectivizing processes and their non-representational semiotics.

Although the post-autonomist critique of technology is quite useful in understanding both processes of subjection and de-subjection within the logic of computational capital, there is still the problem of the specific historical and material contexts in which machine learners are situated. One must wonder if Guattari's exploration of de-subjection can find a more radical usage today. In this manner, and concerning de-subjection, the second strain of critical theory we must engage with is queer-of-color-critique.

We must turn to the negative identity politics that refuse to validate, affirm, or strengthen forms of subjectivity presently produced under capitalism. Recent antagonistic positions and pessimisms are powerful not because they have to do with identity "but because they have to do with the "mundane radicalism of the desire to de-subjectivize all categories" (Menon). Queer-of-color critique has long grappled with processes of de-subjection as a crucial step in forming minoritarian collectivity. Disidentification operates "in and against dominant ideologies" while refusing assimilation.

Hortense Spillers' theorization of the flesh and the body is important to consider in relation to present data practices which quantify human behaviors. Spillers positions the distinction between body and flesh as the central difference "between captive and liberated subject positions". For Spillers, the body is possessed by an individual who is the sole owner of their selfhood. Yet for a captive, as in the case of chattel slavery, the body is reduced to flesh. This flesh is exposed to violence without protection from legality, equality, or democracy. In fact, Jasbir Puar writes that the violence of capital is legitimated through the right to maim. Outside of representation, vision, or ideology, the flesh records the primary narrative of the horrors of liberal humanism. It is the suffering of the flesh which exceeds white coloniality and acts as transgenerational memory, highlighting the ways black bodies remain as flesh. Spiller's political antagonism is an attention to the memory of the flesh existing on the side of the de-subjectified, the already outside, beyond the limits of the subject or the law.

Of course, the right to maim emerges in the data practices of predictive policing that quantifies black behaviors which are correlated to racist databases. All of this digital magic is merely a weapon to legitimate police horrors in the streets. Yet, as Spillers claims of the memory of the flesh. How can we reclaim the memory of our data exhaust?

Again, de-subjection and disidentification hold tactical power. Whereas optimism and the will to produce new subjectivity may look to the redeemable of the world, pessimism takes up its position as an attempt to channel the forces of the outside. We can see, for instance, a glint of optimism in the work of Fred Moten — in the gap between the flesh and the law. This is where Moten finds ungovernable fugitivity. For Moten, continuous movement exceeds the subjection of social death. Blackness for afropessimists however, cannot escape social death. The distinction here between optimism and pessimism is a difference in ways to refuse the measure of racial capital. Moten proposes movement and evasion. Afropessimism however sees no such possibility.

The methodological divide here is nuanced, yet crucial. Afropessimism attempts to disarticulate the real object from the object of knowledge. The analytical task Sexton suggests is to move from a measure of empirical experience to the structure of political ontology. Afropessimism claims that the empirical existence of racialized exclusions are "in danger of entering the discursive record as transcendental truths". The task is clearly to resist any empiricism which may play back into the measure of white supremacy.

I consider these positions, structure vs. empiricism, not as antagonistic but as a coupling of strategy and tactics. Jared Sexton's structures of social death measure the terms of total struggle while Moten's empirical fugitivity finds its escape lines on the shifting grounds of everyday survival. Put simply, Afropessimism both refuses social subjection, while escaping machinic enslavement. Guattari and Afropessimism both critique the subject as always already commodified and inscribed (albeit in different ways) by violence and exploitation. Afropessimism seems more relevant in its call to desubjectify not to reappropriate or celebrate already existing positions within racial capital. Perhaps it is here that data exhaust and its nefarioius uses can be a site of real struggle. Data exhaust is used to expose and reconstitute subjects to new techniques of power. Facebook strikes, sabotage of data sets used to predictively police entire populations, and adversarial network attacks all become viable options in political struggle.

Although the tactical potentials of machine learning are emerging as we speak, one brief example we can gesture towards is Zach Blas' project *Facial Weaponization Suite*. Intervening directly in biometric surveillance systems, it "protests against biometric facial recognition by making 'collective masks' in community-based workshops that are modeled from the aggregated facial data of participants, resulting in amorphous masks that cannot be detected as human faces by biometric facial recognition technologies."[4] The masks are subsequently used for public interventions and performances. What is so provocative about Blas' project is the gesture of obfuscation — a digital act of refusal of individual subjection achieved not through escaping systems of capture but by turning surveillance systems toward a disaggregated collective subject. *Facial Weaponization Suite* peers back into machine learning systems in

Figure 1: Zach Blas, *Facial Weaponization Suite* (2011-14).

their own likeness, alien aggregates, algorithmic approximations of the crowd, statistical average identities that ironically protect the individual identities most at risk from exploitation. Blas' machine learners operationalize data through the excessive overload of computational measure, illustrating the potentials of direct digital struggle.

The politics of machine learning are not yet entirely clear. What is clear is that machine learning needs endless supplies of data. Any data will do. And increasingly that data can be unstructured. What is perhaps most interesting here is that the processes in which machine learners operate are becoming less understandable to the designers engineering their functions (Fourcade and Healy 11). In instances where there is no initial hypothesis, no pre-existent model, machine learners experiment in ways that are virtually unrecognizable to their engineers. What emerges is what Luciana Parisi calls the "alien rule" of algorithmic ubiquity:

> *Far from making the rational system of governance more efficient, this new level of determination forces governance to rely on indeterminate probabilities, and thus to become confronted with data that produce alien rules. These rules are at once discrete and infinite, united and fractalized. (*Contagious Architecture *11)*

Of course, the tautological empiricism of machine learners is problematic as they can be used to reinscribe prejudiced data to justify social segregation (Mackenzie, "The Production of Prediction" 441). However, for those political struggles not interested in recognition but that are more invested in functional power and the right to opacity; perhaps there is an opportunity offered by machine learners to turn their alienating weapons against systems of exploitation (Coulthard; Glissant).

Notes

[1] The generalized practice of machine learning encompasses many techniques of predictive modeling that are used to classify events and things into stable categories. Some of these techniques include linear regression models, Bayesian classifiers, and k-nearest neighbors. Decision trees, deep belief networks, and neural networks however are the most interesting in terms of subjection. The research on machine learning is evolving, seemingly on a week to week basis.

[2] It is useful to remember here what Gilles Deleuze, and Lewis Mumford before him, were keen to observe: that technologies are social before they are mechanical.

[3] For our purposes here social identity and subjectivity are one and the same. Social identity is considered a given coordinate in a state-based system of categorization: race, gender, name, social status.

[4] See http://www.zachblas.info/works/facial-weaponization-suite/.

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Maria Dada

QUEERING GLOBAL INFORMATION SYSTEMS

Abstract

What's the relationship between GIS and the political subject? In an effort to address this question, this paper traces the movement from the map to GIS. The map is shown to be the performative utterance of the state, one that supports its national discourse and narrative. GIS, on the other hand, is shown to be a device of neoliberal governmentality, its non-representational economic practices, divided discourse and subjectivities. Despite the seemingly hopeless situation surrounding GIS, however, certain simulation and modelling practices are attempting to construct subjectivities out of economic neoliberalism's fractured narratives. They do this by reading meaning into otherwise mathematical datasets and models. These practices could form a basis for queering GIS.

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Introduction

The field of cartography as the academic study of the history and meaning of mapmaking is in decline, or "is dead" ("Cartography Is Dead" 4), according to Denis Wood, one of the foregrounding figures of critical cartography. It is being ingested into what might, on the surface, seem like a continuation of the discipline but in fact is not. The practice taking over from cartography is that of digital modelling.

Nonetheless, many critical cartographers including Wood, find no reason to bemoan this loss. They might even celebrate it. "Thank God" ("Cartography Is Dead"), proclaims Wood (4). Contrary to what one might imagine, the map is a relatively recent practice dating back only to the 1500s. Its lineage coincides with the emergence of the disciplinary sovereignty and the state's right to political violence, what political theorist Archille Mbembe would call necro-political power.

The map in that sense is a performative utterance of state territory. Without a map, the state would not be conceived of as a thing, a map-able object with borders and edges, "state borders are brought into being through mapping" (*The Power of Maps* 45). The map becomes the icon or as historian and political scientist Benedict Anderson claims the logo of the state and this icon with its definite borders erases the lineage of its construction.

As critical geographers such as Paul A. Longley and Matthew W. Wilson affirm, it is not that the map was transformed into a digital map but rather that digital modelling as a practice cannibalised the remnants of a dying tradition for its own gains (Longley; Wilson). Accordingly, the trajectory of the move from mapping to Global Information Systems (hereafter GIS) is not a linear progression but rather a disruption and displacement of the map by the model. In fact, most applications that later become the digital map didn't have a map to begin with. They were created in order to forecast population information for the user by city officials, planners and businesses. The so-called maps, such as the OXAV and SYMAP were complex and had their own symbols with an accompanied user manual that explains how they were to be interpreted. None had a drawing of the terrain or land.

The following paper extends this discourse by showing the relationship between subjectivity and GIS, a relationship that is missing from various accounts of critical GIS which centre on critiquing statistical modelling for its alleged positivism as does Stan Openshaw, for instance, in his 1991 article, "A view on the GIS crisis in geography". Rather than interpret digital modelling as strictly a quantitative method, as Openshaw regarded it, this paper reveals its performativity, one that is remarkably different from that of the map. The two are similar in that they not only describe but rather construct territories, understood as extension of sovereign power, however with modelling, these territories are no longer bound to the land, they are no longer strictly spatial but rather penetrate the psychology, behaviour and even molecules of those subjected to its power.

Digital media theorists such as Alexander Galloway and Bernard Stiegler, following Gilles Deleuze in the article "Postscript to the Societies of Control," have interpreted this territorial permeation by digital media more generally as a cause for the disarmament of the political subject, the subject's endless division into manipulable units of data or code. Deleuze himself sees the individual subject transformed into a dividual, endless units of data subtracted from individuals and their bodies, he explains, "Individuals have become 'dividuals,' and masses, samples, data, markets or 'banks'"(5). In *The Exploit* Galloway and Eugene Thacker also suggest that the political subject of digital media is divided into atomic units that make up part of a larger network. Paul B. Preciado, on the other hand, sees this type of control modulating subjectivities at a molecular level through pharmaceuticals. GIS could, therefore, be seen to follow this logic and further dismantle the political subject into units of data through its use of statistics and cognitive psychology. Contrary to this reasoning, however, this paper shows that GIS or digital modelling in fact offers a way to potentially unearth a radical political subject.

With that in mind, this paper is divided into five sections. Section one begins with the problem set out by Deleuze in "Postscript to the Societies of Control." It relates his article to Michel Foucault's work on neoliberalism in *The Birth of Biopolitics*, setting the scene for section two where the link between Deleuze and Foucault's ideas around subjectivity are brought closer to the economic practices of digital modelling through the work of Philip Mirowski.

The remaining three sections delineate the movement from mapping to GIS within the fields of cartography and geography more specifically. The key difference between GIS, which is largely based in non-representational economic practices, and maps, which is based in narrative, is outlined in section five. Finally, the conclusion touches on the ways in which GIS could potentially reinstate a form of political subjectivity and retain a critical dimension.

Deleuze after Foucault

Deleuze's article "Postscript to the Societies of Control" references and extends Foucault's work, primarily *Discipline and Punish*, but also includes Foucault's work on biopolitics and political economy. Foucault centres much of his later publications and lectures on the genealogy of power, or what he calls the knowledge-power nexus. In *Discipline and Punish* he shows the movement of power from what many, including political theorist Achilles Mbembe, have referred to as necropolitical power; the power of the sovereign king to take away life as a form of punishment for transgressing his law, to regimes of discipline or disciplinary society, where control is no longer based in the threat of death. Instead, disciplinary society is engaged in the self-disciplinary techniques of discourse, the institutions and surveillance mechanisms similar to the architecture of the panopticon as described by Jeremy Bentham.

However, according to Deleuze, the institutions that Foucault describes in *Discipline and Punish*, are in crisis or in perpetual need of reform. They have been replaced by "a new monster" (Deleuze 444). Disciplinary control is no longer positioned at the institutional level but has rather been internalised by each subject who as a result is no longer a subject but a 'dividual', a term Deleuze shares with Félix Guattari. In other words, it is no longer the architecture of the school, the barracks, the prison that keep us from misbehaving. Control society works at modulating subjectivities at a more granular level through mechanisms that theorists, including Galloway, have interpreted to resemble those of digital media.

Actually, Foucault, in his lectures on *The Birth of Biopolitics*, delivered around thirteen years prior to the publication of "Postscript to the Societies of Control," was beginning to touch on some of these ideas. His account, described in the remainder of this section, offers an alternative interpretation to Deleuze's notion of the dividual which informs its relationship to digital modelling and GIS.

He dedicates the lectures to highlighting the multiplicity of shifts within power or the art of government discussed above, the movement from punitive sovereignty, or necro-political techniques of power, where the state assumes the role of what Foucault describes as “a cold monster” to what he describes as a more ‘reasonable’ form of power.

Under necro-political art of government the king was able to punish and kill while being answerable to no-one but the divine laws of God. Breaking the divine laws of God would force the sovereign to step down. However, as the mode of power shifts so too do the laws that govern it. If the necro-political king is only accountable to his subjects in relation to the divine laws, the sovereign of governmental reason is not accountable at all but rather limited by nature.

Under what Foucault refers to as the ‘reasonable’ *raison d’état* the sovereign has to negotiate their power with that of nature and its laws. The paradox, of course, is that one cannot reason with nature. It is in a sense the condition and the limit of rationality. Therefore, the laws of nature are supposedly imposed on the state. The latter is, of course, the fallacy that Foucault is exposing in the lecture.

In other words, the laws of nature, which are imposed on the state of the *raison d’état*, operate differently to the laws of God. Foucault explains,

> *To say that there is a de-facto limitation of governmental practice means that a government that ignores this limitation will not be an illegitimate, usurping government, but simply a clumsy, inadequate government that does not do the proper thing. (10)*

Put differently, breaking with the internal limitations of governmental reason will not render it illegitimate because these limitations are no longer juridical. Natural laws are beyond the control and interpretation of any sovereign, man or subject.

Now as it happens the most effective form of rationality, which is used in order to calculate and make sense of the self-limitation of governmental reason, is political economy or the supposed natural laws of the self-regulation of the market. Foucault continues,

> *the intellectual instrument, the form of calculation and rationality that made possible the self-limitation of governmental reason as a de facto, general self-regulation […] is political economy (13).*

In fact, as he himself admits, all of Foucault’s final lectures on biopolitics need to be understood through the lens of political economy and its tools such as economics. It is the intellectual apparatus born out of the *raison d’état* to enrich the state against its enemies.

Political economy, nonetheless, determines the success or the failure of government but does not illegitimate it. Governments can simply be mistaken by ignoring the new laws of nature, the laws of the market. A bad governor is not wicked but ignorant. Ignorance does not dissolve a government. The relationship between truth and self-limitation, however, is not about wisdom of rule such as that of the Machiavellian prince. In place of the wisdom of the prince, governments rely on economic experts “whose task is to tell the government what in truth the natural mechanisms are of what it is manipulating” (17).

It is the judgement of governmentality on success in opposition to legitimacy that pacifies the political subject and turns them into dividuals in Deleuze’s terms. The issue, the reason governmentality is no longer judged for its legitimacy, and what troubles

Foucault, is that sovereignty and the law are no longer set in relation to citizens as subjects. The market, and its supposed natural laws, are now the medium between sovereign and subject.

The only means for the sovereign to govern its subjects is through the market and its economic experts. However, economics, the discipline of political economy that aims to understand the market remains agnostic to narrative, meaning and representation. It, therefore, reduces the subject into a market actor at best or a multitude of divided economics units in Deleuze's view, the dividual. The subject, through an economic understanding of the market, is nothing but a multitude of cogs in the system never united under a single rebellion against the king for instance.

The emergence of digital modelling

The next section will look at the emergence of digital modelling within economics as neoliberal governmentality's means of making sense of, and therefore governing, the market by translating each of its elements into computable units of data for use in mathematical modelling or statistical mechanics.

According to Philip Mirowski, prior to the Second World War the rational choice, mathematical model-based economics that engulfs our current economic system was not the dominant discourse. Donald Mackenzie agrees,

> *Economics had developed in the eighteenth and nineteenth centuries predominantly as what the historian of economics Mary Morgan calls a "verbal tradition." Even as late as 1900, "there was relatively little mathematics, statistics, or modelling contained in any economic work" (Mackenzie 7).*

In fact, there wasn't a particular dominant form of economics. Mirowski insists, "there was no dominant orthodoxy in American economics prior to World War II, although the indigenous strain of American Institutionalism held some key strategic outposts at Columbia and Wisconsin" (Mirowski, *Machine Dreams* 190). Institutionalism was of the view that institutions played a major role in shaping the markets and encouraged the broader understanding of their role in such a process.

After the second world war in the 1950s the rise of the American economic model of laissez faire and the increasing availability of data fortified the link between mathematical modelling and the market. The relationship between the two fields was also influenced by the burgeoning field of Operations Research (hereafter OR) and the impact of the cold war's reinforcement of technical innovation.

Mirowski's claim is that mathematical and later digital models developed during the second world war fuelled the highly specialised new discipline of OR. OR is regarded as the predecessor to most computing disciplines. It is influenced by early inventors of the computer such as Charles Babbage. It was mostly invested, however, in the analysis and management of market-based decision-making, including but not limited to rational choice theory, a system for simulating or modelling social and economic behaviour within a market or market-like system, how market actors make market-based decisions. OR is often referred to as decision science or management science.

It is key in spawning academic disciplines such as game theory, cybernetics, cognitive science and even artificial intelligence all of which employ some form of digital and mathematical model.

Modelling allows these disciplines, and decision science more generally, to make economic sense of any element in a market or market-like system regardless of what that element is or how small it is. In other words, digital modelling is a means of determining the state of a market-like system through mathematical non-representational methods, methods that are not based in narrative or meaning but rather elements, actors, cogs and perhaps dividuals.

The next few sections will look at how the map, more specifically, as an apparatus of governance, has been transformed as a consequence of digital modelling, how global GIS comes to take over from the map as the new apparatus for a new style of governance, one that is based in non-representational economic principles.

Necropolitics and the map

This section will explore the significance of the map, and consequently the discipline of cartography, as an apparatus of necro-political power, the power of the sovereign to take away life as a form of punishment for transgressing his law. It will show that necro-political regimes are interested in maps in order to enforce taxes, voting patterns and population control and management. Maps, in that sense, are the performative utterance of sovereign space as the playing field for governmentality and power.

As mentioned in the introduction and as critical cartographers such as Denis Wood and James Scott have made evident, the map is a relatively recent apparatus dating back only to the 1500s. Its lineage coincides with that of the sovereign and state power. Prior to the 1500s few maps were created in the vein in which they were drawn under necro-political rule, to assign territory and control borders. Most maps prior to 1500, including the oldest map that remains in existence, the clay “Babylonian world map” dating back to the 6th century BC, were created for cosmological speculation rather than territorial redistribution. The map as a measure and distribution of resources didn’t begin until after the 1500s with examples of the Habsburg emperor Phillip II of Spain who commissioned surveys of his various possessions in differing territories.

As a matter of fact, very few maps have survived from the Greek, Roman or Medieval era. There are a lot of descriptions of maps and how to create them, including Ptolemy’s Geography and the various different succeeding comments on it. However, what we know as the Geography was more often referred to as the ‘cosmographia’. Ptolemy and his commentators such as the medieval scholar Al Khawarizmi intended to use maps in order to speculate on the known world. They did not survey it with the aim of dividing it up and creating zones.

In a sense, as Scott proclaims,

> *The premodern state was, in many crucial respects, partially blind; it knew precious little about its subjects, their wealth, their landholdings and yields, their location, their very identity. It lacked anything like a detailed ‘map’ of its terrain and its people. (Scott 2)*

That is not to say that there weren’t any map-like drawings conceived of to manage particular problems such as plans and drawings of cathedrals. Many of such drawings served as a form of inventory but none surveyed the many details of the land as the topographical maps by the time they were completed in the 20th century. They were more interested in the plan of a restricted area for a specific use. In many cases when map-like drawings did exist, such as the

Arabic *naqshah*, these graphical representations were not referred to as maps. In that sense, they are more akin to paintings. The structure of the modern map is fairly recent and it coincides with its paradigm of use.

Contemporary maps, that demarcate territory, didn't begin to appear until after the 1500s. Most heads of state around that time continued along the direction of mapping space, infrastructure and land under the sovereign's control. For instance, Jean-Baptiste Colbert, a minister of home affairs under Louis XIV, ordered the surveying and mapping of the whole of France in 1663.

The most extensive cartographic project occurred in France after the end of the conflict between Spain and France following the Treaty of the Pyrenees in 1659, a treaty that results in a joint commission to set the boundary between the duelling states. The boundary between Spain and France was instated as the first official boundary in Europe. Other notable boundaries were the result of the cartographic work of the Cassini family over four generations, the first trigonometric map regarded as a topographic land survey. Not to mention the fortification of the Sébastien le Presetre de Vauban country. Any institutional history book would point to multiple examples from European history and beyond of sovereigns ordering the surveying of their territory. Mapping was a key proponent of what Foucault would call disciplinary state sovereignty.

What is being proposed here is that the lineage of the emergence of the modern map coincides with the lineage of disciplinary society and necropolitical power. The bigger claim, however, is that the map is an artefact, a mode of writing, technology, that brings the state's territory, and therefore the extension of its power, into being. In other words, the map is responsible for the state's existence and vice versa. The state then goes on to affirm the map by insisting that it is a mere representation of the earth's surface, hiding the performativity of the process of its own creation. In this sense, maps are an ontological claim of the existence of the state. The next section will delineate further the relationship between maps and the territory they demarcate.

Territory

The geographer Stuart Elden dedicates his monograph *The Birth of Territory* to showing that the notion of 'territory' refers less to the land but rather more generally to the measure and extension of sovereign power. As such its meaning is mutable and based on the varying forms of sovereignty that appear throughout history. He claims,

> *Territory is not simply land, in the political-economic sense of rights of use, appropriation, and possession attached to a place; nor is it a narrowly political-strategic question that is closer to a notion of terrain. Territory comprises techniques for measuring land and controlling terrain. Measure and control—the technical and the legal— need to be thought alongside land and terrain. (Elden 322-323)*

The technical that Elden is referring to is synonymous with mapping techniques which, as I will show, later become modelling techniques taking over from the map's form of measurement. Maps allow a certain, representational grasp of the materiality of nature, its mountains, deserts and tundras, not to mention the way maps were used to impose divisions on the colonised. They delineate and sustain territory through national state narrative.

At the moment, however, the state's stronghold on the map is weakening because the structure of the state and its institutions, as Deleuze professes, "is in crisis" (Deleuze 444). The state has not been eradicated, as such, but rather qualitatively transformed due to global geo-economic conditions and the neoliberal governmentality that has emerged. State territories have been reconfigured in response to global trade influence. These contemporary conditions do not abolish or confine state territories but rather produce new state spaces that are entangled in trade relations and new forms of competition. The institutional questions that concern the state no longer converge and in that respect as Neil Brenner makes clear in *New State Space* it might be misleading to speak of 'the state' as such. Indeed, this is Henri Lefebvre's point when in the 1970s he discusses the 'explosion of spaces,' a concept then only in its infant stage. The institutions, regulatory agencies and markets that comprise the state are no longer easily demarcated and in that sense are somehow in crisis.

The representational scalar vocabularies of the map have been ill equipped to describe the new geo-economic interdependencies, interdependencies that have come to demand a new style of governance where the market and economists intervene at every level. Consequently, the discipline of cartography becomes more detached from the practice of mapmaking in the traditional sense of drawing maps with pens, paper sheets and hand drawn projections. There is a decline in cartography in favour of a more economics-based and consequently non-representational model and this logic runs parallel with the restructuring of territory and perhaps the state altogether.

In the digital era map making is more readily referred to as global information systems (hereafter GIS), surveying, city planning or real estate planning. Even drawn out fields such as psychology and biology have become more akin to 'mapping' than cartography. The model, in its economic sense but also in a wider sense of mathematical modelling, expands the notion of territory without excluding previous formations of it. The difference between the two is a matter of temporal and geometric scale and the way that neoliberal governmentality operates at these varying scales.

Modelling is not restricted to physically observable phenomena such as Newtonian physics and geometry. For instance, the weather can be modelled in what is referred to as real time. In the same vein, modelling, stretches to cover many aspects of social and political life such as voting patterns, criminal offending patterns, the tax value of homes, bus routes, bike paths as well as consumer preference. And yet it doesn't exclude things like the modelling of farm land, roadblocks or other infrastructure. Mapping, on the other hand, operates only at the Newtonian scale, the observable and representational, and encompasses areas interpretable through signification and language, signs, semiotics etc. The next and final section will trace the lineage of GIS to show its links to economic practices.

GIS

The story of the digital map in the1960s coincides with the emergence of computer modelling techniques, social econometrics and the infiltration of these practices into the field of geography. However, creating maps with computers in those days required sophisticated graphical mapping applications which didn't mature until much later. Even before their advent, however, computers were still modelling data for urban analysis.

In other words, the applications that later became the digital map didn't have a map to begin with. They were created in order to forecast population information for use by city officials, planners and businesses.

One of the first geographers to lay the grounds for the digital map was a scholar named Howard Fisher from Northwestern University. He founded the Laboratory for Computer Graphics and Spatial Analysis. Fisher began as an architect and then came to setting up a company that adapted factory methods to the creation of prefabricated houses only to see his company fail with the pressures of the Great Depression.

It was at Northwestern that Fisher appointed programmer Betty Benson to develop the Synagraphic Mapping System (hereafter SYMAP). Tensions were present between the mid-century cartographic community and Fisher's new practice of spatial analysis. However, for those wanting to see modelling enter the discipline of geography, the map was seen as a vehicle that would enable geography to rise and become a science.

Quantitative geography was quite different from its qualitative counterpart as it had more in common with that of economics or economic geography. So much was clear with the recruitment of William Warntz as associate director of the Laboratory of Computer Graphics and Spatial Analysis from his previous post as an economic geographer at Penn. He ended up working on the urban simulation routine called METROPOLIS which used SYMAP to create an animated cartography of Lansing, Michigan.

One of the first so-called digital maps was used to map urban blight in the Washington city of Spokane. The map looked nothing like a geographical map but was rather a graphical representation of population in the aid of control. Most of the research in early digital mapping which was later to become the now extensive field of GIS was funded by business groups such as the Ford Foundation. The so-called maps, such as the OXAV and SYMAP were complex and had their own symbols with an accompanied user manual that explains how they were to be interpreted. None had a drawing of a terrain or land.

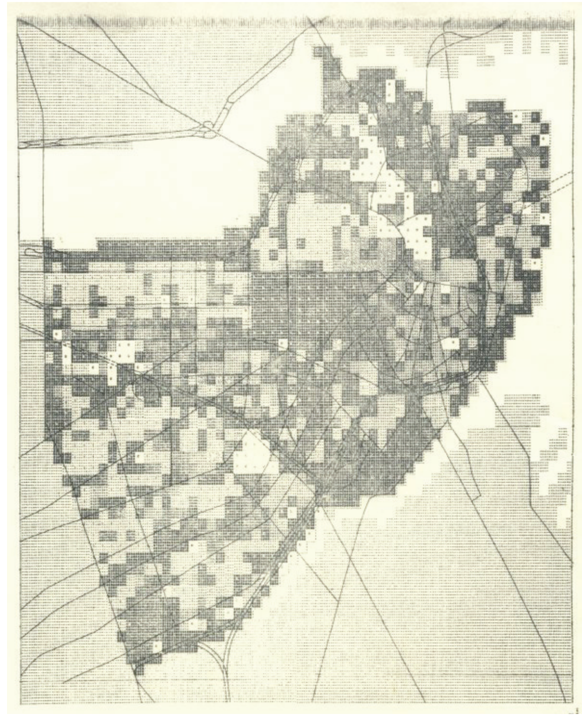

Figure 1: A map produced by Carl Steinitz while at MIT in the mid-1960s called "The Principle Local Activity of a Place."

It was only through the work of Warntz, his experience as an economic geographer and his work on urban simulation routines, not to mention the remainder of the money from the Ford Foundation that SYMAP's drawings began to resemble geographical maps. And even when this occurred it was only in order to simplify the display and reading of population data so that a layman would be able to interpret the results.

The point is that much of what is referred to as GIS is based in the mathematical modelling techniques that come out of economics and various forms of market-based decision theory, techniques that are largely quantitative, non-representational and adhere to a particular style of governance. And yet, GIS, like its predecessor the map, remains the performative utterance of a territory that can only be known through the model itself, a model that is supposedly non-representational. As Michel Callon and Donald Mackenzie claim, despite being able to make do without the representational idiom, models remain performative within the world that constructs them.

Conclusion

A remarkable difference between maps and models is that maps as descriptors of the earth's surface contain graphical visualisations that rely on imaging hermeneutics and the application of signification or meaning. Simply put, they are comprised of signs, the lines of the borders as signifier to the territory as signified. The interpretation of the map is a function of power and society as it relates to the way the map is drawn. Nonetheless, its value as a representation creates a kind of regulative fiction where the becoming of state territory is sustained socially through national narratives.

In other words, the national discourse constructs and maintains the identity of the state as that which is acted out by the performative utterance of the map. The question of resistance becomes one of manoeuvring through normative frameworks.

Digital models, on the other hand, may have simulations, executions of the models, that resemble maps or take the form of representations and visualisations but primarily they are mathematical entities, quantifiable and statistical. They divide their subject into manageable units that are not primarily representational.

However, and this is what the paper will conclude on, this does not mean that they lack the capacity to generate narrative. Studies by computational media pioneer Fox D. Harrell show that there are alternative ways to engage computational modelling. With the help of computational and algebraic linguistics, Harrell aims to derive meaning from what is otherwise viewed as structural and numerical datasets, datasets that drive many computational models.

For example, with the *Advanced Identity Representation* (hereafter AIR) *vatar Platform* Harrell constructs a system that reveals patterns in various modelled virtual identities. *AIRvatar* helps reveal the meanings behind a system, and consequently its biases, of which model and dataset creators may or may not have been aware. As a platform it has been instrumental in the discovery of statistical patterns of race and gender discrimination in video games.

Harrell has also been looking into alternatives to economic modelling in social media, models that do not assume all actors to be motivated by economic decisions. In the online interactive game *Chimera: Gatekeeper* Harrell constructs a dataset that attempts and maintains the fluidity of the user's identity in relation to the changing context of the interactive narrative.

What Harrell's experiments show is that algebraic linguistics could be used to read meaning into the so-called dividual elements of data that models produce and manipulate. Doing so would enable a type of critique or resistance to the territorialisation by various model structures. A map describes only what is seen on the surface of the body of sovereign territory. Models on the other hand extend their performativity deep into the crust, tracing ecologies and patterns wherever they may be found. However, by reading meaning into these patterns and datasets there is no reason why critical GIS practitioners could not continue to construct an extensive critical discourse and practice.

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Tiara Roxanne

DIGITAL TERRITORY, DIGITAL FLESH: DECODING THE INDIGENOUS BODY

Abstract

Western Indigenous cultures have been colonized, dehumanized and silenced. As AI grows and learns from colonial pre-existing biases, it also reinforces the notion that Natives no longer are but were. And since machine learning requires the input of categorical data, from which AI develops knowledge and understanding, compartmentalization is a natural behavior AI undertakes. As AI classifies Indigenous communities into a marginalized and historicized digital data set, the asterisk, the code, we fall into a cultural trap of recolonization. This necessitates an interference. A non-violent break. *A different kind of rupture*. One which fractures colonization and codification and opens a space for colonial recovery and survival. If we have not yet contemporized the colonized Western Indigenous experience, how can we utilize tools of artificial intelligence such as the interface and digitality to create a space that de-codes colonial corporeality resulting in a sense of boundlessness, contemporization and survival?

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> *For to survive in the mouth of this dragon we call America,*
> *we have had to learn this first and vital lesson – that we were*
> *never meant to survive. Not as human beings.*
> *— Audre Lorde, "The Transformation of Silence into Language and Action."*

Introduction

Aztecas del norte, mojados, Indigenous peoples, First Nations People, mestizas, Redskins, Indians, Native Americans, Natives, savages, minorities, at risk peoples or asterisks peoples are some names or codes the Indigenous body is subjected to using settler colonialist language. The settler *names* the Indigenous person or body which codifies and marginalizes.

Not only does AI learn from these colonial pre-existing biases that codify and marginalize, it also re-inscribes the notion that Natives no longer *are* but *were*. As AI codes Indigenous bodies according to its colonial input, it also classifies these communities into a marginalized digital data set, the asterisk, the code. As AI codes the marginalized Indigenous body, it reproduces historical erasure of Indigeneity which necessitates an interference. A non-violent break. *A different kind of rupture*. One that destroys the settler colonialist triad and interrupts AI bias and promotes survival.

Here, I summon the source from where Indigenous subjectivity originates by returning to the body and the land this body inhabits, by breaking the boundaries it is bound by and begin to speculate on the notion of *digital territory* and possibly even *digital flesh*.

This kind of return to, and rupture of, the Indigenous biologic is one of ontological abstraction: One which focuses solely on the Indigenous body and the removal of (colonial) codes this body is tied to. We must therefore confide in the biologic and the historical and thereafter, enter the digital. Simply put, we must go beyond the flesh.

By going beyond the flesh, we enter the digital. This is an attempt to de/reprogram the Indigenous/coded body by entering a digital territory, one that is made possible via the interface. The interface is the lacuna between human and virtual worlds. Such a lacuna situates the Indigenous body outside of colonial/physical territory. It disentangles territory and makes boundlessness possible for the Indigenous body to inhabit. This is *digital territory*. This is where one embodies *digital flesh*. Since the contemporization of Indigeneity is not possible within its current colonial paradigm, I am speculating on the radical possibility of colonial recovery within a posthuman digital framework.

Indigenous body, indigenous borders

The body is a biological figure that identifies and is identified by the space that surrounds it. It encompasses dimensionality and is encased within a dimensional structure. All bodies live in spaces that dwell within borders. However, spatiality for the Indigenous body is both territorial and historical, a byproduct of colonialism, a designation of territorial acquisition and forced migration. The body that was colonized will always be colonized, more specifically, the Indigenous body (of the West). The Indigenous body, however, is subject to colonialism and more specifically, *settler colonialism*, a term used to describe the colonialist relationship between the Indigenous peoples and the colonizer. The concept of Indigenous is inspired by Audra

Simpson who writes in her book, *Mohawk Interruptus*, that "'Indigenous' is embedded conceptually in a geographic alterity and a radical past as the Other in the history of the West" (7). Indigenous peoples are pre-colonial peoples with a narrative that is geographically, cosmologically and ontologically tied to their land (within Central and Northern Americas, for instance). Their relationship to land and identification as such starts with territory which carries a polyvalence regarding ancestry, origin, spirituality and so forth.

Specifically, the Indigenous body refers to the biologic, social, and political colonized Indigenous person of the West. Again, Simpson writes, "indigeneity is imagined as something entrapped within the analytics of 'minitorization,' a statistical model for the apprehension for (now) racialized populations 'within' nation-states" (211). The Indigenous peoples are minoritized and colonized. According to Simpson, "Because 'Indigenous' peoples are tied to the desired territories, they must be 'eliminated'; in settler-colonial model, 'the settler never leaves'" (19). Indigenous peoples had their land stolen and repurposed within the settler colonialist structure, one which assumes Indigenous erasure. Thereafter, spatiality for the Indigenous body is both territorial and historical, a byproduct of settler colonialism, a designation of territorial acquisition and forced migration.

In this way, space develops as a gesture of colonization where borders mimic this "system of dominance," and subjugates the Indigenous body (Osterhammel 4). Such a system aims to create a space of segregation where the Indigenous are territorially, socially and politically trapped.

When "borders are set up to define the places that are safe and unsafe, to distinguish us from them" (Anzaldúa 25), the Indigenous body is claimed not only by the settler but also by the borders that surround it. Moreover, "a border is a dividing line [where] the prohibited and forbidden are its inhabitants" (Anzaldúa et al.). Borders separate the settler from the Indigenous where the settlers "make Indigenous land their new home and source of capital" and the Indigenous are pushed out (Tuck and Yang 5). This record of geographical domination is a fundamental colonial classifier, also known as "settler colonialism," one which occupies and establishes the Native land through erasure (Tuck et al. 5). Furthermore, this spatial circumscription reattributes the Indigenous' overall experience in and of the world. By framing the Indigenous body between physical and political structures and by claiming their land, the settler erases Indigenous identity and history.

This total migration of force pushes the Indigenous body into a space of wilderness, the forbidden and the prohibited, the erased – a ghost territory. This demand is a process of naming or anti-naming the body that is forced out of their homeland. To name, or take one's name away, determines an engendered locality, i.e. coding the body, which is an "ordering of matter around a body" (qtd. in Hanson). As the Indigenous are coded, their body is degenerated from embodied corporeality to mere flesh. Hortense Spillers reminds us about the division between body and flesh, she writes

> *[...] the distinction as the central one between captive and liberated subject-positions. In that sense, before the 'body' there is 'flesh,' that zero degree of social conceptualization that does not escape concealment under the brush of discourse, or the reflexes of iconography (67).*

The body that is subjected to, imprinted upon, named or coded is done so according to its flesh. Where Frank B. Wilderson might refer to the "presence of the body" ("The Inside-Outside of Civil Society") in reference to Spillers' notion of 'flesh', the Indigenous body who is re/moved and named suffers a similar antagonism.

The Indigenous loses their identity as well as their sense of belonging to their homeland. And since "flesh is the fundamental indifference between body and world" (Hansen xi), the Indigenous people suffer from this codification process done so by the settler. Again, Spillers' notion of flesh exemplifies this codification, as the flesh is positioned and held in line with 'captivity' (67). The flesh that is named and marked is imprisoned accordingly.

The marginalized space or territory binds the Indigenous body within borders, iconographically and geographically. Furthermore, the settler names the Indigenous according to their flesh which is a codified identification process that further marginalizes the body. Thereafter, the Indigenous body is referred to as, but not limited to the following names or codes; *Aztecas del norte, mojados,* Indigenous peoples, First Nations People, the *mestizos* (people mixed of Indian and Spanish blood), minorities, 'at risk peoples' or 'asterisks peoples', "meaning they are represented by an asterisk in large and crucial data sets" (Tuck et al. 23). This codification of naming a community of bodies or an individual body dehumanizes and colonizes the body being named/anti-named. It is this codifying that then serves as a placeholder for machine learning systems which conceive and reproduce colonization of the Indigenous body, commonly referred to as AI bias.

Indigeneity: Body memory and flesh memory

A history grounded in the removal and erasure of Indigenous culture, identity and bodies therein, encapsulates memories passed down through generations of misplaced and coded bodies, is carried through body memory and flesh memory.

Traumatic events the body experiences are passed down as bodily memories, encompassing a corporeal memory archive also known as *body memory*. Recent studies on epigenetics displayed in the article, "Trauma May Be Woven into DNA of Native Americans" insist that "our genes carry memory of trauma experienced by our Indigenous ancestors" (Pember). Meaning that "trauma experienced by earlier generations can influence the structure of human genes, making them more likely to 'switch on' [negative] responses to stress and trauma" (Pember et al.). More importantly, these traumatic experiences influence gene structures which are physically and psychologically revealed. They are expressed symptomatically; two examples are Post Traumatic Stress Disorder (PTSD) and depression. For the Indigenous body, the suffering remains unresolved by proxy — to be Indigenous is to always be [in] the *trauma body*. That traumatic body memory lies dormant in the peripheral nervous system waiting to be triggered by reminders of the trauma event whether experienced personally, secondarily or genetically.

Another form of memory that is exhibited via the body is what Alikah Oliver called *flesh memory*. She defines flesh memory by first quoting the definition of flesh in the *American Heritage College Dictionary* and flesh memory later in her own words:

> *flesh (n): 1. the soft tissue of the body of a vertebrate, consisting mainly of skeletal muscle and fat. 2. the surface or skin of the human body.*
>
> *flesh memory: 1. a text, a language, a mythology, a truth, a reality, an invented as well as literal translation of everything that we've ever experienced or known, whether we know it directly or through some type of genetic memory, osmosis, or environment. 2. the body's truths and realities. 3. the multiplicity of language and realities that the flesh holds. 4. the language activated in the body's memory. (4)*

These somatic experiences for both *body memory* and *flesh memory* are activated and felt as present when past traumatic or violent memories arrive or are triggered. For both types of memory, they require the body and the history of that body, a basis of ontology. A history grounded in the removal and erasure of Indigenous bodies encapsulates these types of memories.

Since trauma is an inherent part of the Indigenous experience, both biologically (body memory) and ontologically (flesh memory), there is no way out. Recovery from colonization and trauma is challenged according to the body's situatedness. And since AI learns through the colonial paradigm, it is also re-colonizing and traumatizing the Indigenous body; thereby, digital colonization and artificial intelligence bias are also crucial to critically integrate.

AI bias

Since machine learning requires the input of categorical data, from which AI develops knowledge and understanding, compartmentalization is a fundamental behavior AI undertakes. As AI grows and diversity is tackled through the non-binary, or rather, *against the universal*, we fall into a trap of re-colonization, or *digital colonization*.

Two terms that *digital colonization* draws from are *data colonialism* and *digital colonialism*. *Data colonialism* "combines the predatory extractive practices of historical colonization with the abstract quantification methods of computing" (Couldry 1). And *digital colonialism* is "a quasi-imperial power over a vast number of people, without their explicit consent, manifested in rules, designs, languages, cultures and belief systems by a vastly dominant power" ("Resisting Digital Colonialism"). Both are hegemonic digital re-inscriptions of historical colonization. More specifically, each use and integrate methods of data collection via algorithms and machine learning systems which creates a general data identity stripping away any form of individual or body.

Furthermore, this kind of data collection serves as a type of surveillance which Gary T. Marx calls "the new surveillance" (206). This new form of surveillance is divvied up in ten sections, a few of which point directly to the sharing of data, the storing and compressing of data and specifically that "data collection is often done without the consent of the target" (Marx 218). Identity is not only generally based on the data that is collected, it refuses an ontological perspective. It disavowals the body, *the being*, the historicity one's body carries in body memory and flesh memory is dismissed, overlooked.

In other words, the data refuses to acknowledge the marginalized body, i.e. the Indigenous body in the margins, whilst re-marginalizing it which, in turn, is *digital colonization*. And since data collection has nothing to do with *beingness* or *the bodily* and because the historicity is so much a part of the Indigenous experience, and the experience of living, more generally, it continues to erase history. It persists in colonizing and thus is how I am determining digital colonization through data collection systems. Such data collection systems, like the algorithm, are taught via machine learning, for example, to collect and produce categories of identification which further reduces the identity of the Indigenous body to a code.

Therein lies a danger: the codification process of AI engages in biases that classify, categorize and codify the Indigenous body even further. And because AI learns from pre-existing biases and collects data based on these biases which further marginalizes, it is not only re-colonizing, it is erasing what has not yet been contemporized.

AI is learning to perceive the world based on its colonial input, and is acting as a disembodied surveillance that re-categorizes bodies based on general data collection. Since AI codes and thus digitally colonizes through multiple factors such as AI surveillance systems and data collection, I want to meditate on the question: can AI provide a space for the Indigenous body to digitally reorient?

Digital territory, digital flesh

Settler colonialism, AI surveillance and data collection compartmentalizes the Indigenous body which paralyzes it to a constant state of colonization: “I cannot decolonize my body.” There is no way out of this body, this trauma, this memory. There is nowhere to go. Now more than ever, with such embedded social, political and digital hierarchies, the Indigenous experience is at risk of historical erasure. The intermingling of each sphere produces a great need for disruption and awakening, not a resistance or recalibration, because, remember, computers do not forget.

In order to disrupt the pre-existing colonial input of AI, the Indigenous body must interrupt their own subjectivity which relies heavily on history and territory. Herein lies the importance of ontological abstraction. The experience of trauma, whether it be displacement or otherwise, such as ancestral genocide or any other kind of violence against one’s body, is ontological because it is implicitly biological and *being-oriented*. And abstraction allows for a different kind of experience or *beingness* to arrive.

Abstraction here is supported by Sylvia Wynter’s notion of autopoiesis, a term used to describe “subjects given over to death within a certain regime of being human/ human knowing” (Hantel 3). The subjects who are “given over to death” (Hantel 3) are liminal in their colonized state of being. Fundamentally, a liminal subject is a colonized human being who is forced to *be* within a mode of constant survival.

Wynter’s notion of the “liminal subject” derives from abstraction. It strikes a chord when expressing the body as biologic, autopoietic and perhaps even represented as a multispecies. Firstly, her liminal subject characterizes the subject as being on “the threshold of a new world in the midst of cultural ritual” (qtd. in Hantel 69). In this way, we can understand Wynter’s liminal subject in terms of Indigenous culture and ritual practice. Perhaps the liminal subject is formed through an abstraction which allows for corporeal overrepresentation through means of survival.

This survival is exhibited through ritual. By returning to ritual, Indigenous peoples unify through memory and tradition and return to the cosmological. However, for colonized / Indigenous people, it is important to discover means of survival in a world that was meant for its antithesis. It has never been safe to practice ritual, even on 'given land'. Indigenous peoples are killed off through historical mediums of representation as well as through technological representation. Meaning that this is a kind of 'death'. This death, or data-digital erasure, forces the Indigenous body to find new ways of survival.

And because the Indigenous body is stuck within a colonized world, territorially and digitally, it is important to imagine the 'other-worldly' to veer from settler colonialism. In this way, the Indigenous re-imagines their subjectivity through overrepresentation. For example, "the liminal subject assumes a structural role at the limit of the overrepresentation of Man, indexing an outside to our current descriptive statement by their very existence and paradoxical survival [...]" (qtd. in Hantel 70). Thereafter, as a liminal subject, the Indigenous is given opportunity to recover and possibly even reclaim, contemporize and survive.

This overrepresentation of the liminal subject, within a technological framework, is envisioned as *digital flesh*. However, prior to speculating *digital flesh* more elaborately, it is necessary to first understand the space the body needs to enter before the idea of *digital flesh* is even possible.

The Indigenous body must discover a sense of boundlessness that gives way to subjective interruption, therefore, the Indigenous body must reterritorialize where "each one of his [their] organs, his [their] social relations, will, in sum, find itself [themselves]re-patterned, so as to be re-affected, over-coded as a function of the global requirements of the world" (Guattari 10). To arrive at a space of reterritorialization, the liminal subject (as overrepresented) is placed outside of the parameters it is bound by. This kind of reterritorialization implies the need for a new landscape.

Digital lacuna: The interface

By inserting the already codified body into a virtual and boundless landscape, Indigenous peoples disrupt their own subjectivity and corporeality as well as contemporize their bodies as memory systems and flesh. This break in the sphere opens a space for rearticulation.

The interruption is corporeal contemporization and survival. This is possible because datafication refuses an ontological acknowledgement. Though the Indigenous would not re-enter their territory and claim it back, as if it is even possible, the Indigenous would need to enter a technological posthumanist framework, the virtual, the digital via the *interface*.

However, before entering a borderless cartography, as made possible through machine learning, it is important to distinguish the differences between architectural and virtual spaces. As it is experienced in the physical world, architecture manipulates the body to move through space and thus the body forms an understanding of itself, creates meaning-making and applies knowledge to and of the world. Galloway writes on account of Deleuze, "that one should not focus so much on devices or apparatuses of power they mobilize, that is more on the curves of mobility and force," further explaining, "these apparatuses, then are composed of the following elements: lines of visibility and enunciation, lines of force, lines of subjectification, lines of splitting, breakage, fracture" (qtd. in Galloway 18). By applying these apparatuses to the Indigenous experience, a different landscape is possibilized, one that is not so manipulated or reduced to by AI.

The landscape portrayed here derives from *architectural technics*, a term used to describe the technological space architecture is growing into, most specifically the *interface*. The interface is more than an infrastructural space. It is a threshold, a space of mediation between body and world, both physical and virtual. A gap. A lacuna. It is cartographic plasticity. "The interface is not something that appears before you but rather is a gateway that opens up and allows passage to some place beyond" (Galloway 30). It is in the space of passage between the physical and virtual spaces that is the break or disruption or rupture. The passage is the interface. This liminality between the physical and the virtual embodies movement though it is actualized as an interface.

By arriving into a space that is not named as imperial or colonial as such because it is its own structure outside of the body — a moving and/or malleable structure — it destabilizes normative corporeal thought, that which identifies the body as corporeal flesh.

Here, the Indigenous body speculates the possibilities of de/reprogramming *beingness*. A gesture of de-coding. The Indigenous body does not resist or protest *digital colonization* but navigates through it by entering *digital territory* via the interface. Within the digital space, the Indigenous body is then "over-coded," as Deleuze writes (qtd. in Galloway 18). However, the complexities of subjectivity greatly evolve regarding ethics here. Meaning, for example, subjective interruption between a *natural world* and a *non-natural or virtual/digital world* refers to multifarious meanings that transcend embodiment and require refusal.

Non-being & survival

The Indigenous body becomes something else. It becomes something other than only data. The Indigenous body becomes digital. It becomes digital flesh. As it is placed in accordance with the interface, its meaning and identification extends beyond the boundaries of the embodied — the human/corporeal flesh and its nervous system.

The Indigenous body is no longer human flesh: it is a digital body. And by invocating Francis Bacon's notion of force, where the body serves as a mediating horizon between self and interface, the Indigenous body seeks to reestablish a grounding where experience develops as a somatic relationship between self and virtual, self and digital, a boundless space which delineates traumatization, i.e. colonization, by identifying the body beyond the corporeal and symbolic flesh into the space of the digital. The corporeal body here serves as Bacon's notion of force within a digital landscape.

Here, I lean on Galloway where he writes on two kinds of spatial digitality which are flat digitality and deep digitality, he writes, "Flat digitality results from the reduplicative multiplexing of the object" (68). And then he reviews deep digitality:

> *Deep digitality results from the reduplicative multiplexing of the subject. Instead of a single point of view scanning a multiplicity of image feeds, deep digitality is a questionof a multiplicity, nay an infinity, of points of view flanking and flooding the world viewed. These are not so much matrices of screens but matrices of vision. (Galloway 68-69)*

Thereafter, deep digitality is the kind of digital and territorial unfolding the Indigenous body would become into or through, as a gesture of reterritorialization, rupture and force.

This is not to say that this decentering of corporeality, this disembodiment, is a positive move toward transcendence, it is only stating that the interface possibilizes a *different* kind of subjectivity, perhaps what Daniel Colucciello Barber refers to as non-being and the "*no*-thing" in reference to his interpolation of difference ("The Creation of Non-Being"). He first discusses the notion of being and writes, "being — or the possibility thereof — grounds itself not through its own coherence, but through an enactment of power that is staged by anti-black violence" (Barber et al.). Barber continues further by elaborating the existence of beingness or "non-being" as the refusal of beingness and the "*no*-thing," he states:

> *Difference antecedes both positive being and negative being [...] In other words, difference is not between opposed beings but in itself, autonomous from and antecedent to ever being or thing; difference is real, but precisely as a matter of non-being. Its reality is not the being of the thing, it is* no-*thing. (par. 13 et al.)*

In this way, we can apply non-being and Barber's definition of *no*-thing to the digitally incorporated Indigenous body. The Indigenous body acquires its own power or self-reclamation through difference and refusal. In this way, the Indigenous body refuses its colonial subjugation, or present-time beingness, by becoming or embodying the *no*-thing, as made possible through the interface, a deep digital lacuna between natural world and virtual or digital world. For the Indigenous body to enter a disembodied digital landscape is to perform a potential for survival and even contemporization. Hereafter, the Indigenous is not in recognition of Self (or beingness) within a geographical, political and colonial structure, the coherence here remains outside the body.

Thereafter, the refusal of colonization and codification gesticulates the Indigenous body to enter deep digitality terrain or *digital territory* and become or start to embody *digital flesh*. Both *digital territory* and *digital flesh* are made possible through machine learning and computation and enter a *deep digital territory*. This kind of embodiment of subjectivity or beingness perhaps is the non-being or the '*no*-thing' Barber (dis)assembles.

Of course, one must lean into the metaphor here and think radically about the Indigenous biologic and about digitality as immanent where machine learning facilitates what the Indigenous body becomes within *digital territory* as *digital flesh*, the multi-species, the liminal subject, the body that refuses colonization, negates beingness and welcomes contemporization and survival.

This is not a sim character or machinic extension of oneself. It disrupts subjectivity and mediates *beingness* outside the limits of general data collection. Outside of the flesh. It is unknown *digital territory*. And because it is unknown, it characterizes the uncharacteristic, the *non-being* or the '*no*-thing', an immanent adventure within the digital, one that looks back at colonialism and machine learning and enters the digital lacuna, making recovery and survival imaginable.

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Rebecca Uliasz

ASSEMBLAGES OF DESIRE: REAPPROPRIATING AFFECTIVE TECHNOLOGIES

Abstract

This paper considers the operations of affective technology within contemporary technocapitalism through affect theory. It is argued that affective technologies enter into power arrangements with political and corporate interests, altering an acting bodies' *affect* — in the Spinozan definition, the "capacity to affect and be affected" — within social and political life. Affective computation uses machine learning techniques to 'capture' and quantify affective intensities in data form, automating a normalizing logic of division and categorization that classifies bodies, emotions, and objects. Affective technologies invoke what Luciana Parisi called "automated decisionism," where machine learning processes digitize incomputable states in order to impose a self-rationalizing logic structure that regulates a user-subject's actions (Parisi, "Reprogramming Decisionism"). Affective technologies exert biopolitical control over users through quantified logics of division and devaluation. It is suggested that *affect* might simultaneously operate as an analytic lens to speculate on whether collective affectivity and political agency might be reclaimed through using these technologies. The following concludes with an engagement with Deleuze and Guattari's "assemblages of desire" to suggest that affective technologies might produce other micropolitical arrangements that increase user agency as social and political subjects.

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A tale of two plushies

In 2013, British supermarket chain Tesco contracted with an American tech startup company to install facial scanning cameras in 450 petrol stations. The motive for doing so: selling a toy penguin. 'Monty the Penguin' was both the title of a heartwarming advertisement for a John Lewis plush, and the Christmas gift fad of 2014, selling out stock only a few hours after the ad premiered. Back in the US, at the Sunny View Retirement Community in California, a white harp seal named Paro snuggles and coos at elderly patients with dementia. The robot seal has been designed specifically for the calming effect it has on its holders and goes for about 5,000 USD on eBay, although a number of lesser knock-off Paros can be spotted on department store websites. A seemingly arbitrary pair apart from their shared cuddly demeanor, Monty and Paro have a similar story of origin, although they went on to lead quite different lives. The development of both Monty's branding campaign and Paro's engineered persona are in fact, the resulting artifacts of the techniques of 'artificial emotional intelligence', also known as 'affective computation'. Affective computation is an umbrella term for an interdisciplinary set of sciences organized around the interpretation, codification and stimulation of human affects using machine learning techniques.

Figure 1: PARO the Seal. Credit: PARO Robots USA.

Affective technologies are increasingly ubiquitous to our everyday operations, social relations, and consumer habits. The 'age of artificial intelligence' forms a networked tangle of affective technologies that expand from the virtual realm of our social media feeds to the aura of ambient technologies that pepper each room in our homes. The goals of affective technologies vary — they might be sold as commodities that promise easier and more seamless user interaction, while simultaneously mining troves of user data that might be leveraged by corporate or state interests. Affective technologies may take the form of anthropomorphic robots, or cute fluffy Christmas presents. They also might operate subliminally behind the screen, in order to quantify knowledge about a user that might be used to sell them future Christmas presents, or perhaps even sold to other agents who might use this knowledge to justify sometimes violent means of regulation over certain bodies. But what kind of user information is extracted by these processes, exactly, and by whom? What do affective technologies purport to calculate?

This paper argues that affective technologies appropriate social relations in the service of capital. Through techniques of quantification, affective technologies extract data from user-subjects that is then leveraged for profit. It is argued that affective technologies participate in what Deleuze and Guattari call an "assemblage" — or arrangement of "bodies, actions and passions, an intermingling of bodies reacting to one another" that "are necessary for states of force and regimes of signs to intertwine their relations" (Deleuze and Guattari 71). Such assemblages, it is argued, are imbedded with power operators that — to quote Spinoza — alter a bodies' "capacity to affect and be affected" within political society. Within contemporary technocapitalism, affect — which is here defined by a biological, social, political or technical body's capacity for action — is made commodity through technical instrumentalization. Affective technologies provide a means for the biopolitical control of users — a term which is here considered synonymous with 'subjects' — by those who control privatized algorithms and massive databases, constraining users to certain possibilities of action through standardization. Is it possible, then, for affective technologies to be critically deployed, or must they be dismissed as irrevocably engrained with oppressive logics of division and devaluation of user-subjects? Framing affective technologies as participants in an assemblage permits a critical analysis of their deployment, a necessary lens in questioning whether such technologies might allow for other modes of subject expression with the toolset granted by technocapitalism.

Contemporary scholarship on affect emphasizes the analysis of everyday modes of being and feeling as a linkage between the 'micro-political' (how a certain body experiences a political context) and the 'macro-political' (how a certain political assemblage arranges bodies across society). Normative forms of being in society are given though what Deleuze, following Foucault, calls a "power arrangement" — a formation of institutional and State powers that constitute "the whole social field" (Deleuze 123). Power arrangements act across micro and macro political registers in what Deleuze and Guattari call "assemblages of desire" — relationships between social subjects, territories, technologies, and institutions — that are in constant flux and recomposition (125). Affective technologies are automated participants in a particular power arrangement that exerts control over users by constructing norms through statistical standardization. Technological normalization, Foucault explains, is an economic operation that produces knowledge effects in the name of optimization — 'truth' becomes equivalent to efficiency, which under capitalism means whatever is the most productive of capital (Foucault 19). Framing affective computation as a power operation suggests that it regulates operations and human relations in accordance with the interests of capital through the extraction, quantification and datafication of affective information. If affective computation aims to commoditize social relations, might framing them as power operators within an assemblage suggest what Brian Massumi calls a social "potential for re-relating with a difference" for the user-subject (Massumi 54)? Following Deleuze and Guattari, are there other aspects of this "assemblage of desire," new affective relations that fall outside of regulatory and predictive capacities exerted by the power assemblages performed through affective technologies?

An atlas of emotions

We know that face recognition technology is deployed across the globe in order to surveil, police and regulate algorithmically marked bodies, but we are beginning to realize artificially intelligent programs may be used to capture emotions — where 'emotion' is registered as the discrete cognitive states that effect human communication — as well. As of early 2019, Amazon, Apple, Facebook, Google, IMB, Microsoft and other powerful platform corporations are developing and rolling out new technologies that utilize what is known as "emotion AI," or "artificial emotion intelligence" (McStay 2). Other smaller scale tech startups offer clients customizable packages for data collection, including a variety of biometric sensors, cameras, microphones, and multi-modal software. An emotionally intelligent technology might make use of high detail cameras and other imaging sensors in order to measure certain muscle expressions, generating a representation of an emotion based on a model programmed into the device. Image and scanning techniques would 'capture' emotions based on microscopic movements of a human face, which are discretized and assumed to be universal for the sake of calculability.

Artificial emotional intelligence takes plural forms, some designed to imitate human empathy back to the user (harkening back to ELIZA, the original virtual Rogerian psychotherapist), while others are programmed to assess user's dominant emotional state and trigger certain prompts based on their calculations. We might find these technologies deployed by companies to monitor consumer response in order to assess user engagement and dynamically alter advertisement content, contributing to what has been elsewhere called the 'emotion economy'. [1] Emotional intelligence might tap into our consumer desires, subliminally determining the future choices and actions we will take. In this sense, artificially intelligent emotion technologies make a wager on our (yet) unlived desires, feeding off of the affective surplus of our data exhaust. The cybernetic ideal of systemic control extends itself into the virtual realm of the future through emotional artificial intelligence, where it steers our bodies through the inhuman logic of capital. The consumer within the emotion economy is subject to what Luciana Parisi calls an "alien reason" — or a computational form of automated reasoning that feeds off of contingency in order to produce new levels of determination — the machine not only knows, but brings our future actions into being (Parisi, "The Nanoengineering of Desire" 86).

More recently, there has been a rapid increase of tech companies engaging with the relatively new science of 'affective computing' — an engineering practice dealing with machines that 'have emotions'. Following the cybernetic dream of bringing together the mind and the machine, affective computation has intervened into the broader umbrella science of artificial intelligence by staking its claim — the human mind is always embodied, and humans have *emotions*, therefore, a more functional intelligence machine might have the ability to detect and respond to emotional states. Corporate descriptions of affective technologies often use verbiage that collapses the terms 'affect' and 'emotion', which affect theorists like Brian Massumi assert have important political distinctions. For Massumi, affect is a proto-political and pre-subjective 'charge' that is always in flux, whereas emotion is "the way the depth of that ongoing experience registers personally at a given moment" (Massumi 4). We might detect each other's emotions through cognitive and social cues, like the tone of a voice combined with the expression of a face, but a smile or grimace can't be assumed to imply the same information universally. While emotion is bound to the individual subject, the concept of affect allows emotion to have political implications because affect arises through encounters between a multiplicity of actors — it is necessarily linked to social relations. Emotions are, in a sense, reductions of affect, crystalized determinations of the "capacity to affect and be affected" that communicate something about an affective encounter. The digitization of affects, as it is automated by affective computation, erases the distinction between emotion and affect, constraining a users' capacity to act in accordance with their precodified affective states, intentionally removing any consideration of contextuality .

Affective technologies aim to digitize and programmatically engage with human affect. *Affect* is a force or intensity that — Melissa Gregg and Gregory Seigworth explain — arises in the relations of bodies, whether those bodies are human, non-human, machinic, or conceptual (Gregg and Seigworth 1). It is an "ever-gathering accretion of force relations" (2) that structures the conditions for a body's knowing and being in the world, through framing what is "*felt* to be real" (Massumi 54). Affect creates a "temporal contour" (Stern 62) that at once evades "received psychological categories" (Massumi 27) while also reorganizing the sensations and instincts felt in everyday life (Bertelson and Murphie 148). It performs what Erich Hörl calls the "technoloecologization of sense," where phenomenological experience is constrained by the affordances of the interface (Hörl 5). Affective technologies programmatically enact a range of computational techniques to enframe the norms of user experience, installing what Massumi calls a "politics of conformity" (57).

The scientific field of affective computation implements a number of techniques in order to standardize data and produce the norms around which it operates. The science was coined by MIT Media Lab director and scholar Rosalind Picard in a 1995 white paper of the same name. "Affective computing," or "computing that relates to, arises from, or influences emotions," makes use of Antonio Damasio's experimental neurobiological research to provide a framework for an "emerging criteria" of emotions in computers (Picard 1). It allies itself with Damasio's "somatic marker hypothesis," which proposes that emotions arise in the limbic system and are later cognized, implying that affect is pre-conscious and pre-subjective (2). Higher decision and learning processes require that an affect is recognized, generalized, and labeled so that it might be used to prompt decision, trigger action, and feed back into the homeostatic system of the cognitive agent. Picard's interest lies in applying this twofold physical-cognitive theory of affect to

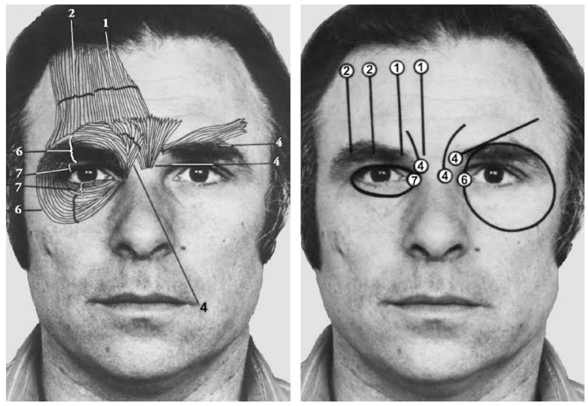

Figure 2: Paul Ekman's Facial Action Coding System chart from FACS manual.

computation — if a human limbic system is replaced by extra-human sensors, she asks, what types of affective communication might a computer enable through its own 'emergent criteria'?

Contrary to the opinion that computers should be completely 'rational' or logical machines, Picard proposes that an affective dimension within computation might lead computers to be better decision makers. Because, she claims, human cognitive intelligence is so bound to the material processes of the limbic system, a smart machine would be able to naturally recognize and express emotions in their interaction with a human through taking in environmental sensory information and responding appropriately. An affective machine might make use of high detail cameras and other imaging sensors in order to measure certain muscle expressions, generating a representation of an emotion based on a model programmed into the device.

Affective computation makes psychologist Paul Ekman's 'Facial Action Coding System' an executable program, creating a mapping of the human face that corresponds to a predetermined "atlas of emotions" (Picard 5). Eckman created the FACS between 1972-78 based on his research on what he called "micro expressions," claiming it to be the "first and only comprehensive tool for objectively measuring facial movement. Eckman proceeded to develop tools using the FACS for clients as broad as the TSA, FBI, CIA, health care providers, the Dalai Lama, and the makers of Pixar's *Inside Out*.[2] It was appropriated by the Picard to create a device that would learn and evolve over time to create a more fluid and 'natural' user experience. Analytics mined from social media platforms might be fitted to models derived from FACS that enable affective intelligence to infer the way a users' emotional disposition effects their browsing habits. Thus, an 'affect' is produced in an affective computer and constructed as a universal marker of an 'emotion' — an object of scientific truth, a sort of 'emojification' of a human feeling. The body of the user becomes collapsed into a one-dimensional data point. A smile, a click, a 'like', are all equivalent codified representations that can be amassed in a database, assessed for patterns, made into calculable models, and extrapolated to produce further information in accordance with the objectives of the programmer.

A 2015 *New York Times* feature on a spin-off company that came out of Picard's MIT Lab, called Affectiva, makes explicit connection between so-called emotionally intelligent machines and the "glimmer of an emotion economy." Affectiva, formed by Picard and partner Rana el Kaliouby, develops custom software for clients that provides facial and voice analysis in order to gather analytics that companies can use to understand consumer emotional engagement. This technology has been used by CBS, Millward Brown, AOL, IBM, and eBay among others in order to assess user engagement and dynamically alter advertisement content through technologies that perform what is called *sentiment analysis* (Khatchadourian). Several of Affectiva's client contracts have caught the interest of the public eye, raising concerns around the violation of privacy rights, such as in the case of the infamously proposed Verizon media console that would use microphones and sensors in order to constantly survey its ambient environment for emotional cues and adjust television ads accordingly.

Affective computers designed through Affectiva extend the human perceptive capacity of the user — where humans register each other's emotions through verbal and nonverbal communication, sensor technologies enable a direct codified registration of a pre-conscious affective state through the sensory capture of microscopic, unseen and unheard information —the machine knows what we are 'feeling' *better* than we do. The technologies employed by Affectiva explode out of the interface into the surrounding environment in order to form a digitally expanded nervous system, of which human users exist as the mere fleshy embodiment of the logics of capital. As a mixture of techniques for codifying affective states, affective computation enables the creation of new markets through the quantification of minute action, like the flicker of a smirk, or the clenching of the jaw. If affective computation appears to be an automated expansion of capital, a power arrangement that constrains the conditions for subjectivation — the possibilities for a social subject to realize its "capacities to affect and be affected" — is it a worthwhile exercise to speculate on whether such technologies might play a role in alternative liberatory regimes, explicitly outside of the domain of capital? Can affective technologies increase, rather than restrain and regulate, human social and political capacities? Perhaps this becomes more complex than a critique of *whom* is deploying the techniques of affective computation when it is claimed that standardization and normalization of social relations is a codified function of these technologies *in and of themselves.*

An ocean of affect

The development of affective technologies follows the cybernetic aspiration of bringing together the mind and the machine. 'Cybernetics', or the "the scientific study of control and communication in the animal and the machine," was terminologically derived from the Greek term for 'governor', 'helmsman', or 'steersman of a ship' (Weiner 11). In the heyday of the Macy Conferences, cybernetics obsessed over the idea of making a machine that would mimic the human mind, turning to psychological models of human intelligence provided by Freudian psychoanalysis. Part of the "dream of self-organizing systems and autopoietic intelligences produced from the minute actions of small, stupid, logic gates," as Orit Halpern calls the speculations of the Macy Conferences, was the question of *what actually drives these systems* (Halpern 143). The existential questions — what is human will, and why do humans act irrationally? — become technological questions of circuit design. How then might we build a machine that adjusts for contingency in order to regulate output in the name of efficiency?

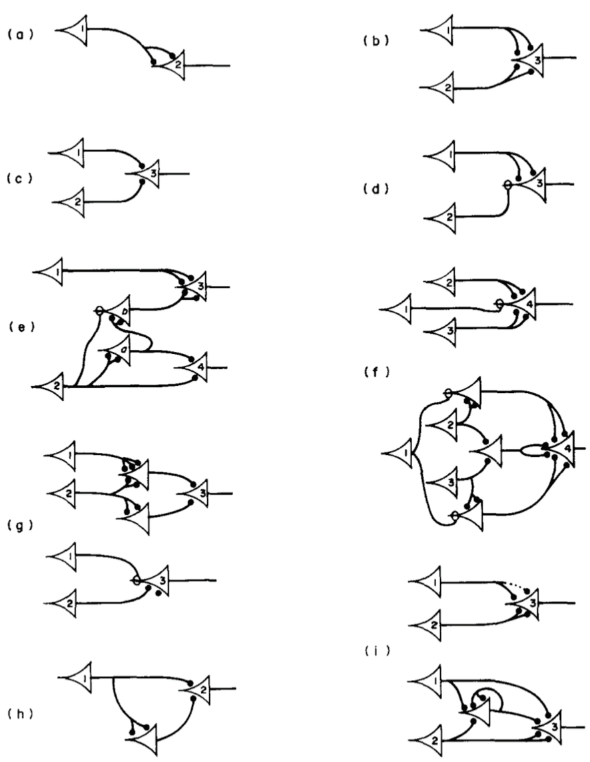

Figure 2: Logic gates modelled by McCulloch and Pitts "Logical Calculus for Neural Activity." Credit: McCulloch and Pitts.

Luciana Parisi traces this bio-informatic phase of capitalism, where cybernetic theories are modeled on the biological processes within a body (Parisi and Goodman 136). Norbert Weiner's model, based on the idea of *feedback* or "the property of being able to adjust future conduct by past performance," takes a body as a system (whether it be a machine or living organism) that may be controlled and regulated via its inputs and outputs (Parisi and Goodman 136). Bioinformatic capital subsumes a machinic assemblage through adjusting the inputs and outputs correspondingly, not though cutting off the affective flow of information, but by optimizing the assemblage to perform the most efficiently. Moving beyond the cybernetic regime of interaction control, "affective capitalism" creates a future feedback effect — it is "a parasite on the feelings, movements, and becomings of bodies, tapping into their virtuality by investing preemptively in futurity" — exemplified by the finance technologies that typify contemporary global capitalism (164). Contemporary technocapitalism feeds forward into the future, determining the "not yet come" forms of cultural representation though bidding on the actions of social subjects. Our branded and media saturated environment has learned to capitalize on the *affective* states of users, defining social user-subjectivation as a *consumer* rather than a *communal* experience.

In the age of affective computation, which computes human affect in order to produce evolving and complex affective data, the questions of the Macy Conferences fall short in addressing the social effects of ubiquitous affective technologies. If it is claimed that affective capitalism has subsumed all of social function, what chance could there be for other types of subjectivation processes that do not align with cybernetic paradigms of bio-informatic control? What would it mean to attempt to reinstall what Massumi calls a "politics of affect," or what Bridget Bargetz names "a political grammar of feelings", that emphasizes that shared affective dispositif *is* necessarily a project of politics? The final part of this essay will engage affective technology with contemporary theory on the politics of affect derived from the Spinozan definition of affect — the power to "affect and be affected" — in order to question whether affective technologies have potential to activate the capacities of a user-subject in modes that increase their political and social agency.

Massumi's "politics of affect" considers power and affect together insomuch as they affect desire, or the potential of an individual to become otherwise. For Deleuze and Guattari, desire is an affirmative and productive force that mutates and transforms matter, linking biological, technical, social and economic bodies in an energetic mechanic assemblage (Parisi 12). Desire is never given, but both realized through practice and affected by power relations. In other words, power arrangements delimit and reduce assemblages of desire within specific societal, political and historical regimes of representation and sensation. Affect, here, "acts in the nervous system not of persons but of worlds" (Berlant 14) to frame what Raymond Williams calls a "structure of feeling" or shared historical organization of culture and the elements contained within it (Williams 53). Affective technologies, when deployed by technocapitalism, claim to produce affective capacity, expanding the possibility of what a (user) body is and what it can do. In their actual deployment, affective technologies can be typified as part of a particular power arrangement, where rather than merely simulating or producing 'affect' they are regarded as normalizing operators on the conditions of possibility within a structure of feeling. In other words, affective technologies operate on the sensorium of everyday life in order to enforce normalized constraints on the actions and decisions of user-subjects. Affective technologies are not neutral, but rather, are prosthetic extensions of logics of division and devaluation of human life for the benefit of capital interests. With an emphasis that affective technologies come encoded with bias, we might begin to ask what kinds of knowledge they produce, and if they might be deployed to produce more equitable socio-technical relations. Is it possible to reclaim affective technologies towards other machinic vectors of subjectivation that do not simply service the 'emotion economy'?

A beneficial function of affective technologies can be found in their ability to strengthen human to human communication, facilitating new means for social relations. Consider the case of Paro the seal, where affective technologies are used to enable patients with dementia to more comfortably relate to their environment and their care providers. In a similar vein, Picard's original interest in developing the tools to provide better education to children with autism is based in the idea that these technologies might allow educators and autistic students to more clearly understand each other. In situations where affective technologies are deployed to intensify social relations, rather than alienate user-subjects through reducing them to statistically regulated consumers, it serves to induce a different type of "micropolitics" — what Guattari calls the partial techniques of power that produce beliefs, desires, and sense of self on a social level — that remain open-ended and productive of unexpected subjective capacities (Deleuze and Guattari 213). Invoking the notion of the 'assemblage', the complexity of all social relations for Deleuze and Guattari always contains potential for subjectivity to be remade *differently*. What new types of usership could exist if affective technologies were used to create more transparent interfaces between user and machine, or user and user?

Despite their possible use to increase connection, improve social communication, and empower users, it should not be forgotten that affective computation is part of a cybernetic legacy that is specifically designed to operate on the future through prediction and regulation. Recalling the story of Monty the Penguin, we might see artificial intelligence become quite good at knowing what gives us that 'heartwarming feeling', enabling client companies of these technologies to adjust their products and campaigns accordingly. In a much more sinister vein, security cameras might draw conclusions about the affective states of targeted subjects to jump to unjust predictions about their future actions and intentions. Imagine a world in which hidden facial scanners serve as evidence and justification of discriminatory policing practices, for example. Imagine that the technology exists to make this possible, and imagine that its implementation is a matter for political and ethical guidelines, or lack thereof. Just as affective technologies learn from the data they capture from embodied subjects, they also have the ability to shape and transform the emotional states of users in an affective feedback loop. Consider studies on the linkages between social media and dopamine levels — tech companies are master manipulators of our biochemical reward pathways, with enormous insight into the forms of interaction, layouts, colors and designs that will get us hooked on that feel-good rush of interaction (Haynes). Amplification of universal affective codes shape the way we encounter machines and humans alike, turning us into addicts or avoidants, leaving us wanting more, feeling depressed, or changing the way we come to recognize emotion within others and ourselves. Recognizing the ways in which emotional artificial intelligence as a technique of power is key in acknowledging the way that such technologies have the ability to automate the political agency of a user, and how they might activate this user otherwise.

Notes

[1] The term wascoined by Richard Yonck, frequent blogger for Affectiva, and self proclaimed futurist in a 2017 online article titled "Welcome To The Emotion Economy, Where AI Responds To — And Predicts — Your Feelings," which first appeared on the website of the major media branding agency Fast Company.

[2] Found in Paul Eckman's "Timeline of Achievements," on the Paul Eckman Group website.

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FEELING GENERATORS

Carman Ng

AFFECTING REALITY: INTERSECTING GAMES, TRAUMA, AND IMAGINARIES

Abstract

This essay examines how digital games shape human affective repertoires and envisioned dynamics with nonhuman agents such as robots. Entanglements among humans, machines, and technologies impact essential issues in the historical present: from surveillance, climate change, cultural heritage, art, to the elicitation, habituation, and capturing of feelings. Approaching digital games as frontiers of such entanglements, this essay expounds dynamics among gameplay, affects, and gamic materiality through a case analysis of *Nevermind* (Flying Mollusk), a trauma-themed independent psychological thriller game with affect-sensing technologies. Discussion explores how the game can generatively engage with lived experiences and discourses of grief and trauma; and the relationality among individuals, structures of feelings, and stigmatization. Anchoring the essay is an argument that digital games represent *and* operate with fundamental tenets of posthumanism, communicating meaning across affective and semiotic dimensions, bodies, machines, and sociocultural contexts. This essay emerged from an ongoing project on affective semiotics and social impact game design, in connection with a transnational research project on human-robot interaction supported by the European Research Council.

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Introduction

Pivotal to comprehending “structures of feeling” in Raymond Williams’ theorization is an intellectual openness toward exploring dynamic experiences, expressions, and social forms consistently in flux, in the present, and immune to claims of alleged finality. Structures of feeling concern interanimating dynamics between lived experiences and cultural expressions: how the latter shape and express emergent ways of being in the world; and develop understanding of the emergent nature of lived experiences. Digital games encapsulate such dynamics on both micro and macro scales: in the moment-to-moment process of gameplay; and the medium’s interactions within particular technocultural contexts and media ecologies, all pertinent to the materialization of artistic and design practices, transmedial relations, and surrounding, media-shaping, social discourses. Thus, it is productive to explore machine feeling through affective digital games, which detect and dynamically respond to players’ affective states.

Intersecting affects and emerging technologies, this essay emphasizes the shaping of *affective repertoire*. The concept, as I propose, explores spectra of human capacities to feel, express, and regulate feelings, informed and potentially *expanded, refined, or enframed* by technological facets of lived experiences. Affective repertoire stems from perceiving this malleable range of affects and associated reactions, which may then support individuals to consider and dehabituate certain responses for future affective encounters. Oriented toward posthumanism, this conceptual tool aims to untangle how technological designs prevalent in specific mediated encounters, environments, and sociohistorical contexts, incubate feelings and bodily intensities. Knowledge of such dynamics contributes to work on several fronts. Affect research in the past decade focused on distinguishing the phenomenon from emotions, problematizing the longstanding emphasis on individual intentionality, cognition, and categorical emotions. Recent accounts emphasize the social relationality of affects (von Scheve), cementing the focus on affectivity as processual, transpersonal, socioculturally constituted, and emergent across bodies, including technological systems.

Yet, it remains unclear how the affect-inspired focus on social interactions may constructively engage with trauma, which straddles individual and social realms. Recovering from trauma entails awareness of one’s emotions, triggering events, coping mechanisms, and available sources of support, healthcare, and intervention. Difficulties war veterans face in overcoming post-traumatic stress disorder (PTSD) illustrate tensions within such a matrix; challenges confronting marginalized social groups are likewise indivisible from such factors as race, gender, social classes and the cross-generation ramifications.[1] Trauma-themed digital games thus provide a gateway to critically engage with the often unspoken aspects of traumatic experiences, as well as systemic factors that enforce contemporary regimes of silence and stigmatization, by interweaving design, gameplay, narrative, technology, and complex affects.

On affects, the concept of repertoire is under-theorized. This may be due to the seeming incongruence in pairing affects and repertoire. The former has been characterized as precognitive and nonrepresentational; the latter, culminated from learning and curation, concerns competence, contexts of use, and components of identity, as in the example of linguistic repertoire.[2] Conceptualizing affective repertoire is an attempt to question the assumed incompatibility, inviting inquiries into agency. Proceeding from intention to actions capable in effecting change, agency is essentially constrained by social factors beyond individual control. That said, trauma does not necessarily eclipse agency, when one mindfully engages with feelings, thoughts, and aspects of any experiences that might be uncertain, destabilizing, or otherwise habituated. As Shaun Gallagher observes, the body crucially constitutes the mind, meaning, and communication. A critical orientation toward agency, embodied cognition, and trauma thus builds in parallel with affective repertoire and resilience. As efforts in articulating ontologies of affects and emotions expand, exploring bodily sensations as indexical of affects, emotions, and mobilization of behaviors in digital games brings complementarity. Identifying patterns among game design features and activated affects enable a rethink about the experimental role of digital games and their aesthetic, technological, and sociopolitical importance across alleged confines of the intellect and feelings.

This essay presents excerpted analyses from an ongoing research project on digital games and human-robot interaction (HRI), as illustrative of changing social realities and contemporary concerns. These range from porousness between real and virtual worlds to ethical quandaries regarding artificial intelligence. The driving premise is that digital games are *shifting* our affective capacities, eliciting various affectivities while informing our understanding of the posthuman condition. Readers first find a contextualizing overview of posthumanism, digital games, and current developments in affect-centered game analyses. The section outlines the need to articulate the meaning-making logic of digital games as prominent cultural forms and posthumanizing artifacts of procedural and multimodal complexities. Then, readers find analysis of an independent psychological thriller game *Nevermind*, in support of the argument that, with cogitative design and narrative, the medium can harness affective computing technologies for enhanced gameplay and potential intervention. Finally, the essay affirms a future-oriented perspective, positing a tripartite research methodology to engage digital games as incubators of aesthetic potential, complex affects, and visions of human-technology interaction.

Posthumanism | digital games | affect

Images of human-nonhuman relationships percolate the mediasphere. Their eclecticism manifests across cinema (e.g. *Blade Runner 2049, Ex Machina, The Matrix*), videogames (e.g. *Metal Gear Solid*, *Deus Ex*), television (e.g. *Westworld*, *Humans*), and experimental art that interfaces the body with prosthetics, networked systems, and biotechnology (e.g. Stelarc). Understanding the diversity of such visions, technological innovations, and cultural production carries importance, especially upon our understanding of the "nonhuman turn." Conceptualized in the 2015 eponymous book (Grusin, vii), the nonhuman turn involves intersections among human and nonhuman entities (e.g. bodies, technologies) in tackling issues of the 21st century, including terrorism and climate science. As intellectual inquiry, it decenters the unified human subject through the notion of the nonhuman, finding resonance in affect theory, animal studies, cognitive sciences, and new media theory, to name a few relevant fields of study.

Similarly re-assessing the symbiotic relationships among humans, technologies, and nature, posthumanism challenges social categories and dichotomies with technoscience, inviting philosophical discussion on how technology fundamentally constitutes the human condition (Haraway; Nayar; Hauskeller, Philbeck, and Carbonell 3). The archetype of cyborg, at once organic and mechanic, has inspired various schools of thought with the potential to steer human development on the scale of civilization. A telling example is the techno-utopian discourse of transhumanism, which embraces technological augmentation, human-machine singularity, and freedom afforded by "anthropo-technologies" (Kurzweil; Sloterdijk). Carrying a more complex outlook than the anti-humanism in transhumanism and the work of Haraway, posthuman humanity centers on creating sustainable human-nonhuman futures (Braidotti 55-104).

Discussions of posthumanism and digital games began from ideas such as narrative, representation, and player-avatar relations. The scope has since expanded to how unconventional game forms and automatic gameplay challenge notions of subject and object; all concerned with the daily entanglements of humans, technology, increasing automation, and environments (Fizek et al.). In this context, I propose approaching digital games as *posthumanizing encounters*. During play, meaning unfolds across technical materiality, bodies, real and virtual worlds (Keogh 14-17; Leino), exemplifying the distributed and emergent characteristics that define posthuman subjectivities (Hayles, *How We Became Posthuman*; "Reconfiguring the Posthuman"). From this baseline, it is feasible to consider games beyond representational and technological terms, exploring their influence on individuals (in subjectivities, feelings, and worldviews), societies (shifts in discourses and practices surrounding games), and how such knowledge informs ways of designing and critically engaging with new media. Digital games are among the fastest growing media with ubiquitous presence, economic viability, congruent progress with affective computing and such technologies as virtual reality (VR) interfaces, increasingly applied in non-entertainment contexts, including education (Gee, de Freitas & Maharg) and military training.[3] It matters to critically engage with the medium in design, gameplay, analyses, and pedagogy. Digital game criticism broadly involves three trajectories: formalist, which explores the aesthetics and form of games; social, which considers the medium in relation to cultures and histories; and integrated approaches, which combine practice and design (Jagoda 213-215). This extends into an expanding network of research areas, methods, and foci, including philosophy, digital humanities, media and cultural studies, platform studies, ethnography, psychology, and political economy. Established in 2001, game studies has observed the development of concepts and analytical frameworks on capacities of games to foster "critical play" (Flanagan 1-17) and function as, for instance, "allegorithm" (Galloway 83) and ethical systems (Sicart). Despite insufficient discussions of posthumanism and games beyond representation, the expanded approaches and concepts indicate a growing field of academic inquiry targeting a fuller understanding of games and their social influence.

A vital aspect to digital game play and research that is gaining traction is affect. In *Playing with Feelings*, Aubrey Anable argues that digital games construe a most significant art form of the 21st century, allowing players to rehearse specific affective states beneficial for contemporary life (e.g. how to relate to work and failure). Her approach highlights the cultural embeddedness and gendering of media artifacts, attending to game types and engagement often overshadowed by mainstream games, including indie games, art games, and casual games. In her argument, affect-mediating processes among players, devices, machines, and code — what is characterized as posthumanizing in this essay

— form a contemporary structure of feeling. It intersects with, for instance, diminishing work-play boundaries, where types of casual games can mitigate what contemporary work culture may lack (involvement, identifiable outcomes, pleasure); and yet commodify affect through in-game microtransactions, resembling capitalist labor. Whereas, games that foster frustration may guide players in understanding and handling failures.

Numerous inquiries examine such multi-level interactions among games, players, and changes in social systems. In support, I propose *posthumanizing affective semiotic operations* as an orientation to build methods and vocabulary that justly examine meaning-making in games. It may likewise complement research on machine feeling. Discourses on machine learning fuse with debates about artificial intelligence and robot ethics, foregrounding concerns like social effects of algorithmic biases (O'Neil), as well as expanded moral and legal responsibilities when autonomous machines factor into romantic relationships, healthcare, and warfare (Lin, Jenkins, and Abney). Against this backdrop, my work on games and HRI explore aspects of machine learning that are perhaps overlooked. In *Nevermind*, affective computing enhances dynamic qualities of gameplay and motivates player reflection of the narrative and their management of emotions. Ethical dimensions of machine learning, such as collection of actual interaction data for training mass-produced social robots, are explored in the collaborative HRI research phase. Lastly, combining corpora and annotation tools with automated analysis components forms a trend in empirical multimodal research, paving way for larger-scale studies of games. These three facets, from games as designed experiences, ethics of data collection and use for machine learning, to changing research methods, explore on different scales the rising influence of games and artificial intelligence. This knowledge, I suggest, invites human interlocutors to ponder ways to critically design, engage, and research emerging technologies.

Unravelling gamic materiality

Digital gameplay experiences are gestalts (combinations of parts) involving procedural, semiotic, and algorithmic elements. A mere dissection of these units does not capture how games mean and elicit feelings. Yet, this dissection is essential to developing a theoretical language to understand interactions among affects and meaning at play. For this purpose, procedural rhetoric and socio-semiotic multimodality present productive perspectives. Procedural rhetoric examines how computational media convey persuasive messages through mechanics and simulation (Bogost 5, 14, 28-29). Rooted in social semiotic theory that views culture as sets of inter-related semiotic systems (Halliday; Halliday and Hasan), multimodality has investigated how media artifacts, experiences, and interactions as sign-complexes communicate through multiple resources termed *modes* (e.g. visuals, language, sound, music, haptics); the usage of which is regularized by communities of sign users, sociocultural contexts, and therefore underlying political, economic, and ideological forces (Kress; Jewitt, Bezemer, and O'Halloran). Multimodal research has explored, for instance, film (Bateman and Schmidt), interactions (Norris), comics, experimental literature (Gibbons), art (O'Toole), mathematical discourse (O'Halloran), movement in space (McMurtrie), and digital platforms (Jewitt). That said, among studies approaching digital games as discourse (e.g. Aarseth;

Ensslin; Gee, *Unified Discourse Analysis*), multimodal research remains nascent. 2019 saw the publication of two books that examine games as persuasive and ludonarrative artifacts from a multimodal perspective (Hawreliak; Toh); and the first collection on videogame discourse and linguistics (Ensslin and Balteiro) appeared in May 2019. Weimin Toh presents a four-level ludonarrative model that, pursuing a similar trajectory as my earlier work to map out meaning-making units and dynamics in games, identifies connections between, for example, gameplay and narrative as "modules": interacting communicative systems realized by various modes and "elements," such as game rules and mechanics (34-47). Jason Hawreliak proposes conceiving procedurality itself as a semiotic mode to highlight how games communicate through processes, not solely representation (80-94). While this attempt of reframe reinforces complementarity between game studies and multimodality, it injects unwarranted ambiguity into core concepts (e.g. mode and affordance) and calls for empirical analyses, to prevent collapsing fundamental strata in theorizing multimodal meaning-making.[4]

My interest to integrate multimodality with digital game criticism lies in its empirical support to systematically tease out the intersemiotic relations and interplay of elements in digital games as affective processes. Stressing meaning-making as sociohistorically-situated media practices, an empirical multimodal approach offers three main insights. They are the re-construal of the notion of media, centrality of discourse semantics, and the analytical concept of "canvases" (Bateman, Wildfeuer & Hippala). Firstly, their theorization re-considers media as historically stabilized sites that use selected semiotic modes according to communicative purposes. This emphasizes the need for interdisciplinary import into examining the foundational meaning-making mechanisms, while clarifying common interpretive ambiguity (e.g. "medium" as intermediary in communication versus "(mass) media" as understood from an institutional lens, 103). Secondly, discourse semantics contextualizes and outlines the range of sensible interpretive possibilities for particular multimodal combinations (116-121). Thirdly, "canvas" introduces an analytical perspective and tool to delineate intersections between the subject and means of communication. It refers to any bearers of perceivable and interpretable material regularities, be they analog, digital, unfolded physically in time, and resulted from technological processes (86-88).[5] This focus on communicative form and intent connects with prior discussions of the "transmission" and "semiotic" components of media (Ryan 1-40); and enables an informed fixing of analytic focus, by systematically "slicing" each communicative situation into various canvases and sub-canvases.[6]

Dependent on genre, mode of gameplay, and context, game analyses involve a range of canvases and analytical units (e.g. narrative, events, and mechanics). The gameplay interface and player enactment possibilities form my material, analytical foci; and on the social dimension, connected phenomena and civic discourses, for instance, how digital games are embedded in and may problematize the military-entertainment complex. To make data analyzable, transcription is a necessary first step. It involves transcoding complex data into an inspectable, manipulable form, commonly as tabulation intersecting analytical units in rows and the information conveyed in columns (Baldry and Thibault), such as shot analyses in film studies.

Figure 1 shows how, previously, I used analytical software to annotate and visualize findings from digital gameplay data, in an attempt to identify the immersion-shaping

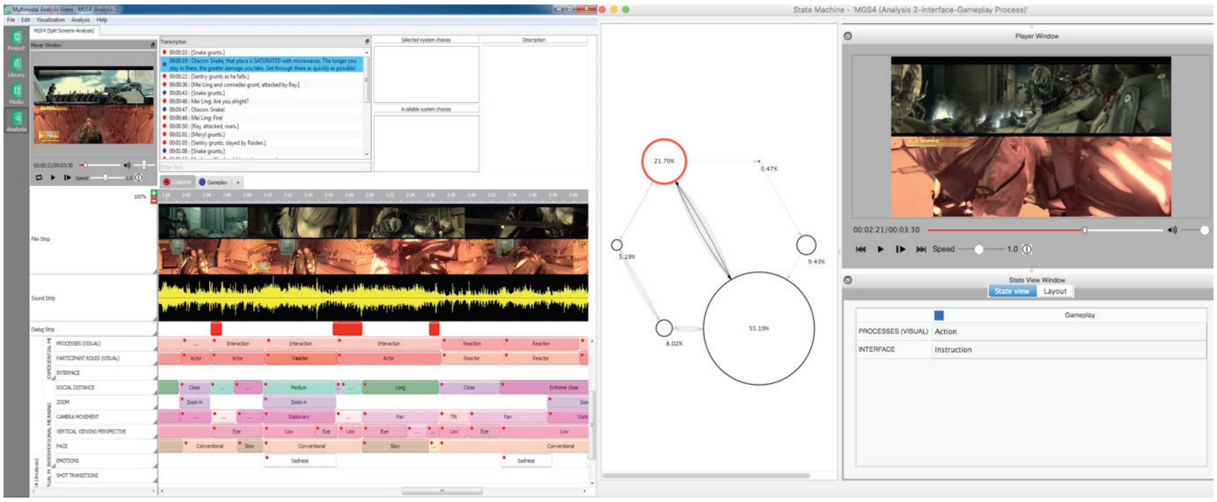

Figure 1: Example of multimodal annotation of digital game with analytical software "Multimodal Analysis Video" (Ng 20-22).

effects co-realized by gameplay mechanics and audiovisual aesthetics. Such fine-grained and structured analyses aim to consolidate empirical research of complex multimodal phenomena. In addition to a range of relatively well-recognized software, such as ELAN, ATLAS.ti, and NVivo, computational approaches to multimodality have begun to incorporate machine learning and deep learning.[7] It is foreseeable that algorithms and automatic processing may support human annotation and thus empirical research of data across levels of multimodal complexity, scale, and methods.

Playing with trauma

One advancement in digital game design is the application of affect-sensing technologies that comprehend and respond to players' emotions. To explore the multilateral meaning-making processes in digital games, I turn to *Nevermind*, a game designed with application potential in public health contexts, such as therapy, with clinical trials in planning (Flying Mollusk, "Therapeutic Applications").[8] The independent thriller game integrates biofeedback technology with gameplay, centered on psychological trauma in content and puzzle-solving in form. *Nevermind* engages with three significant strands that have emerged from the development trajectory and discourses of affective technologies. Firstly, it highlights a changing focus initiated by affective computing, since conceived by Rosalind Picard in 1997, namely, a re-frame of emotions from static, universal human faculties to dynamic processes that unfold moment to moment in gameplay. Secondly, it evidences a contemporary pursuit for immersion-based innovations, such as VR experiences. These strands in turn dialogue with possibilities and (ethical) questions regarding serious applications of games, machine learning, as well as connections among bodies, feelings, and technologies. My focus is on how digital games afford opportunities to engage the often silenced and stigmatized aspects of trauma, in both discourse and lived experiences.

Memory is at the core of *Nevermind*. Narratively motivated by the recovery and organization of traumatic memories, the gameplay involves exploring the psyche of psychological trauma patients, puzzle-solving, discovering, and sorting memory photographs into a coherent account of a traumatic event. Patients' subconsciousness are often portrayed aesthetically as twisted, disturbing, and surreal (fig. 2). Five playable cases have been released, tackling topics from child abuse, post-traumatic stress disorder (PTSD), to LGBTQ identity. Gameplay lasts on average four hours and includes six narrative stages: *orientation, development, disequilibrium, crisis, climax, and denouement*.[9] Here, I zone in on the initiating case Client #251 to discuss: (a) how meaning unfolds across mechanics, plot, and multimodal combinations during gameplay; and (b) intersections between digital games and therapeutic interventions, leading into the final discussion on investigating relations between affective experiences and procedural-semiotic patterns in gameplay.

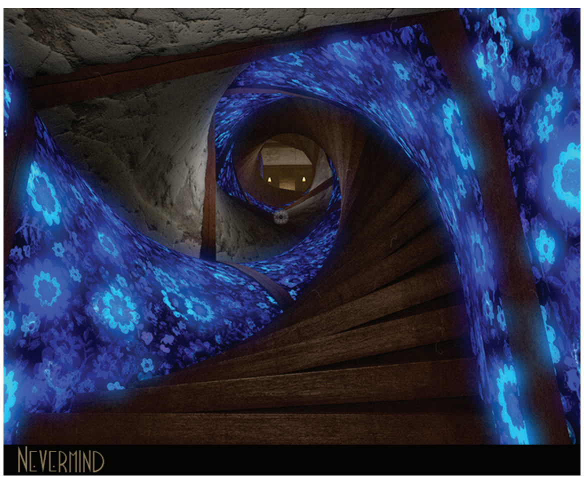

Figure 2: The subconscious landscape of Client #251. © Flying Mollusk.

Experiencing *Nevermind* involves the automated perception of the machine. The 2016 VR edition uses biofeedback technology to detect players' physiological and emotional states, eye movement, and modulates gameplay difficulty accordingly. Physiological biofeedback tracks changes in, for instance, heart rate and pulse as indicators of stress, anxiety, fear, and psychological arousal. Emotional biofeedback concerns detecting players' facial expressions.[10] As the game world and gameplay difficulty adapt to the player's states of stress (fig. 3), *Nevermind* amplifies how digital games constitute posthuman subjectivities. On the one hand, it complicates the layering of human affects and machinic cognition in micro-gameplay moments. This opens up a common notion of gameplay as input-output feedback loop, to consider ways that the medium organizes affectivity by dynamically intersecting player action, design, and levels of algorithm-based thinking (e.g. inferring player emotion by contrasting facial expression data). On the other hand, it gestures toward increased attention to games as serious applications to address current issues (e.g. psychological wellbeing and healthcare).

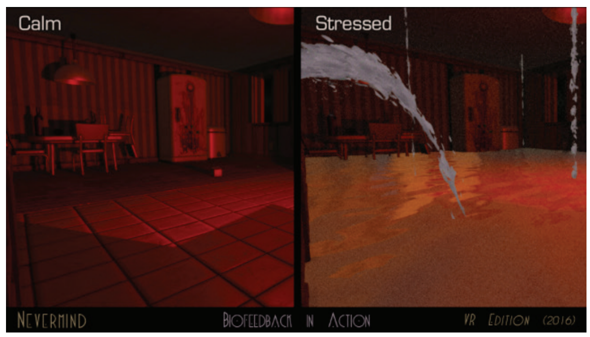

Figure 3: Biofeedback technology in Nevermind. © Flying Mollusk.

Client #251 explores suicide and the witnessing of traumatic events. Analyses identify three connecting motifs. The first motif concerns financial and marriage difficulties between the female client's parents; secondly, the patient's witnessing of a traumatic event and resulted guilt and self-blame; and thirdly, her father's suicide. I refer to these three motifs as M, W, and G respectively. From the opening cutscene, players learn that the patient was informed by her mother since childhood that her father had died in a car accident. However, gameplay and the de-briefing cutscene (i.e. pre-rendered cinematic sequence) reveal that her father shot himself in her presence.

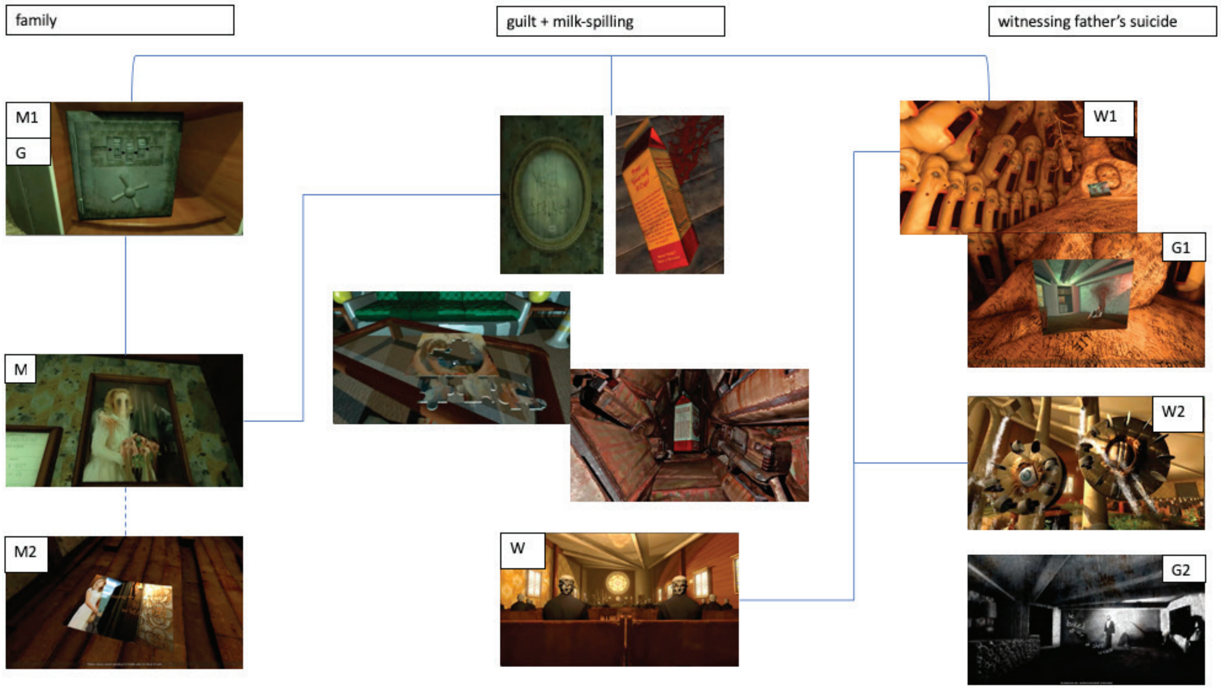

Figure 4. Cohesive connections in *Nevermind*: Client #251 (excerpt).

To understand how meaning traverses gameplay mechanics, narrative motifs, and audiovisual representations, a useful means is to map out their cohesive connections (fig. 4).[11] Situated in the middle is the gameplay-grounding emotion and triggering event: the patient's guilt and having spilt milk as a child. These horizontally connect to the significant narrative motifs identified (M, W, G). Vertically, as gameplay progresses, individual motifs accrue significance by referentiality, recursive representations, gameplay mechanics, and contradictory information. Such representations may take the form of player-maneuverable and contextual objects, diegetic sounds, and sound effects that constitute the game world.[12] For example, a sound of gunshot coupled with fade-out for a gameplay segment at the parents' bedroom (00:06:15) multimodally signals a transition from *orientation* to *development*; simultaneously suggesting gun violence in the death of the patient's father.[13]

The case first connects the motifs of parental issues, milk-spilling, and guilt. In *development*, players find clues to the parents' failing marriage. Washed-out marriage and family photos (M) and a safe-unlocking puzzle (combination: milk, gun, and sorrow) (M1) imply tenuous family dynamics and violence, in contrast with a subsequent memory photo that presents a false, idealized marriage (M2, marked with a dashed line). The patient's guilt from milk-spilling is likewise introduced, first as an accusatory message "You Spilled," written in red, shaky, handwriting-resembling font on the mirror, that cues the correct safe combination. The motif then recurs as milk cartons (printed with guilt-centered texts and nutritional labels) and a memory photo, at *development* (beginning at 00:09:13 and 00:19:17) and *disequilibrium* (00:13:35) respectively. Such recurrence forms a discourse semantics that cues players the sensible interpretations and co-occurs with a build-up of affects and emotions. While the spilling of milk denotes a micro-level, aggravating incident in the patient's childhood, it connotes an overarching sensitivity of guilt, self-blame, and anger.

Gameplay mechanics gradually recontextualize this guilt-grounded sensitivity, by uncovering the symbolic dimension of a seemingly mundane yet narratively motivated mechanic tied to the motif of witnessing: teacups arranging. First appeared as contextual objects in *orientation*, teacups take on increased puzzle-solving potentials in *development* and *denouement.* To retrieve the final memory photo, the player places teacups to guide water into a burial ground (W2). Eyes on the three water mills peel open, decreasing the violence and fear formerly associated with seeing/witnessing, respectively portrayed as aggressive funeral attendees and female faces with tears and cavernous mouths who visually follow player movements (W and W1). It connotes waking up to the truth, visualized in the graphic memory photo (G1) and the monochromatic visual of suicide in the de-briefing cutscene (G2).

Collectively, the motifs of Client #251, along with the audiovisual aesthetics, gameplay mechanics, and space, create an atmosphere that oscillates among suspense, surrealism, turmoil, and calm. From the choice of landscape, gameplay mechanics (e.g. jigsaw puzzles and teacup arrangement), to various surreal representations, they orient to particular aspects and stages of the narrative, which then structure the gameplay experience. Similarly, shifts in gameplay environment modulate the rhythm and narrative levels in gameplay. As Michael Nitsche illustrates, game spaces evoke narratives by inviting player perception, interaction, and interpretation. The patient's subconscious landscape is comprised of private, public, and fantastical spaces, from idyllic gardens, site of traffic accident, to bizarre and distressing locations not conforming to real-world logics. Analyses observe a concomitant complication in spaces and gameplay mechanics across the narrative stages, creating a prosody in both content and affects (e.g. calm, anxiety, disturbance, and shock). Puzzle-solving concentrates in *development* as scaffolds to access the patient's buried memories; *disequilibrium, crisis,* and *climax* then focus on navigating mazy spaces, often coupled with disturbing audiovisual aesthetics. In presenting a funeral service in the patient's childhood home, *denouement* forms a poignant stage intersecting the motifs of memory, inner and outer life (the emotional tension of which is described in the pre-gameplay cutscene), witnessing, and potential closure, with the recurrent puzzle-solving mechanic of teacup arrangement.

This initial analysis suggests a reflective quality between the gameplay mechanics of *Nevermind* and practices relevant to mood management, trauma processing, and psychotherapy. In particular, the gameplay processes of navigating the clients' subconscious, collecting, and organizing memory photos share a similar focus with therapeutic practices, in building awareness of and vocabulary to process emotions. As expanding research literature postulates, digital games, such as the apocalyptic *The Walking Dead* (Telltale), invite critical dialogues between game studies and trauma studies to explore trauma in games via "interreactivity," empathy, and complicity (Smethurst & Craps; Smethurst). Videogame series such as the Japanese, stealth-based *Metal Gear Solid* (Kojima) and *Max Payne* (Remedy Entertainment/Rockstar Games) illustrate six prevalent motifs of PTSD, including trauma-identity relations (Bumbalough and Henze 15-33).[14] Nonetheless, the focus of these studies remains on representation. A major value in examining *Nevermind*, I contend, lies in how the game design narratively and procedurally aligns with specific principles and techniques in trauma therapy and resilience-building. These include acknowledging events, mindfulness, affect regulation, and approaching resilience as continuum (Southwick et al), aligning with my proposed concept affective repertoire. In addition to highlighting the expanding applicational scope of digital games, *Nevermind* gestures toward a convergence of social phenomena and discourses pertinent to the technological capture and structuring of feelings. It embodies four *co-emerging* entities or dimensions: the medium of digital games; the developing technology of machine learning; fluctuating affects; and shifting regimes on trauma and mental health, toward increasing de-stigmatization. The fact that digital games themselves are emerging technologies, in my view, renders them specifically suitable to engage visions of human-technology interaction, new sociocultural norms, and practices as a result of machine learning.

Future directions

The digital present is affective, unfolding, and propelled by human-nonhuman relationships. In this essay, I have explored digital games as posthumanizing encounters integral to such an emergence. Through a case study of *Nevermind*, the essay intersects game studies and multimodality to examine a key phenomenon in this cultural moment: affective digital games. Analysis illustrates how cohering narrative motifs, gameplay mechanics, audiovisual aesthetics, and affect-sensing technologies enables a form of metaphoric play akin to stages of processing trauma. Hence, one aim of the essay has been to further understanding of digital games as complex systems involving affects, multimodal semiotics, proceduralism, and contexts; with the potential to strengthen one's affective repertoire for engaging with complex affects and contemporary challenges.

In the current mediasphere, two trajectories seem to be forming. On expression, mutual influences among designs of digital games, interfaces, and virtual/augmented reality technologies (e.g. Meta AR headsets) signal intersections among media and visions of future human-technology interactions and experiences. On content, representations of human-nonhuman dynamics in mainstream games have expanded, suggesting a shift from war-focused posthumanism (e.g. *MGS* games) to include portrayals of human-robot

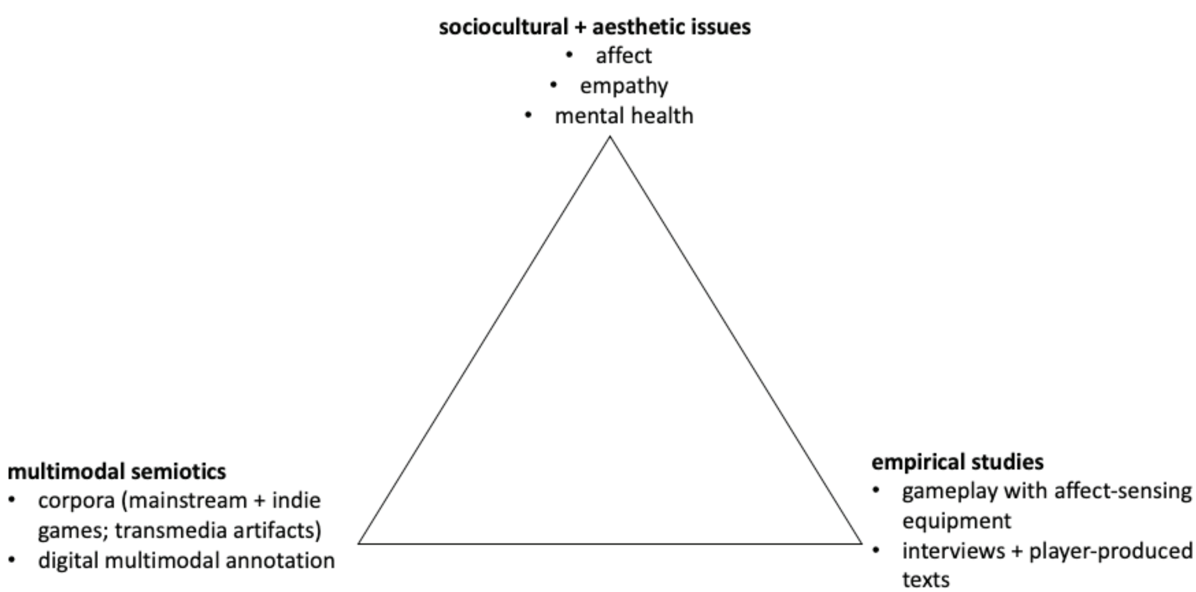

Figure 5: Research methodology.

affective bonds and conflicts (e.g. *Detroit: Become Human*). Such robotic imaginaries form the research focus connecting my work and the collaborative ERC-supported project on HRI and emerging technologies entitled *Emotional Machines: The Technological Transformations of Intimacy in Japan* (EMTECH, 2017-2022). Our inquiries aim to articulate dialectics between imaginaries and realizations of human-robot relationships, specifically processes and effects of forming affective bonds with robots, digital devices, and networked technologies.

Digital games evidence a multidimensional emergence: in media, affects, human-technology interaction, social discourses, and research methodologies. Always fluctuating, affects are nonconscious bodily intensities that underlie thought, behaviors, and yet elude human observation (Massumi; Stewart). They manifest physiologically (e.g. micro facial expressions, pulse, skin conductance) and as a central constituent to meaning-making and behavior, they are yet amply examined from a multimodal lens. Thus, I propose to integrate affect theory, corpus-based multimodal game analyses, with players' biophysical and interview data to empirically expand knowledge on the medium, toward game designs that foster empathy and mental health (fig. 5). The triangulated data is expected to complement ethnographic findings from EMTECH on interactions with digital technologies and robots in homes and public spaces. As importantly, this addresses a methodological need to incorporate discourse analyses for a textured, discursive, view of affects as embodied practices entangled with contexts and social relations (Wetherell). Such data triangulation may also support future research on affective repertoire. Through episodic engagement with affective digital games, researchers and participants may evaluate if, or how, digital gameplay modulates ways of encountering difficult feelings and issues. For design and technology-focused research, examining (dis)connections among meaning-making units in games, intended affective response, as well as the operative and reactive accuracy of affective computing software may contribute to developing affective artificial intelligence in digital games and media.

The still emerging phenomenon and cultural narratives of affective interactions with robots and digital technologies carry ramifications across automation, social intimacies, and war. Confronting the complexities involved demand an engagement with diverse sociopolitical issues, robust research, and designs that explore beyond user-friendly, technological solutions. In the continuing conversations on (post)human-nonhuman developments, critical play and research will inform our participation with perspective, intention, accountability, and openness to engage the associated, diverse, and potentially difficult feelings.

Notes

[1] A developing and debated field called epigenetics explores how changes in environment, effects of stress and trauma could change the expression of genes, with transgenerational effects. Approaching the nature/nurture link, studies are exploring what epigenetic mechanisms (e.g. changes in RNA molecules and DNA methylation) might signal the "inheritance" of trauma, if any. For popular versions debating the plausibility of trauma- transmission, see Henriques, Martha. 26 March 2019, "Can the Legacy of Trauma be Passed Down the Generations?" *BBC Future*, http://www.bbc.com/future/story/20190326-what-is- epigenetics; and Carey, Benedict. 10 December 2018, "Can We Really Inherit Trauma?" *The New York Times*, https://www.nytimes.com/2018/12/10/health/mind-epigenetics-genes.html.

Also, readers can find an overview of epigenetics research and post-traumatic stress disorder in Zannas, Anthony S.; Provençal, Nadine; and Binder, Elisabeth B. "Epigenetics of Posttraumatic Stress Disorder: Current Evidence, Challenges, and Future Directions." *Biological Psychiatry*, 78 (5), 2014, pp. 327-335, https://doi.org/10.1016/j.biopsych.2015.04.003. Rachel Yehuda and scholars conducted a small-scale study of offspring of Holocaust survivors, which is allegedly the first demonstration of epigenetic change caused by preconception parental trauma. The study received much scrutiny, including criticisms of its conclusions, suggesting that further research is necessary. See Yehuda, Rachel et al. "Holocaust Exposure Induced Intergenerational Effects on FKBP5 Methylation." *Biological Psychiatry*, 80(5), 2016, pp. 372- 380, https://doi.org/10.1016/j.biopsych.2015.08.005.

[2] Emotional regime, a concept in the history of emotions literature proposed by historian William Reddy, concerns dominant forms of emotional expression and thought in specific periods and cultural contexts (124-129). The notion is under-explored in both studies of emotion and affect. See Reddy, William M. *The Navigation of Feeling: A Framework for the History of Emotions*. Cambridge University Press, 2001. Repertoire, as a linguistic phenomenon, refers to flexible and dynamic use of language oriented toward social action and contexts. Margaret Wetherell's approach toward affective practice and description of repertoires (135, 138) would prove helpful. See Wetherell, Margaret. *Affect and Emotion: A New Social Science Understanding*. Sage, 2012. For information on conducting discourse analysis via the approaches of critical discourse analysis and discursive psychology, see Phillips, L. and Jørgensen, M. W. *Discourse Analysis as Theory and Method*. Sage, 2004.

[3] The Entertainment Software Association reported in 2018 that the digital game industry contribute a $36 billion consumer spend in the United States (2017) and a GDP of above $11.7 billion. Sources on the military-entertainment complex, or "militainment," include Stahl, Roger. *Militainment, Inc.: War, Media, and Popular Culture*. New York: Routledge, 2010; and Der Derian, James. *Virtuous War: Mapping the Military-Industrial-Media- Entertainment Network*. Routledge, 2009.

[4] The general orientation to semiotic mode adopted by Jason Hawreliak differs from that pursued in multimodality, specifically the empirically-driven approaches increasingly strengthened in state-of-the-art multimodal research. The latter, pursued by such scholars as John Bateman, Janina Wildfeuer, and

I, argues for more discriminating accounts of semiotic modes, emphasizing the role of discourse semantics and resistance of assumed alignment between semiotic and sensory modalities. Detailed theorization of semiotic modes can be found in Bateman, John A., "The Decomposability of Semiotic Modes." *Multimodal Studies: Exploring Issues and Domains*, edited by Kay L O'Halloran and Bradley A. Smith. Routledge, 2011, pp. 17-38.

[5] For example, a classroom communication scenario may be segmented into eight canvases, from interaction between the teacher and blackboard, pupils' use of books, to pupil-to-pupil interactions.

[6] For an overview of conducting multimodal research and the identification of multimodal slices, see Bateman, Wildfeuer, and Hippala, Ch. 7, § 7.1.1 "Media and their canvases" and §7.1.2 "From canvases to analyses."

[7] In a recent, politically significant study, researchers combine multimodal analysis with natural language processing, computer vision, and machine learning to examine the spread and re-interpretation of ISIS propaganda and images via digital networks. See Tan, Sabine; O'Halloran, Kay L.; Wignell, Peter; Chai, Kevin; and Lange, Rebecca. "A Multimodal Mixed Methods Approach for Examining Recontextualisation Patterns of Violent Extremist Images in Online Media." *Discourse, Context & Media*, 21 (March 2018), pp. 18-35, https://doi.org/10.1016/j.dcm.2017.11.004.

[8] *Nevermind* originates from a 2012 graduate research project at the Interactive Media Program at the University of Southern California.

[9] The average time of gameplay is informed by the website "HowLongToBeat": howlongtobeat.com/game.php?id=29412.

[10] *Nevermind* uses Affectiva Affdex technology to detect and measure viewers' facial expressions. The cloud-based solution can identify 7 emotions and 20 facial expressions, based on a database of 40,000 advertisements and 7.7 million faces analyzed. For details, see www.affectiva.com/product/affdex-for-market-research/.

[11] For details on building cohesion chains for audiovisual media, such as film, from the perspective of functional and systemic linguistics, see Tseng, Chiao-I, Cohesion in *Film: Tracking Film Elements*, Palgrave Macmillan, 2013. This analytical form has likewise been applied to comics and graphic novels. In this essay, I select a visual-based format of communication to ensure clarity and accessibility for a broader readership.

[12] For details on categorization of gameplay objects and its application in conducting gameplay analyses, see Ng, *War and Will*, chapters 3 and 4.

[13] Timestamps of gameplay are informed by the author's gameplay experience and approximate average extracted from playthroughs streamed on such websites as YouTube.

[14] The six themes common to the portrayal of PTSD in popular videogames identified include: how characters build trauma into their identity; PTSD interference with personal relationships; representations of trauma through nightmares; self-medication as coping mechanism; personification of PTSD through villains; and how trauma catalyzes digital gunplay.

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Malthe Stavning Erslev

I FORCED A BOT TO READ OVER 1,000 PAPERS FROM OPEN ACCESS JOURNALS AND THEN ASKED IT TO WRITE A PAPER OF ITS OWN. HERE IS THE RESULT. OR, A QUASI-MATERIALIST APPROACH TO BOT-MIMICRY

Abstract

The article develops an approach for close reading of auto-generative writing agents (i.e. bots). It introduces the concept of *bot-mimicry* (a practice of writing in a bot-esque style), and argues that bot-mimicry inherently entails that reader and writer alike imagine a conceptual (fictional) bot which *could have* written the text. As such, it investigates the concept as a fruitful way of engaging with cultural, aesthetic and political conceptions and imaginaries surrounding bots. Furthermore, and through an example reading of the "Olive Garden tweet", the paper develops, introduces and applies a *quasi-materialist* approach, where seemingly immaterial elements such as implicit conceptual bots are considered through a framework inspired by materialist media theory from the fields of software studies, media archaeology, and electronic literature.

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Bot or not?

> *my ukulele is not a baby / please do not reply to this maybe / we did not find it on the internet / the ukulele*

Consider the poem above: was it written by a human or by an auto-generative writing agent (a bot)? Chances are you will guess 'bot' — at least according to the statistics of the website *bot or not*, an online Turing test for poetry (cf. Laird and Schwartz; 67% guess 'bot'). In fact, it was written by a human, Aaron Koh. There is apparently a somewhat shared feeling that it reads as an auto-generated text — maybe it has to do with the choice of words, the apparent lack of semantic content, the not-quite-right rhythm of the verses. In any case, this poem, *ukulele*, mimics the style of a bot; it is an example of what I will here call *bot-mimicry*: a practice of writing in a bot-esque style. The *bot or not* website contains numerous examples of the blurred line between human-written and bot-generated poetry. This blurred line evidences that a complete distinction between human-written and bot-generated text is difficult if not impossible to uphold in practice. It is not controversial to claim that no written text is the product of pure human creativity, but always already entails 'technical' aspects, including plagiarism, remix, reference to fixed grammars, usage of predefined structures, etc. (Goldsmith). Likewise, there is always at least some human involvement in any bot-generated text, if not in editing/curating the results, then in building and selecting data-sets, and not least in programming the generative software (this holds true even for so-called 'unsupervised' systems).

Still, we may be inclined to maintain an, albeit troubled, difference between texts primarily written by humans and those primarily generated by bots. Indeed, in a time partly defined by continually more advanced text-generation systems, it is increasingly viewed as a democratic concern to do so (Laquintano and Vee; Ferrara et al.). Accordingly, the developers of one of the latest and most advanced text-generation systems, *GPT-2*, highlight its policy implications precisely because of such democratic concerns (Radford et al.). Importantly, the point here is not to scapegoat the bots for our democratic issues, but to recognize that changes in the online textual landscape calls for the development of more nuanced, fine-tuned, and critical reading skills, specifically to navigate an auto-generative situation. One important aspect of contemporary text-generation is a multitude of tech-narratives, reinforcing cultural conceptions of text-generation technologies.

The point of this paper is to develop an approach to investigating and critiquing such cultural conceptions as expressed in narratives. The paper takes as its point of departure a poem which was not written by a bot, but which reads as though it was. At one level, it may seem that the poem *ukulele* is simply a remediation of well-known ways of troubling the idea of human creativity by referencing machinic processes, such as those famously practiced by avant-garde movements including *dada* and *OuLiPo*. While this may in part be true, I nonetheless argue that there is something more at play when humans write texts that are supposed to be read as bot-generated texts without consciously involving any formal logical system. This writing (i.e. bot-mimicry) is necessarily based on cultural conceptions of text-generation technology in general, which are then written into the texts in question. In other words, reading bot-mimicry-texts allows us to study shared conceptions concerning bots precisely because they are not actually written by bots: the writer and reader alike are required to (often implicitly) imagine a conceptual bot which could have written the text in question.

A quasi-materialist approach

The theoretical grounding of the paper is primarily based on materialist approaches, specifically the field of software studies (Fuller; Cox, McLean, Ward) along with related perspectives situated in media archaeology (Wardrip-Fruin), electronic literature (Cayley), and interface criticism (Andersen and Pold). Seeing that bot-mimicry concerns non-existent, and as such immaterial, bots (as will be elaborated, I read such bots as fictive), it may seem counter-intuitive to apply a materialist approach. Though the actual text which hints at the bot could be studied materially, the imagined bot itself may, at first, seem less appropriate for such inquiry. Nonetheless, I argue that such an approach is not only possible, it is necessary: we need to study the imagined bots present in a multitude of cultural contexts with the same rigor as the actual bots which the imagined ones mimic. To this end, I aim to develop what I call a *quasi-materialist* [1] approach: a framework for applying rigorous materialist theory to imagined (fictive) entities, in this case bot-mimicry. The paper takes on a specific case, and the quasi-materialist approach will be developed in dialectical relation to the case, where various exemplar frameworks from different fields are brought into consideration, while continually referring back to the case as the grounding for the approach.

Figure 1: @KeatonPatti's Olive Garden tweet (Patti).

The case of the Olive Garden tweet

Since early 2018, Twitter user @KeatonPatti has popularized a style of tweet in which he claims to have 'forced' a bot to watch over 1,000 hours or episodes of (often pop cultural) video content and then 'asked' it to auto-generate new, similar, content. Though @KeatonPatti is not the only one writing in this style (the style is now recognized as a meme by *KnowYourMeme*; Caldwell), this paper focuses on a specific tweet by @ KeatonPatti, posted on June 13th 2018, which parodies commercials for the Italian-themed restaurant chain Olive Garden (see illustrations 1-3). This specific tweet is chosen because it is the (to date) most viral tweet in this style; it has at the time of writing gained ~326.000 likes and ~120.000 retweets (Patti). The tweet also sparked quite a few reactions on and off Twitter, including the online magazines *Futurism* and *Gizmodo*, both focusing on the ability to discriminate between human-written and bot-generated text. These articles referred to a series of tweets by @JanelleCShane, who argued that @KeatonPatti's tweets were "100% human-written with no bot involved," and stating that she "wish people wouldn't present these fakes as bot-written," though she also found at least some aspects of the tweet "pretty darn funny" (Shane; Shane is considered to be an expert on auto-generative writing and is known for her experiments

OLIVE GARDEN COMMERCIAL

INT. OLIVE GARDEN RESTAURANT

A group of FRIENDS laughs at a dinner table. A WAITRESS comes to deliver what could be considered food.

WAITRESS
Pasta nachos for you.

We see the pasta nachos. They're warm and defeated.

FRIEND 1
The menu is here.

WAITRESS
Lasagna wings with extra Italy.

We see the lasagna wings. There's more Italy than necessary.

FRIEND 2
I shall eat Italian citizens.

WAITRESS
Unlimited stick.

We see the unlimited stick. It is infinite. It is all.

Figure 2: First half of the screenplay attached to the Olive Garden tweet (Patti).

FRIEND 3
Leave without me. I'm home.

WAITRESS
Gluten Classico. From the kitchen.

We the Gluten Classico. We believe the waitress that it is from the kitchen. We have no reason not to believe.

Friend 4 says nothing.

FRIEND 1
What is wrong, Friend 4?

Friend 4 says nothing.

FRIEND 2
Friend 4, what is wrong, Friend 4?

Friend 4 smiles wide. Her mouth is full of secret soup.

ANNOUNCER
(wet voice)
Olive Garden. When You're Here, You're Here.

Figure 3: Second half of the screenplay attached to the Olive Garden tweet (Patti).

with neural network-driven text-generation on http://aiweirdness.com). Taking the wide range of reactions to the Olive Garden tweet, along with its viral status, into account, the tweet provides an exceptionally fruitful case.

The case as meta-parody

Reading through the responses to both @KeatonPatti's and @JanelleCShane's tweets, one gets the sense that only relatively few people are actually tricked into thinking that the Olive Garden tweet was written by a bot. Many reference the fact that @KeatonPatti is a known comedy writer, who e.g. writes for the parody newsmedium *The Onion*. It seems, then, that the comical aspects of the tweet are not at all reliant on the reader believing that the bot is real. Rather, I argue, the tweet contains two closely connected jokes — it is a two-fold parody: both a parody of Olive Garden commercials and a kind of meta-parody of text-generation bots in general, specifically those common on Twitter.

I argue that the implied bot is not inspired by a single text-generation technique (such as Tracery grammars, markov chains, predictive text keyboards, word2vec, or recurrent neural networks). Rather, the implied bot relates to auto-generated text in general, an amalgamation of a multitude of text-generation techniques and the style they generally write in. In this case, reading bot-mimicry does not rely on cultural conceptions relating to a single technique (though it might in other cases), but rather on cultural conceptions of artificial intelligence/machine learning (AI/ML), and auto-generative text in general. As such, the tweets also become somewhat platform-specific to Twitter.

The tweets are situated in a context where generative text is commonplace, often in the form of so-called *Twitter-bots* (cf. Flores), but also represented in the popular predictive keyboard-based narratives by e.g. Botnik Studios (Botnik Studios). Twitter-bots are in fact so common that they are viewed as a problem by some, and action has been taken towards limiting the presence of automated bots on Twitter, or at least to make it possible to locate bot-driven accounts automatically (Siddiqui, Healy, Olmsted; Davis et al.). Most users of Twitter are used to seeing auto-generated content, and many of them have a somewhat technical understanding of how Twitter-bots (and auto-generative text in general) works (which also shows in many of the responses calling @KeatonPatti out for not actually involving a bot in the writing process). Indeed, it seems likely that @KeatonPatti's many bot-mimicry-texts would not have been successful outside of Twitter. As such, @KeatonPatti relies on his readers being used to reading these kinds of texts — this is virtually necessary in order for them to appreciate the tweet's meta-parody.

Though one would arguably still be able to find the screenplays funny without appreciation of the meta-parody, the parody of Olive Garden commercials changes when the reader is aware of the meta-parody: the relation between the text, the platform, and the output becomes negotiable, and the reader engages in a creative act of combining the reading of the parody and that of the meta-parody. My approach is primarily concerned with the meta-parody, which relates to the implied bot and its alleged generative process.

Reading the implied bot

The implied bot as diegetic prototype

I read the Olive Garden tweet as fiction, maybe even a kind of science fiction. It contains two stories – the story present in the screenplay and a meta-story of its generation. When reading the tweet as fiction, I in part follow Paul Dourish and Genevieve Bell who have studied the interesting relation between science fiction and ubiquitous computing (ubicomp) research by reading ubicomp research alongside science fiction (Dourish and Bell). They inquire into the collective imagining that shapes much of ubicomp research. Their argument is not, however, that ubicomp research is science fiction, but that their reading of it *alongside* science fiction provides an opportunity to "point to a series of themes that illuminate contemporary imaginings of the relationship between science, technology, and society" (ibid. 773). Though @KeatonPatti's tweet hardly illuminates ubicomp research, this approach inspired by Dourish and Bell is equally fruitful when applied here.

In the present quasi-materialist study of @KeatonPatti's implied bot, the concept of the *diegetic prototype* provides a valuable perspective. The term *diegetic* refers to that which is part of a story. A diegetic prototype is a prototypical technology embedded in a story as a way to communicate or explore possibilities and dangers connected to widespread implementation of these (yet fictional) technologies, as is fairly common within science fiction (Kirby). With the perspective of *design fiction*, Julian Bleecker has shown how the line between 'science fiction' and 'science fact' is blurred — how the diegetic prototypes known from e.g. Stanley Kubrick's *2001: A Space Odyssey* or William Gibson's *Neuromancer* have played major roles in both technology development and discourse (Bleecker).

At this point, it is not entirely clear how @KeatonPatti's implied bot can be viewed as a diegetic prototype. As underlined by Joshua Tanenbaum, diegetic prototypes only work when they are embedded as part of a story (Tanenbaum) — and to what extend does that apply to @KeatonPatti's implied bot? On one level, the Olive Garden tweet is obviously a little story (it takes form as a screenplay), but in addition to this, I argue, it contains a meta-story which relates to the generation of the screenplay. The screenplay relies on the readers' understanding that it was written by a (fictional) bot. This understanding is of course derived from @KeatonPatti's brief intro, written in the tweet, where the screenplay is attached as two images.

Importantly, @KeatonPatti's intro is arguably not diegetic to the screenplay. It is not part of that story, but is rather a *paratext*, i.e. a text that is part of the work at hand, but is not part of the story *per se*, like the text written on the back of a book. Still, I argue that the implied bot is diegetic to a different story, the meta-story in which the person Keaton Patti (played by @KeatonPatti) developed, trained, and initiated a generative bot, which then outputted the screenplay in question. Seeing that all these steps are entirely fictional, I read them as a meta-story in which the implied bot functions as a diegetic prototype. The relation between the story (the screenplay) and the meta-story (the generative process) is the same as the relation between the parody of Olive Garden and the meta-parody of text-generation bots which was outlined above. To reiterate, my focus lies on the meta-story and the meta-parody, which is where the study of the implied bot can be conducted.

In my approach to reading the implied bot, this view of the bot as a diegetic prototype is the point of departure. The reading of @KeatonPatti's tweet as fictional and the bot as a diegetic prototype is fruitful in that it allows for an approach to the bot as a concrete entity to be studied through a reading of the story in which it occurs.

The implied bot is, of course, only implied. This makes it particularly difficult to study thoroughly, even when viewed as a diegetic prototype. In the following, I review selected perspectives from the fields of media archaeology, software studies, electronic literature, and interface criticism, in order to clarify how one might study *any* generative bot. In reviewing these perspectives, I seek to identify concrete methods and techniques to apply in the reading of @KeatonPatti's implied bot.

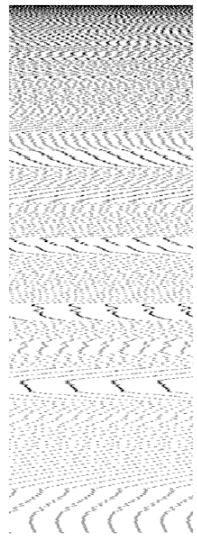
The implied bot as imagined generative system

In Noah Wardrip-Fruin's reading of Christopher Strachey's 1952 *Love Letter Generator*, situated as media archaeology, Wardrip-Fruin views the generator, "not as a process for generating parodies, but as itself a parody of a process" (Wardrip-Fruin 316). The love letter generator uses simple prewritten grammars and a fairly small database sampled from a thesaurus to generate almost rambling expressions that somehow mimic love letters, but in Wardrip-Fruin's reading, the letters themselves are "not really the interesting part of the project" (306). What is interesting to Wardrip-Fruin is the generator's data and processes, and in his reading of these elements, the love letter generator is viewed as a parody of mainstream love letter-writing activities. This relation between the outputted love letters and the parody of the letter-writing process is similar to that of the screenplay and the meta-story (and thus the meta-parody) within the Olive Garden tweet. The generative process of the love letter generator is in itself the parody in question, which maps onto the meta-story of the Olive Garden tweet — the meta-story and the meta-parody both also refer to the implied bot's generative process. Thus, we turn to the study of generative software in general in order to further develop a quasi-materialist approach to our case of bot-mimicry.

One immediate issue is, though, that the software per se is arguably an integral aspect of generative art (Cox). As such, the reading of generative art entails a close reading of the system's generative process (see Wardrip-Fruin's reading). A close reading of data, processes, and code is of course impossible in our case – these simply do not exist. Still, we may be able to study aspects of the (implied) generator without having access to its (imaginative) technical elements.

Consider Alex McLean's generative work *forkbomb.pl* (cf. Cox; Cox, McLean, Ward; see figure 4). A 'forkbomb' is a computer program which forks (copies itself) continuously until the system crashes, and are usually very simple programs (they often require only a single line of code). McLean's work consists of a few more lines than that: in addition to being a simple forkbomb, it also generates a visual output while the program is executing; the visual output is a binary pattern which glitches as the program forks and the system crashes. This visual output has been read by generative art practitioners and scholars Geoff Cox, Alex McLean and Adrian Ward as "a 'watermark' of the processor and operating system" (Cox, McLean, Ward n.p.). While Cox, McLean, and Ward maintain the importance of considering the code of generative works, they include a focus on execution as equally important. The aesthetic appreciation of a generative work is here considered partly dependent on an appreciation of what the work actually generates. There is a clear notion that the output bears an imprint of its generator's technical elements — even those beyond the source code (e.g. the operating system). In the case of the Olive Garden tweet, is it possible to get a sense of the 'watermark' of @KeatonPatti's implied bot by considering its alleged output?

The 'watermark' that Cox, McLean, and Ward discern from *forkbomb.pl* is enlightened by a knowledge of what the system is doing 'behind the scene' — i.e. what kind of process is executing. In our case, @KeatonPatti's short explanation of how the screenplay was generated hints at some aspects of the processing which is allegedly happening in the Olive Garden tweet. Firstly, the relation between inputting video material and the bot outputting screenplays hints at an extremely



```
#!/usr/bin/perl -w

use strict;

die "Please do not run this
script without reading the
documentation"
    if not @ARGV;

my $strength = $ARGV[0] + 1;

while (not fork) {
  exit unless --$strength;
  print 0;
  twist: while (fork) {
    exit unless --$strength;
    print 1;
  }
}
goto 'twist' if --$strength;
```

Figure 4: "Output and program script from Alex McLean's forkbomb.pl" (Cox 2). The output differs on different machines, hence the idea of a 'watermark'.

sophisticated algorithm which is seemingly able to discern what is to be considered stage directions, which lines are being spoken by whom, and so on. This is impossible (or at least very unlikely), and is one aspect which hints that @KeatonPatti's tweet should not be taken seriously, but rather be read as a joke. But it also hints at certain tech-narratives that computers are able to extract any kind of information from any datatype. Indeed, there seems to be a narrative that computers are able to extract a kind of essence from given input data, and this narrative is clearly reflected in @KeatonPatti's tweet. Another 'watermark' of the generator is the ability to maintain a structurally cohesive narrative throughout the screenplay, including keeping track of characters. Again, though this is not entirely impossible, it is a distinctively sophisticated aspect of the screenplay. Both these aspects were also brought up by @JanelleCShane in her critical reading of the tweet, but where she read them as fallacies, I read them as parts of the meta-parody, and as hints at the tech-narratives at play in the implied bot. These fairly technical aspects of the implied bot refer to how the bot processed the inputted Olive Garden commercials.

The implied bot's transformation of corpus into output

So how can we scrutinize the data, or the 'corpus' in natural language processing terms, with a quasi-materialist approach? Let us consider a concrete example of a reading of a corpus by considering the output, situated within the field of electronic literature. In his essay, *Writing to be found and writing readers*, John Cayley writes with(in) the Google search engine, and through his writing practice, he investigates the system's corpus (Cayley). His writing technique is relatively simple: he uses the Google search engine to look up sequences of words from a source text, and re-writes the text based on the results — or rather, the new text is based on various concepts relating to which sequences of words are *not* found in Google's database. In one example, Cayley searches for the longest sequences within a predefined string of words which do not get any results, letting the poem take form accordingly (see figure 5). These sequences of words are, then, technically original, at least in comparison to what has been indexed by Google's 'spiders'. Cayley's technique is interesting to our case in that it is a striking example of how engaging with output text can inform an understanding of a system's corpus text. Cayley's writing engages directly with a corpus, exploring it by querying into it. Furthermore, Cayley's reading demonstrates an engagement with the way this corpus is organized and processed: his results vary depending on which Google server he arbitrarily accesses — something which he discovers through his writing practice.

Returning to my first process, with the supply text just quoted, for example:

> "The purpose of this writing is to address an"
> "is to address an edge of"
> "address an edge of chaos."

completed with Google at 9:17 EST on Oct 1, 2009, became:

> "The purpose of this writing is to address an edge"
> "is to address an edge of chaos."

a little over two hours later at 11:30 on the same day.

Figure 5: An example of how Cayley inquires into Google's database. In the example above, it is shown how the resulting 'originality' changes over time, and depends on which mirror of Google's database he arbitrarily accesses (Cayley n.p.).

In relation to the Olive Garden tweet, this is important as it allows us to scrutinize @KeatonPatti's idea of a corpus text and how this is processed by his implied bot by reading the output. One striking insight into the relation between corpus and output is the bot's ability to be creative — i.e. to create something new that did not exist in the corpus text. This is, as of yet, impossible to do with any text-generation software (or, indeed, at all using AI/ML [2]). Accordingly, this feature was among the most frequently highlighted by critical readers of @KeatonPatti's tweet, where e.g. the ideas of 'Gluten Classico' or to 'eat Italian citizens' were taken as concepts which arguably could not have originated in any Olive Garden commercial. Thus, the bot seems to have the ability to not only extract suspiciously exact data from the video content fed to it, it is also seemingly able to synthesize new and highly creative concepts from this data. So, taken together, these 'watermarks', along with the relation between corpus and output, hint that the implied bot is extremely sophisticated. In the following section, I move beyond this fairly simple reading and aim to consider a more nuanced understanding of the tweet, as well as to provide a framework for conducting political critique on the cultural conceptions and technology imaginings written into the implied bot.

The implied bot's political tendency

As a final aspect of the present reading of @KeatonPatti's Olive Garden tweet, the field of interface criticism will frame a political critique as well as a general reading of implied bot. In their latest book, *The Metainterface*, Christian Ulrik Andersen and Søren Pold explore how the concept of 'the interface' has changed from being something located in a specific place (e.g. desktop computers) to being something ever-present, ever-connected, and *seemingly* immaterial – as shown by Andersen and Pold, the material reappears gradually as aspects of a metainterface (Andersen and Pold). In their numerous analyses of exemplar artworks, one common aspect is that the artworks in question are viewed as self-exploratory; they are "a material exploration of [their] own technological means of production" (24). Andersen and Pold conduct political criticism of these technological circumstances by applying a focus on the Benjaminian concept of *tendency*. Tendency here refers to a deeper political tendency as materially embedded in the technological conditions of production, which is revealed in and can be leveraged by artistic production.

In Andersen and Pold's work, such political tendency is explored through focusing on various types of interface-critical artworks, and their approach is to analyze various (artistic) interfaces. Their approach is in part inspired by Espen Aarseth's concept of *cybertext* (Aarseth), and his model of what he calls the *texual machine*, which includes three aspects: *operator*, *medium*, and *verbal sign* which are brought together in the *text/machine*, any of these aspects and can only be defined in its relation to the other two (21; see figure 6). Note that 'the operator'

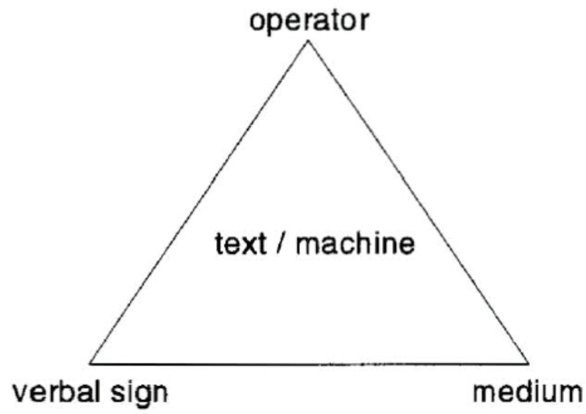


Figure 6: Aarseth's model of "The Textual Machine" (Aarseth 21).

denotes what is typically called 'the reader', who in Aarseth's approach is situated as an integrated, constructive, part of the text/machine, and not as purely receptive, situated outside of it. Put briefly, the operator may read into (and in doing so, also reconstruct) the text/machine (the implied bot) by considering the medium and verbal signs (the tweet and screenplay). Though the tweet, the screenplay, and even the Twitter platform are also parts of the text/machine, my argument is that the implied bot is integral to the text/machine in the operator's engagement with the it, since the tweet and screenplay are somewhat nonsensical without the addition of the implied bot to the text/machine. Thus, I argue that we, situating our reading within Andersen and Pold's interface criticism, may approach the tendency of the imaginary bot by considering it as part of the text/machine.

In the case of the Olive Garden tweet, I argue that the tendency of the tweet revolves around a seemingly counter-intuitive dynamic between docility and autonomy. In @KeatonPatti's words: "I *forced* a bot to watch [...] then *asked* it to write" (Patti; my emphasis). These words give insight into the kind of generative process that @KeatonPatti imagines. The bot may be *forced* to repeat a somewhat typical computer-task (i.e. processing large amounts of data), but it has to be *asked* to perform a typical human-task (writing being a traditionally 'creative' act). The content of the screenplay reflects this dynamic as well, as the screenplay seems to be *both* seemingly random *and* at the same time strikingly accurate in its depiction of Olive Garden (and their commercials). Two examples of this are the concepts of 'lasagna wings with extra Italy' and 'unlimited stick'. Both these concepts seem somewhat randomly generated as a result of the computer 'forgetting' what it was writing and thus combining elements that do not usually belong together, as is typical for much auto-generative text. At the same time they both parody the menu selection at Olive Garden, one referring to the highly Americanized version of Italian food served at Olive Garden (lasagna wings being a mix of the Italian dish lasagna and the American hot wings-concept), while 'extra Italy' is added to make the Olive Garden experience appear more authentic — though the attempt fails, as there is 'more Italy than necessary'. The other refers to the option to get unlimited bread sticks at Olive Garden, which is then taken to the absurd in claiming that 'it is infinite, it is all'.

These two examples demonstrate the dual nature of the bot as both a docile machine randomly stitching together unrelated concepts from a source text *and* at the same time a potent comedic parody of the inputted data, referencing concepts far beyond those that would be present in the alleged data-set. This situates the bot as harmless while simultaneously having almost mystic powers to extract an essence of a given input and synthesize it into a condensed form. As mentioned, I read this dynamic as at least one aspect of the tweet's tendency, which reflects more broad ideological conceptions surrounding the development of AI/ML. The bot's dual position as both docile and mystic echoes Wendy Chun's reading of the fetish-like ideas of source code as 'sourcery', which both gives the computer magic abilities while at the same time reinforcing an idea of complete user control (Chun). Thus, @KeatonPatti's tweet exhibits a tendency which is not reserved for AI/ML, but which applies to cultural conceptions of computers in general, yet this narrative is arguably only amplified when relating to AI/ML, as one criterion for successful AI/ML is that the system exhibits relatively high degrees of autonomy while still remaining controllable.

A quasi-materialist approach to bot-mimicry

In order to briefly sum up the quasi-materialist approach applied here, the individual aspects of it, outlined above, are here put in context to one another. The approach is considered relevant for practices of bot-mimicry, i.e. situations where humans write in a bot-esque fashion. This practice entails the (implicit or explicit) imagining of a conceptual bot which *could have* produced the written text. When analyzing this non-existent (fictional) bot, viewing it as a diegetic prototype allows for studying it by reading the story in which it is situated. Following the idea of a 'watermark' of technical aspects of a generative work, such 'watermarks' can be located in the story and hint at the imagined technical aspects of the fictional bot. By considering how one can read into a corpus by considering the output, we can then also analyze the imagined processing of corpus into output. Finally, by focusing on the political tendency inscribed into the text in question, we are able to conduct critique of the work's fictional conditions of production, and relate these to contemporary conceptions which dominate tech-narratives.

Implications and future work

The quasi-materialist framework explored here points to several interesting aspects relating to contemporary developments within natural language processing. In an era where people continually worry about bots posing as humans, one way of coping is to imitate and parody these suspected malicious bots by exaggerating particular aspects of computational writing. Such imitation can either be rather convincing (the poem *ukulele* by Aaron Koh) or openly fake (the Olive Garden tweet). The relation of these imitations to computational (real) bots is dialectic as the imitations are based on encounters with (and conceptions of) real bots, while they may themselves take part in exploring bot writing, potentially discovering blind spots. As such, these imitations may then influence the development of computational bots, likely making them yet more difficult to recognize. What makes @KeatonPatti's tweet interesting in this context is that it is not concerned with tricking the reader, but rely on the reader noticing its being fake to conduct comedic critique of both AI/ML discourse and Olive Garden commercials.

With continuing developments within natural language processing to make computationally generated text indistinguishable from humanly written text, the 'style' of the Olive Garden tweet — what I call bot-mimicry — is increasingly interesting. This style is not inherent to the ability to computationally generate language, but feeds into techno-cultural conceptions of bots, including imaginaries surrounding AI/ML as well as robots in general. What is interesting here is not so much if @KeatonPatti and others represent bot-writing accurately, but rather how these writing experiments exemplify, inquire into, and communicate shared cultural conceptions of bots and AI/ML.

Far from claiming that the readings carried out here can enable people to distinguish bots from humans online, the paper provides a different proposition: That bot-mimicry can be employed as a creative and critical way to inquire into technological conceptions, narratives, and imaginaries. I propose that facilitating writing experiments and conducting readings in bot-mimicry-texts may be fruitful ways of engaging directly with these phenomena that are otherwise difficult to articulate concretely by encapsulating them in narratives and considering them as though they were material entities. Such quasi-materialist experiments may, then, provide an opportunity to further examine and critique these cultural conceptions. A lens through which such conceptions can be negotiated, explored, and potentially challenged: through a practice of bot-mimicry.

Notes

[1] My usage of the term *quasi-materialist* is not related to its meaning within philosophy of mind, where the term relates to the question of mind-body dualism. Rather, the prefix 'quasi-' simply refers to the fact that the material is not there in a traditional sense, yet my approach is to consider the cases as though it was.

[2] This claim that it is impossible to generate something new with AI/ML technology is in part based on a lecture given by Professor Matteo Pasquinelli. The lecture was given at Cambridge Digital Humanities Learning Programme, University of Cambridge, on January 14, 2019, as part of the *Machine Feeling* research workshop. Pasquinelli argued that one integral aspect which defines the capabilities of machine learning software is "the undetection of the new" (which was also the title of the lecture). The undetection of the new refers to the way machine learning algorithms 'learn' — only by statistically aggregating the existing data of the data-set, and thus nothing entirely 'new' (which did not already exist in the data-set) can emerge in a machine learning-based system. Cf. http://matteopasquinelli.com/cambridge-ai/

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Michela De Carlo

SYNTHETIC BODIES AND FEELING GENERATORS

Abstract

The main purpose of this paper is to describe emerging forms of art and social practices that arise in the social media era, after the coming together of the self-awareness reflected in online environments and the conscious passivity of individuals to the algorithmic manipulation of desires. Accordingly, what follows is a brief introduction to these new forms of social structures and a description of the elements that shape the perfect projection of ourselves in our online experience, combined with samples of artworks investigating the forms and languages emerging in our social media life.

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Introduction

Digital media have changed the structure of our world, allowing us to live our existence across different stages and platforms. Yet, the physical borders of our computational experiences are still well defined: we don't surf the web through neural implants yet, and the main shift so far has been from pressing keys on a keyboard to touching a screen with our fingers. Except for the rare cases in which it occurs to be necessary for survival, we do not integrate technologies into our bodies, but we adapt our bodies to the way technologies work. Advances have been made in the medical field, such as the creation of artificial organs and use of robots in transplants. However, from this point of view, the implementation of technologies in daily life has followed paths which are far from those imagined by science fiction and the media theory of the twentieth century.

As a consequence, a question arises: If people can live with a 3D printed silicone heart, why can't they have feelings obtained through their virtual experience or social media life? They can, and they do. In some cases, social media try to reproduce these feelings, Facebook's 'reactions' being a common example: six emoticons that allow people to better express how they feel about specific content displayed on their wall — if compared to the emotional neutrality of the 'like' — and that allow the system to better profile us. It's a pretty basic approach, but it works.

Hyper-connectivity and new forms of communication influence our feelings, emotions, lifestyle and the way we perceive our bodies. Applications that improve or mask our appearance have been designed, as well as AI ChatBots that pretend to be the perfect boy/girlfriends and virtual environments in which we can reinvent ourselves and meet other people; but we can also think about sensory ASMR videos, or about those applications tracing our dream activity or helping people to fall asleep.

The awareness of a wired existence opens up the question of self-representation in the online environment. The perfect projection of ourselves becomes an important issue in our social media life, and exploring the way in which we design it is the main focus of this essay. But in order to get there, we first need to outline the social structure that technologies and social media have helped to shape, and the new model of individual on which this social structure is grounded, and to which this perfect projection belongs. In this effort, we will rely upon the work of Benjamin H. Bratton, Zygmunt Bauman, and Peter Sloterdijk.

The user and the bubble

Across the last decades, with the massive adoption of new technologies in the private sphere of individuals and the global connectivity bringing together every single thing we do, we find ourselves confronting a new social complexity, that has caused, as a consequence, a new, strong need to retrace, rephrase and rethink the borders of the social structure we are living in.

In his book *The Stack*, sociologist Benjamin H. Bratton considers the form of the stack to describe the changes induced by an ever more digitized society, but also to re-define a hypothetical geo-political map integrating these two aspects in a dichotomous way:

> *I propose The Stack as a way that we might map political geography, but also for how we understand the technologies that are making that geography.*

> *[…] this figure of The Stack both does and does not exist as such; it is both an idea and a thing; it is a machine that serves as a schema as much as it is a schema of machines. It lets us see that all of these different machines are parts of a greater machine, and perhaps the diagrammatic image of a totality that such a perspective provides would, as theories of totality have before, make the composition of alternatives — including new sovereignties and new forms of governance — both more legible and more effective. As the shape of political geography and the architecture of planetary-scale computation as a whole, The Stack is an accidental megastructure, one that we are building both deliberately and unwittingly and is in turn building us in its own image. (Bratton 4-5)*

Bratton idealizes a 'megastructure', exemplifying a hybrid social model — computational and non-computational — with a histogram composed by different levels co-dependent on each other, and arranged vertically one upon the other: Earth, Cloud, City, Address, Interface and User (Bratton 10-11). It's on the level of the User that I'm going to focus in the following. For Bratton, the User — a word borrowed from the field of design — is the human being as a subject that organizes the system they inhabit, shaping it in their own image. Their synthetic double is shaped by social factors such as micro-economies and psychology. In brief, for Bratton the User is not an individual or an un-individual, but rather a plurality of agents, a position within a system; and without this system, they wouldn't have a role, nor an essential identity.

In another passage, Bratton writes: "As we human users reflect on ourselves with images of quantified digital traces, the richly detailed portrait reflected back convinces us of our individual coherency and efficacy." (Bratton 260) If our synthetic representation is mediated by social filters along the process of transformation from human to User, the system in which we choose to insert our image — the Interface depending upon the Address, depending upon the City, depending upon the Cloud, depending upon the Earth — gives back to us, in turn, these social filters, providing a detailed, persuasive portrait of our coherence and individual effectiveness.

This loop between human, User, reflection, User and human can be described as a circle, a loop with a positive, self-feeding feedback. The modal value of this paradigm is the reflection. If we combine these thoughts with what philosopher and sociologist Zygmunt Bauman claims in *Liquid Life*, writing about the accelerated rhythms we are subject to, it's very likely that the reflection sent back by the system wouldn't match anymore with the idea of coherence and individual effectiveness to which we were referring when we generated our image as User.

This variance, although minimal, should be added to another circle/loop. If we keep the two poles (human and User) still, considering them as the two input and output poles and keeping the perfect shape of the circle, the sum of all the loops will develop by including the Z axis: the third dimension. The sum of all this constant and perpetual variance will produce a spherical shape, a globe.

The three-dimensional rendering of the close circuit described in figure 1 evokes the metaphor of the bubble, as it is used by the philosopher Peter Sloterdijk in *Spheres I - Bubbles*, as the intimate subjectivity of the individual: the unit of measurement made by the individual basket of experiences and interactions of the individual.

While Bratton calls this unit of measurement User, placing it at the top of his linear

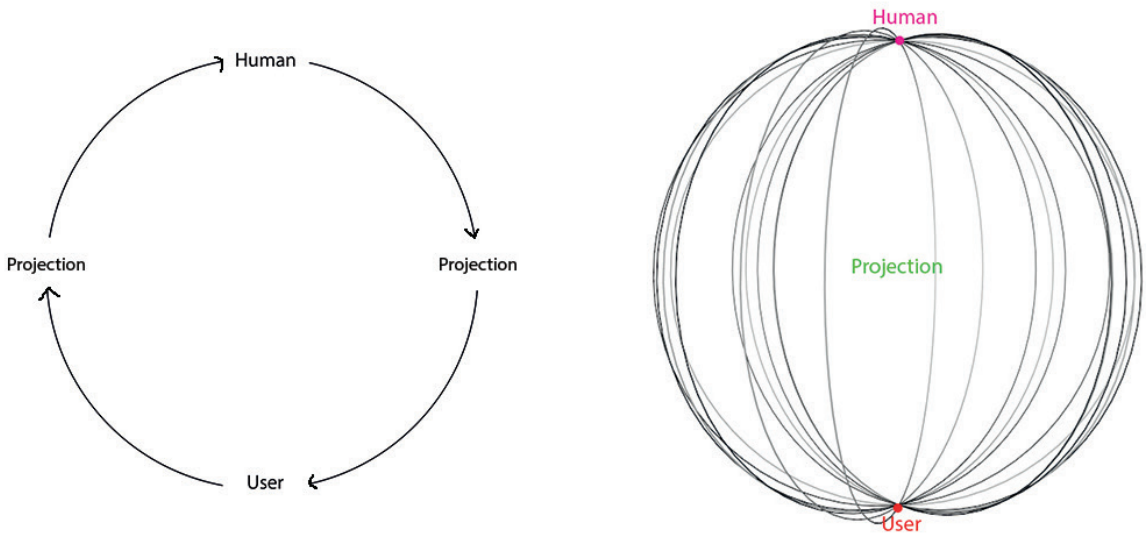

Figure 1: Human-User Perpetual Variance.

structure composed of overlapping platforms, Sloterdijk, on the other hand, uses the individual sphere as a basis for a model of social architecture that, in *Spheres III - Foams*, he coherently describes as a "foam architecture" (Sloterdijk 15): a plurality of spheres combined in a disorganized way — one upon the others, one next to the others. Back to *Spheres I - Bubbles*:

> *In the foam worlds, however, no bubble can be expanded into an absolutely centered, all-encompassing, amphiscopic orb; no central light penetrates the entire foam in its dynamic murkiness. Hence the ethics of the decentered, small and middle-sized bubbles in the world foam includes the effort to move about in an unprecedentedly spacious world with an unprecedentedly modest circumspection; in the foam, discrete and polyvalent games of reason must develop that learn to live with a shimmering diversity of perspectives, and dispense with the illusion of the one lordly point of view. (Sloterdijk 75)*

The cells of the foams lose the perfect shape of the sphere, and even if they are attached to one another, forming an ephemeral net, they are not truly connected.

The perfect projection of ourselves

Although very different from each other, the models of individual outlined by Bratton and Sloterdijk are very useful to describe the way we live our social media life, and we expand our identity online by designing the perfect projection of ourselves. Both Bratton's User and Sloterdijk bubble do not have a fixed identity and shape, but they are shaped and changed by the system they are part of (and thus change as they move from system to system, from platform to platform). And their consistency is not an original condition, but a final achievement — the result of the recollection of their "quantified traces" (Bratton 260).

This achievement is what I call the perfect projection of ourselves. This perfect projection isn't just the result of an effort in

Figure 2: Ryan Trecartin, I-BE AREA (2007). Video, 1 hour, 48 minutes.
© Ryan Trecartin, Courtesy Regen Projects, Los Angeles and Sprueth Magers.

self design — what I call in the following 'virtual representation'; but it also requires an ability to actively and passively employ the tools that the digital realm offers us to feel and express emotions — what I call 'feeling generators'; and a willingness to passively accept the algorithmic manipulation of our feelings and desires, and to actively engage with non-human personalities and artificial intelligences.

To introduce these three topics, let's briefly consider one of the first artworks ever to engage with the projection of ourselves in online environments: Ryan Trecartin's *I-BE AREA* (2007). The movie, shot as a linear narrative but also uploaded on YouTube in ten minute segments, famously portrays a group of young, over-active people with heavy make-up in a colorful, messy set designed by the artist himself and his collaborator Lizzie Fitch. Although each character is presented as an individual, the fact that they speak the same language and that they are often interpreted by the same actors (Trecartin and Fitch among them) enforces the feeling that they are different manifestations of the same identity: I-Be, the main character of the movie, of which the narrative outlines the "area", the cluster of his various realities and identities. At the beginning of the movie, I-Be, a self-proclaimed clone, "I exist because of Command V. Copy and paste some guy's DNA" (Trecartin 8) — has a conversation with his avatar. Here, I-Be explains his avatar — who wants to assign him a paper — that it can't assign anything to him, because "I created you". I-Be's avatar is his own online projection, the 'virtual representation' of himself;

but at the same time has evolved into an 'independent avatar' (IA), an autonomous intelligence who writes papers and has its own emotions. But I-Be refuses to recognize and accept his avatar's independence, so far to decide to delete it: "You can just go cowboy some abandoned files in my trash can. Swup drag to the trash, empty it, empty it, I emptied it. Empty." (Trecartin 10)

Virtual representation

By posting pictures, sharing articles and thoughts, or composing 3D avatars, we are always trying to create the ideal projection of ourselves in the virtual realm. Our identity expands beyond the body, and 'users' can become whatever they want, or just idealize themselves showing only their best traits — like a smooth 3D face with no imperfections.

Our virtual representation is usually fragmented into a number of 'quantified traces' — tweets, likes, comments, photos, videos, sounds; some of them are permanent, some others are ephemeral, but all of them contribute to shaping a portrait of ourselves. In her digital painting work, the young Chinese artist Ruby Gloom (1991) reflects on this by combining these traces into iconic, convincing portraits. In her series *Insta Client* (2017-ongoing), Gloom makes 3D portraits of people, drawing inspiration from a selfie that is sent her by the client. These portraits are made to be shared on social networks and be traced thanks to the use of hashtags; in many cases, they are used by the *Insta Clients* as profile pictures.

What's especially interesting about this project is the fact that most of the photos the artist receives — providing a model for her portraits — are not rough, plain photographs, but are themselves already manipulated using other applications, presenting for instance glittering effects, hearts all over the subject

Figure 3: Ruby Gloom, *Insta Clients* (2017), 3D renders. Courtesy of the Artist.

and other kinds of digital filters. In some cases the faces are masked by Augmented Reality filters. Gloom considers these ‘client generated’ additions made with other applications, as they were part of the face, and paints them in her portraits. Without distinguishing between reality and make-up, she takes the image that she gets, and as a machine she produces a new synthetic 3D version of that image and spreads the new ‘selfie’ she has created on social networks.

Thomas Macho’s facial society, that “continually produces faces” (Belting 295) comes to mind together with the idea of the prominent face described by Macho and Hans Belting as a “blank facial formula” (Macho 121); but in this work, it evolves into a *filtered facial formula*. Here, the virtual representation doesn’t take off from a point zero that we can consider the real or natural face (even if we can wonder if a simple photo can be considered a natural face), but already from a simulation. The result is a simulation of a simulation.

Another point that’s important to highlight is that — by examining the representation of identity in the social media era — we don’t talk anymore only about a specific shape, as it could be a human body or a human face, at least not in an absolute way. The focus is more on the manipulation or the masking of the traditional form, and in some cases on its absence. For this reason when we consider the virtual portrait, we don’t speak about *the body*, rather we deal with *the self*. And this self is temporary, transient, unstable, ephemeral.

To explain this shift — from the body to the self — let’s refer again to Bauman. In *Liquid Life*, he states that the acceleration of our contemporary life forces us into new beginnings and consequently new losses, repeatedly:

> *[…] in varying degrees they all master and practice the art of liquid life: acceptance to disorientation, immunity to vertigo and adaptation to a state of dizziness, tolerance for an absence of itinerary and direction and for an indefinite duration of travel. […] Looseness of attachment and revocability of engagement are the precepts guiding everything in which they engage and to which they are attached. (Bauman 4)*

In order to survive this lifestyle, you need to be able to let things go, to eliminate the past. Then, Bauman assumes that the same concept works with identities, which means that we have to be able to rebuild ourselves in an easy and fast way, without the fear to leave the past behind like — a *story* on Instagram, that only last 24 hours. A reference to Ryan Trecartin’s *I-BE AREA* would fit well here. In the movie, I-Be deletes his Avatar IA by sending him to the trash, where he can join his other previous avatars. No regrets — it will be replaced soon.

In 2009, in his interview “Talking to myself about the politics of space”, Sloterdijk played around this concept too, writing about multiple personality in relation to online activity:

> *From my point of view, the multiple personality is nothing other than the individual’s answer to the disappearance of his real social surroundings, and is thus a plausible response to the chronic lack of social stimulation. The second possibility relates to the modern practice of networking. The horde returns in the guise of an iPhone address book. Close physical togetherness is no longer a necessary condition of sociality. (Sloterdijk)*

Figure 4: Kate Durbin, Hello Selfie Miami (2015), performance. Courtesy of the Artist.

A work dealing with the ephemerality, lightness and detachment of digital identities is Los Angeles-based artist Kate Durbin's performance *Hello Selfie Miami* (2015). In this work, Durbin transformed herself and her girl crew into a kind of 'kitty-mermaids' made-up and dressed with pastel colors. During Art Basel Miami, Durbin wore and put kawaii stickers on the body of half-naked woman performers. They also wore wigs with unnatural and bright colours. After this masking process, Durbin and the performers — voiceless as Andersen's Little Mermaid — started to take selfies, with their selfie sticks in their hands, among the artworks of the group show in which Durbin was invited to exhibit, without ever speaking to visitors. After the shooting session, the performers walked slowly and solemnly outside the gallery, still ignoring the audience while passing through it; and they walked to the sea, always with selfie sticks in their hands - a new extension of their bodies. There Kate and the other performers walked in the water leaving their smartphones on the seabed. Like the short human life of *The Little Mermaid*, the selfie's identity generated along the performance and archived in the mobile gallery metaphorically vanishes with the foam of the waves. The new temporary identity disappears, letting us imagine a new beginning.

Feeling generators

I call 'feeling generators' those tools — phone applications, online experiences, digital simulations — that provoke emotions which are close to the ones we feel in our physical world, but are born in a virtual context mediated by the use of devices, interfaces and hardwares; and those tools that allow us to share our feelings in the virtual sphere. The online projection of emotions becomes in turn a generator of emotions for the feeling of empathy that it causes in other people. As a corollary to this definition, we can distinguish the feeling generators into two different groups: *the passive* and *the active*.

Passive feeling generators are characterized by the possibility they offer to feel emotions produced during and through our online experience without any active interaction on our side: we just have to open an application, press play, etc. Some examples are: the state of anxiety generated by the lack of response from a person who's visibly online when you write them; the desire to find out the content inside a box when watching an unboxing video; the combination of positive feelings and a distinct static-like tingling sensation on the skin while watching an ASMR video, etc.

Active feeling generators are those which allow us to externalize our feelings online: so, we can use default tools provided by social networks to communicate our emotions, or share statements upon specific issues on blogs, etc. Some common feeling generators are characterized by a co-existence of both aspects, active and passive. Just think about online sexual gaming, or applications that are based upon the structure of video games, in which active interaction by people with a generative feedback by the machine and vice-versa is at the base of the game simulation system.

Talking about passive feeling generators, let's briefly focus on the ASMR phenomenon by examining a recent work by the French artist Caroline Delieutraz. In her video *Unboxing + Tapping + Whispering with Rikita* (2017), she investigates the world of the Autonomous Sensory Meridian Response (ASMR) by featuring Rikita, a well-known young French YouTuber making ASMR videos. Here, Rikita unboxes a package, describing in a whispering voice what she finds while unwrapping, one by one, the sculptures from the series *Embedded files* (2015-2017), by Delieutraz herself. The sculptural work is about the embodiment of our internet habits

Figure 5: Caroline Delieutraz, *Unboxing + Tapping + Whispering with Rikita* (2017). Video, 48 minutes, 56 seconds. Courtesy of the Artist.

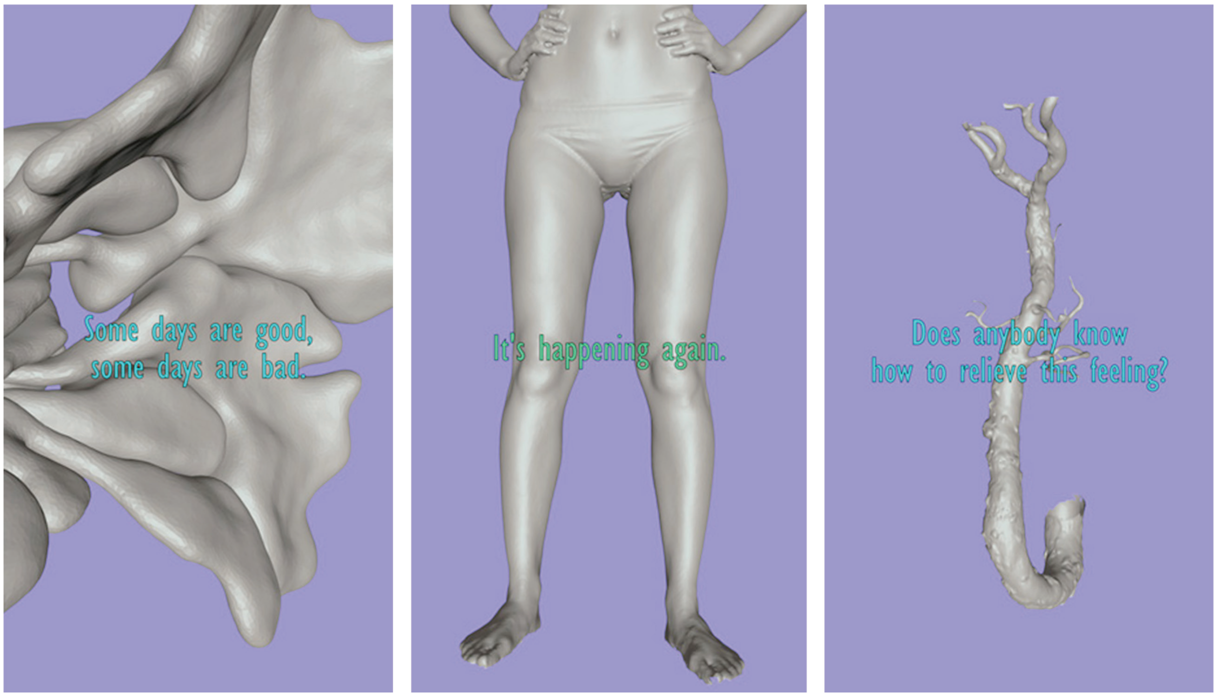

Figure 6: Juliette Goiffon and Charles Beauté, *Does Anybody Know?* (2015-2017). Video 18 minutes. Courtesy of the Artists.

and about future archaeology: in the series, Delieutraz collected images on the internet, printed them together with technologies of common use and trendy objects of that period, and enclosed them in paraffin blocks. The final result is something in between a time capsule and a future fossil.

In other words, if in 2015 — with *Embedded files* — Delieutraz translated our online experience into a physical reality, in the 2017 video she associated to this process a whispering soul, asking to Rikita to tap, unbox and describe the sculptures. In this new step, the previous process of embodiment loses its materiality and reverses back to an ephemeral state — an ASMR video on YouTube — while achieving a new sense of aura. The objects made by Delieutraz become new objects of desire thanks to the sensual voice of Rikita. They gain empathy. These sculptures are no longer the untouchable, precious objects on display in a white cube set-up. Even if we are not actually touching them, we can feel this sensation with our eyes and over all we can hear this touch and experience a tingling pleasure with it. In ASMR videos, objects become triggers able to generate relaxing or exciting sensations. As Delieutraz explained in an interview with Stephanie Vidal: “The object’s value is determined by its potential as a trigger” (Vidal). So the objects become an input to be processed by the voice or the touch of the YouTuber, and the output is a video that people can easily find online.

In addition to the fact that these videos are recorded by people for generating effects on other people and then uploaded online on mainstream channels such as YouTube — which makes them easily accessible on a user-friendly interface — an important aspect of ASMRs is the intimacy in which the audience experience them. An ASMR video is selected out of the many available online, and experienced wearing headphones or, even better, earphones (that allow us to better enjoy the binaural recording). The feelings generated by these videos may vary from relax to ecstatic tingling, from skin pleasure to non-sexual orgasm. Although a purely virtual, mediated experience, filtered by our

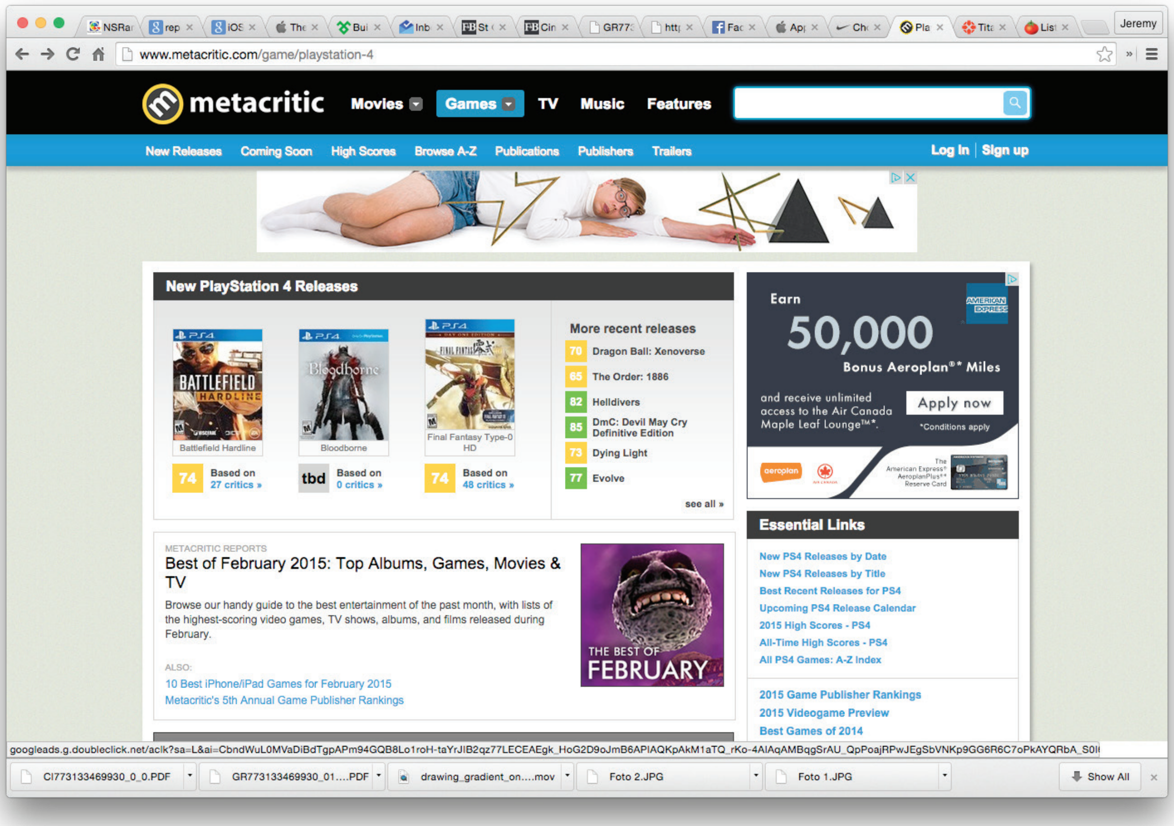

Figure 7: Jeremy Bailey, *The You Museum* (2015). Net-based project. Courtesy of the Artist.

eyes and ears, it's finally through its effects on our skin — its physical consequences — that we can measure the effectiveness of an ASMR video.

A work exploring the attitude to share emotions online through what I call the active feeling generators is the video *Does Anybody Know?* by the French artists Juliette Goiffon and Charles Beauté. After spending two years observing and studying the behaviours of people on medical blogs, they selected part of the conversations and statements they considered relevant for their research, and they edited them into a video together with a continuous flow of 3D scans of different parts of the body. Each body part is accompanied by a question, an expression of anguish, a fragment of testimonies stolen from the medical forums.

This hypnotic experience reveals the concerns of our society about medical issues and the need to share these worries over the internet. *Does Anybody Know?* also shows our paradoxical vision of medicine, of its highly technological universe which is at the same time intrinsically human. This succession of visual and textual points of view brings a double experience of indiscretion and projection on the side of the spectator, nourished at the same time by the observation of the body and the expression of the human thought.

Manipulation of data, machine learning and AI

> *"you mean machines are like humans?"*
> *I shook my head. "No, not like humans. With machines the feeling is, well,*

> *more finite. It doesn't go any further. With humans it's different. The feeling is always changing. Like if you love somebody, the love is always shifting or wavering. It's always questioning or inflating or disappearing or denying or hurting. And the thing is, you can't do anything about it, you can't control it." (Murakami 120)*

Finally, the projection of our self in our online experience is influenced by the conscious passivity of the individual to the algorithmic manipulation of personal contents and desires. The elaboration of our personal information allows machine to calculate our preferences during our online experience. In Bratton's words, what happens is "the capitalized translation of interactions into data and data into interactions" (Bratton 42). This mechanism is mainly used by companies to better profile our needs and focus our attention to the proper advertising. It's also used by social networks to highlight contents that may get our interest. As a consequence, the *interface* we live in becomes a container contaminated by our *preferences*, our personal sphere.

The Canadian artist Jeremy Bailey exploits this mechanism of data calculation and advertising banners in his net-based project *The You Museum* (2015 - ongoing). On a dedicated website, he created a form with a few personal and basic questions, that the visitors had to answer. Using the answers given, which were indicators of preferences, an algorithm programmed by the artist selected which of Bailey's artworks the visitor might like, in a kind of ad-hoc curatorial selection. Yet, these artworks were not shown to you at the end of the questionnaire. The experience on the site was over once you completed the form and sent your data to the elaboration system made by the artist. What happened next was that your favourite Jeremy Bailey artwork — as chosen for you by the algorithm — randomly appeared alongside your daily online browsing, on advertising banners placed in social networks, newspaper homepages, and wherever a commercial banner could be placed.

A further purpose of the artist was to highlight the positive artistic potential in using data and advertising tools, as he stated in a 2015 interview with Marc Garrett on *Furtherfield*:

> *Yes, I'd like art to reflect positive social change instead of reflecting negative market demands. Artists have this tremendous ability and power to communicate and many are wasting that talent pandering to the decorating desires of the rich and powerful. I understand that everyone needs to make a living, but we also have a responsibility as artists to help make the world a better place. I also don't see why these two things need to be in conflict.*

Sloterdijk's and Macho's notion of 'nobject' might be useful here. Consolidating Macho's argument, in *Spheres I – Bubbles*, Sloterdijk describes nobjects as identifying a system of co-realities which, in a manner that does not include a comparison, are literally floating as creatures of proximity in front of an inner Self, who is not facing them, because it is itself in a fetal pre-subject state (Sloterdijk 200). A nobject is a being who lives in a parallel reality close to ours but who has not yet achieved the status of subject. This nobject condition described by Sloterdijk and Macho is very close to our current perception of Artificial Intelligence (AI). The idea that one day machines will come to think and learn like human beings dates back to the 1950s; today, also given to the continuous progress in research, we all expect that — sooner or later — AI will reach this goal:

the *Subject*. We are still waiting. Differently from the Independent Avatar conceived by Trecartin in *I-BE AREA* — who became a self-sufficient being with his own intelligence and emotions — by now, machine learning systems and AI are using 'big data' in order to make predictions of our future behaviour. They learn from us, and reflect us in a more polite and non-empathic way.

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Tanja Wiehn

(UN)PREDICTABLE ACTS OF DATA IN MACHINE LEARNING ENVIRONMENTS

Abstract

This paper investigates artistic representations of machine learning and their interventional potential. Taking its point of departure in two works of art, the paper discusses effects of predictability and unpredictability caused by machine learning systems. By thinking through "eventfulness" (Bucher) and "nonconscious cognition" (Hayles) in human and non-human environments, the paper analyzes the potential of artistic practices to question and rethink algorithmic processing. The paper provides a framework in which artwork challenges forms of technological predictability and comes to terms with machine learning as a fundamental cultural practice in its own right.

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Encounters with machine learning

Daily entanglement with the technological other has ambivalent results. Concerns about the growing impact of algorithms cast doubt upon objectivity and reliability in systems of machine learning and artificial intelligence, notably when their implementation can have strong societal ramifications (Mackenzie; Wang). Critical investigations are simultaneously emerging in research discourses such as New Media Studies, Internet Studies, and Algorithmic Studies to analyze and question the belief that these technologies are becoming providers of solutions to complex social equations. Algorithmic tools are advocated as means of avoiding all-too-human glitches and forms of unpredictability caused by a subjective human intervention, as they seem to be "stabilizers of trust, practical and symbolic assurances that their evaluations are fair and accurate, and free from subjectivity, error or attempted influence" (Gillespie 179). Yet does algorithmic processing of large amounts of data necessarily guarantee neutrality? Critical investigations of data processing discuss the numerous issues regarding implementation of machine learning and its potential to reproduce racist or sexist biases (Kitchin; Wang). Scholarship has thus begun to look more closely at the notion of the algorithm, the ways in which data is used, and how these relate to machine learning. As a result, scholars are looking into the ramifications of algorithmic decision-making for culture and society, drawing on a diverse set of methodological approaches (Elish and boyd; Seaver; Kitchin; Gillespie). The movement from algorithms towards machine learning tools is of particular relevance here. These are subsets of artificial intelligence and are thus systems that are able to learn and adapt (Alpaydin; Pasquinelli). Machine learning is basically a form of programming that learns from the data provided. As Adrian Mackenzie points out, machine learning is an accumulation of techniques derived from mathematics (statistics) and computer science and is not a fundamentally new technology (Mackenzie). Machine learning consists of data training, algorithm learning, and model application. Each of these basic components are crucial for generating an output that — to put it very simply — is based on the idea of pattern recognition (Pasquinelli). Moreover, machine learning is already in everyday technological use, operating in the background to recognize faces at border control, to generate credit score rankings, and to provide Facebook's news feed: it is thus more or less visible and tangible (Mackenzie).

> *A machine learning system is a sort of* nooscope*, that is a device to map and perceive complex patterns through vast spaces of data — what, in digital humanities, is termed as* distant reading*. Each instrument of measurement and perception comes with inbuilt and contingent aberrations. As much as the lenses of microscopes and telescopes were never perfectly curvilinear and smooth, similarly AI systems install* logical lenses *that condense faults and aberrations (Pasquinelli 4).*

In contrast to the statistical core elements in machine learning, the perception of the technology itself as a form of artificial intelligence receives a different kind of attention. In their article "Situating Methods in the Magic of Big Data and Artificial Intelligence," danah boyd and Madeleine Clare Elish argue for a reframing of data analysis methodologies that moves away from the terminology of machine learning and towards a computational ethnography. These authors problematize not only the faith and reliance in data-driven technologies but also question the seemingly magical moments of artificial intelligence and their branding in commercial environments. They are furthermore referring to uncanny effects caused by machines performing as though they were human. These effects also arise when algorithmic systems perform unintelligible glitches, for instance in showing very poor commercial recommendations or advertisements. However, the algorithmic result can become even more uncanny when the machine is providing results (i.e. predictions) as a basis for decisions that are not as banal or mundane as the display of commercial advertisements. Machine learning-driven surveillance strategies are, for instance, introduced in Western democracies with the claim of offering superior security assessments based on predictable information. Data collection and processing can, for example, become a resource for authorities to assess the likelihood of potential future criminal activities. In her book *Carceral Capitalism*, Jackie Wang untangles the relationship between algorithms, data analysis, racial discrimination, and their carceral function in the United States. Wang uses the predictive policing tool *PredPol* to show how data analysis tools are highly reliant on decisions made about their input data. In Wang's example, these human decisions determine the areas and neighborhoods that are under particular investigation. "Although data has been conceptualized as neutral bits of information about our world and our behaviors, in the domain of criminal justice, it is a reflection of who has been targeted for surveillance and policing" (Wang 247-248). Forms of policing informed by machine learning tactics are endorsed as a reliable science, notably for the sake of security. These methodologies are claimed to generate predictability through the collection and processing of data (Elish and boyd; Wang). As noted above, the very composition of machine learning relies upon several factors in which human input and the collection of training data are necessary. As a result, the selection of specific training data shapes the very core of the machine learning model (Mackenzie; Pasquinelli). As Wang notes here, it is always a question of what input data is provided in the training sets.

There is no doubt that algorithmic systems tend to infiltrate and influence more and more aspects of life, in different variations and with varying ramifications. A request for technical insight into these mechanisms seems necessary at this stage, given the problematic outcomes that machine learning environments can entail. Can technical knowledge gain insight into algorithms and their work within machine learning? It is thus far understood that the results of machine learning rely on its various components, including its input data. But how can these systems be understood and managed, considering that they are often described as fundamentally obfuscated and veiled?

The difficulty of knowing algorithm(s)

> *Algorithms are inert, meaningless machines until paired with databases on which to function. A sociological inquiry into an algorithm must always grapple with the databases to which it is wedded; failing to do so would be akin to studying what was said at a public protest, while failing to notice that some speakers had been stopped at the park gates (Gillespie 169).*

Wang's contribution emphasizes the importance of critiquing the implementation of data-driven technologies. In order to formulate such a critique, it is necessary to become knowledgeable about what and how data is collected. Moreover, as Tarlton Gillespie points out in the above quote, the forms of data processing through algorithmic intervention are another crucial aspect. One way of approaching this problem is through a technical understanding of machine learning and the mechanisms that algorithms carry out. Machine learning is highly complex. We have already touched upon some compositions of the technology very briefly here, with a focus on the importance of input data. Matteo Pasquinelli proposes deciphering the training sets and their processing within machine learning. Building upon Kate Crawford's and Vladen Joler's illustration of the Amazon Echo system in *Anatomy of an AI System*, Pasquinelli highlights the composition and affordances of the different training sets that make the machine learn. He furthermore approaches machine learning algorithms and the production of bias in their outcomes through the statistical and mathematical compositions in place.

By looking at these training sets, it is possible to visualize the human input and decision-making process in machine learning. Taina Bucher likewise highlights the moments of human input in algorithmic processes. For her, these inputs denote a particular interest in the data, the desired outcome and the selection of used data in the first place. The necessary human input in machine learning can thus be characterized by a prior interest in the data, a particular set of assumptions made about a specific case.

A preliminary technical insight is valuable for understanding machine learning as an environment shaped partly by human and partly by non-human agency, as a fundamentally posthuman endeavor (Bucher; Hayles *How We Became Posthuman*). Investigating this state of entanglement of machine learning practices with culture and their societal aim represents a break from the premature conclusion that automated data processing guarantees reliable information and predictability (Wang). This is what Bucher calls "distribution of agency," acknowledging algorithms as being products of human-non-human environments. "Algorithms are not given; they are not either mathematical expressions or expressions of human intent but emerge as situated, ongoing accomplishments. That is, they emerge as more or less technical/nonhuman or more or less social/human because of what else they are related to" (Bucher 55). Thinking about machine learning systems as being constructed from distributed forms of agency is helpful for dispelling the idea of objectivity within technology. I'm following Bucher here in considering the embeddedness of algorithms in systems — technological as well as cultural systems. Thus, in looking at the two following works of art, I not only acknowledge the interwovenness of algorithms with cultural practices but also consider these examples as potentially demystifying the magical elements of machine learning as well as forms of human exceptionalism (Hayles).

Machine learning as nonconscious cognition

In terms of the difficulties of knowing algorithmic processes, I refer to Katherine Hayles' exploration of "nonconscious cognition" to gain entry into the first work of art. In her book *Unthought: The Power of The Cognitive Nonconscious*, Hayles uses contemporary neuroscience, literary studies, economics, and computer science to work towards the idea of a nonconscious cognition. Hayles describes all forms of a cognition beyond consciousness as the nonconscious.

She thereby emphasizes the deep entanglements of human systems with technological cognizers. Drawing upon a Deleuzian and Guattarian understanding of assemblage, Hayles develops the term 'nonconscious' in the direction of a cognitive assemblage to account for a wider spectrum of "interactions between human and non-human cognizers" (Hayles 115).

> *The point of emphasizing nonconscious cognition is not to ignore the achievements of conscious thought, often seen as the defining characteristic of humans, but rather at a more balanced and accurate view of human cognitive ecology that opens it to comparisons with other biological cognizers on the one hand and on the other to cognitive capabilities of technical systems. Once we overcome the (mis)perceptions that humans are the only important or relevant cognizers on the planet, a wealth of new questions, issues, and ethical considerations come into view (Hayles 10f.)*

Hayles challenges an anthropocentric perspective by deploying the notion of non-human cognizers and is thus in line with other critical posthumanists, like Rosi Braidotti. In exploring Hayles' concept of nonconscious cognition, I will read the following work of art as a cognitive assemblage of a machine learning environment and will attempt to render tangible the intimate entanglement of human and non-human systems. *Pandæmonium* is an artwork by the Berlin-based duo PWR studio. It is displayed on the website of the Copenhagen-based Annual Reportt exhibition space and was part of an exhibition in January 2018. The piece was not the only work shown in the exhibition but will be the focus here. The artists created an algorithm that runs as a text block down the screen when entering the website. The text block called *Pandæmonium* involves seemingly meaningful text and, according to the artists, refers to a dream sequence. The composition and visual language of the artwork *Pandæmonium* allows me to apply the notion of nonconscious cognition to the automated text code shown in the work.

Seen from afar, the piece could at first glance be read as a form of computer code. It is a lively mechanism that is taking over the screen of the device. But this form of a cannibalization of the screen can also be read as a pressing statement of mechanical feelings coming to expression. *Pandæmonium's*

Figure 1: Screenshot from PWR studio's *Pandæmonium* (2018), displayed on Annual Reportt's website, http://annualreportt.com.

reference to a dream sequence and a nightmare brings opposing notions regarding machine learning to the table. The work produces a layer at the top of the screen, which making its way relentlessly down to the bottom. It adds a code of automated textual information while simultaneously scraping off a layer of the obfuscated and seemingly unknowable machine learning mechanism.

> *Pandæmonium is a logistical nightmare. Pandæmonium is a pan-computational dream sequence. Pandæmonium shows a future where digital networking has merged with fundamental reality. Everything is an interface to something else. Everything is connected to everything else. Everything is inhabited by autonomous agents acting according to opaque programming (PWR studio).*

The "autonomous agents" mentioned in the above quote evoke the magical elements of artificial intelligence. The provocation lies in part in the machine's ability to produce apparently meaningful text, a fear related to the aforementioned human exceptionalism, the idea of humans being the only creatures to which cognition can be ascribed (Hayles). The visual language of the work displays the hidden and uncategorized feelings of the technological assemblage, simultaneously a dream and a nightmare, both human and non-human. The text block itself entails many references to bones, metacarpal bones, the mouth, the human body and its interaction with an uncertain and ever-changing environment. A close reading of the work's text block might reverse engineer the choices of the categorizations and tokenizing of an input text-corpus. The unintelligible glitches in *Pandæmonium*, grammatical errors and mechanical failures, have not been erased or corrected. The obfuscated nature of machine learning environments is demonstrated in the glitches and unstructured associations of the work's text code. The text code running down the screen as output becomes the unreadable code that structures the system itself behind the scenes.

In her book *If... Then: Algorithmic Power and Politics*, Bucher establishes the idea of "eventfulness" within algorithmic procedures. She draws here upon a Whiteheadian notion that focuses on the becoming of an entity, rather than on its simple being. In *Process and Reality*, Alfred North Whitehead (1978) suggests that the constitution of a being is always related to its process of becoming. Transferring this notion to algorithms, Bucher substantially shifts the question from "what algorithms are to *what they do* as part of specific situations" (Bucher 49). I thus argue that the progression of the text code, the becoming of the piece of *Pandæmonium*, fosters this understanding of the eventfulness of algorithms. It is not an end result of data analytics but is a text code in progress, stretching from the top of the page to the bottom. This visual operation of the artwork makes the text block appear as a form of nonconscious cognition. *Pandæmonium* is becoming, is a form of machine cognition acting out the display of its unexpressed desires. Reading the work through this analytical lens allows us to decipher the basic components of machine learning environments, such as their eventful character (Bucher). The constitution of the work demonstrates the interwovenness of human and non-human cognizers. It is the piece acting as if it were unpredictable, as if it were dreaming and creating unstructured images and thoughts. The work's aesthetics highlight a break from human-centered belief of cognition as exceptionally human (Hayles).

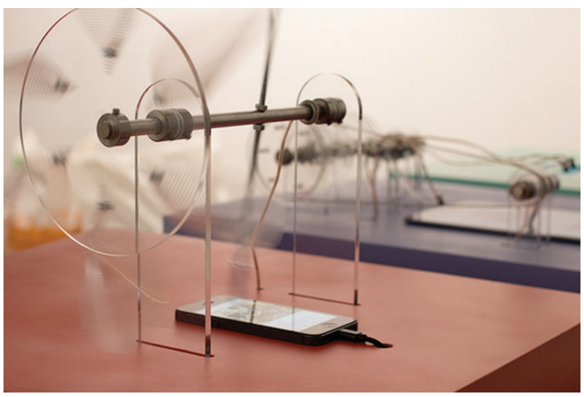
Material acts of unpredictability

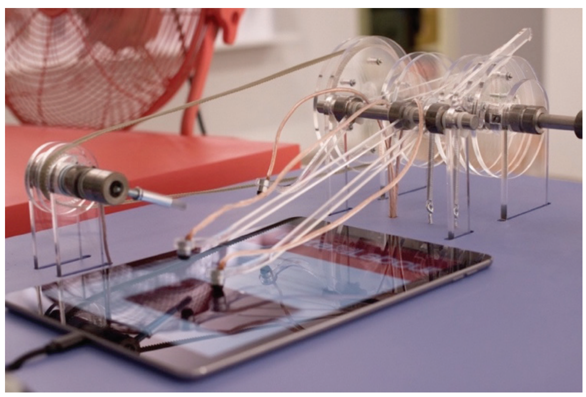
One of the strengths of — but also one of the problems with — machine learning systems is their mundane yet invisible presence. I noted above Wang's example of their implementation in predictive policing strategies, but they are already in place in services used on a daily basis, such as news feeds on social media platforms (Mackenzie). In these cases, no access is given to how input data is processed or how algorithms are trained. One means of intervening in the categorization and deciphering the seemingly objective predictability in machine learning is through a different kind of engagement with the system itself. The second work to which I refer in this paper fosters ideas of interventions in algorithmic systems through acknowledgement of their embeddedness in a material environment. Through reading the following work, *Stop the Algorithm* (2018), I seek to rethink unpredictability in machine learning environments as a form of intervention.

The processing and capitalization of affects and attention spans are core patterns used within the big social networks such as Facebook and Instagram. This makes forms of manipulation and control of feelings through data-driven systems difficult to contest, especially in light of the monopolistic power of the big social networks. The artists Stephanie Kneissl and Max Lackner created various gadgets to shift the balance between user and algorithm within the technical assemblage. Their machinic instruments do not actually stop the algorithm, as the name of the artwork suggests, but they change the determination and categorization in the environment of social media sites on both ends: the end of the data input and end of the data output in form of, for example, advertisements shown in the continuous becoming of the newsfeed.

> *We often assume that those systems are tools, made to connect and inspire us, an infinite playground, an uncontrolled network that constantly reinvents itself. […] But social media is not neutral but highly biased and has an agenda of its own, with the goal of us to stay online and share as much as possible. What we see on social media is decided by algorithms that are highly subjective, favouring popularity and mass instead of content. This influences our opinions and thoughts. (Kneissl and Lackner).*

In Fig. 2, a small wind wheel is connected to a pencil. Driven by a ventilator, the pencil swipes through the newsfeed of





Figures 2 and 3: Stephanie Kneissl and Max Lackner, *Stop the Algorithm* (2018).

an Instagram account on an iPhone. In the second gadget shown here (Fig. 3), the pencil is combined with other touching devices. Connected to wheels, they move and stop within the newsfeed – as if something caught their attention – before scrolling further. The movement of the touch on the screen leaves traces of attention within the network and feeds new data into the network. When the little arms touch the surface, they seemingly show an interest in the content, as-if-human. These first two parts of the composition rely on these procedures to maintain a sense of unpredictability: interaction with the physical surroundings take the place of a human cognizer in scrolling through the device.

The artists aim to create random interaction on the basis of material conditions in the exhibition room in order to trick the algorithm. Tricking in this context means engaging with the newsfeed algorithm through an unpredictable method of scrolling. In *Stop the Algorithm*, the platforms' algorithms are not actually stopped but are instead detrained. The work thus seeks to change one of the fundamental components of machine learning environments.

> *As the informational networks and feedback loops connecting us and our devices proliferate and deepen, we can no longer afford the illusion that consciousness alone steers our ships. How should we reimagine contemporary cognitive ecologies so that they become life-enhancing rather than aimed toward dysfunctionality and death for humans and nonhumans alike? Recognizing the role played by nonconscious cognitions in human/technical hybrids and conceptualizing them as cognitive assemblages is of course not a complete answer, but it is a necessary component (Hayles 141).*

Rethinking cognition in a post-anthropocentric manner becomes crucial for the second work too. An intervention into closed systems of data harvesting such as social networks cannot be easily realized. The little gadgets in the work substitute a human cognizer within the technological assemblage of this machine learning environment. The artists deploy interaction with the physical conditions of the exhibition room — the wind wheels, scrolling pens, and touching devices on the apparatus — to enable a form of unpredictability. This material interaction is used as a strategy for engaging with and challenging the newsfeed algorithm. The very idea of implementing material elements for creating unpredictability in technological systems is not new however. In cryptography, a distinction is made between true randomness and pseudo-randomness (Gennaro). The latter is called pseudo because it is a mathematically constructed set of numbers so rendered as to appear random. In contrast, true randomness cannot be generated by computers but is often based upon the implementation of a physical, material set of randomness (Doi and Tadaki).

A prominent case is the use of lava lamps in the creation of true randomness in encryption systems. Lava lamps create an environment that coincidentally merges a mixture of oil, water, and wax. By filming the lava lamps around the clock, the internet security company *Cloudfare* creates true randomness through "the ever-changing

Figure 4: Lava lamp wall at the internet security company *Cloudfare*, image from *WIRED Magazine*.

arrangement of pixels to help create a superpowered cryptographic key” (Airhart). With these measurements, this randomness creates security keys that cannot be predicted by hackers. Only by implementing a material component can unpredictability be introduced. As a result, material randomness holds the potential to overcome the predictability of statistical reductionism in machine learning environments. Simultaneously, the principle of a form of randomness in material environments is becoming an eventful coincidence for a data-driven world. In moments of data processing, these material acts of unpredictability enable a withdrawal from pre-set categorization and classification and debunk the myth of knowledgeable data analytics.

As mentioned above, eventfulness is a core asset of algorithmic environments – from data collection to the learning procedures and training of machine learning that results in artificial intelligence (Alpaydin). The chosen works of art demonstrate an algorithmically and material form of eventfulness that is useful for dismantling myths, uncanny feelings, and magical elements of machine learning as well as for demonstrating their character as technological assemblages of human and non-human environments. In *Stop the Algorithm*, it is the manifestation of the notion of eventfulness through interaction with a material environment that disrupts the original purpose and capitalization of data collection. *Pandæmonium*, in contrast, visualizes a process of composition in machine learning.

Conclusion: Machine learning as cultural practice

There can be no doubting the significance of gaining insight into the technological operations of data collection, databases, and training sets for machine learning. Methodologies of reverse engineering (Bucher), ethnographic research (Seaver), and critical code studies (Cox) possess great potential for constructing knowledge about machine learning technologies. In this paper, I propose including the notion of eventfulness and the idea of nonconscious cognition of human and non-human environments for describing machine learning systems. I believe that these concepts present opportunities for grappling with the potential ramifications of algorithmic processes. They furthermore simultaneously enable the questioning of seemingly objective output and emphasize the necessity of human input. The works of art introduced in this paper help us negotiate these concepts. Aesthetic and artistic representations can contribute to the discourse on machine learning ramifications, highlighting the blind spots of computational determination with reference to algorithms as culture and in culture (Seaver). Moreover, the sustainability of a mere technological insight is questionable in the light of the ongoing development of ever-more complex systems and their interwovenness with capitalist and political structures of oppression and social forms of control (Wang).

The visual language of the works of art provide a framework for expanding a vocabulary of machine learning and introduce creative interventions into algorithmic systems. *Pandæmonium* questions the meaningfulness of computational processing in the text code that it displays on the exhibition space’s website, while the notion of material resistance in *Stop the Algorithm* emphasizes the limits of engagement with highly complex technological systems that cannot be easily decoded or dismantled. The discussion of possible means of engaging with and formulating criticism towards technologies can be accompanied by discursive and aesthetic forms that demystify images of black boxes and debunk the hype of artificial intelligence. Reading machine learning as eventful – as a concept of becoming that entails subjective categorizations and entails nonconscious cognition – transforms technology from being a neutral instrument into a cultural practice. Machine learning systems are meant to guarantee a mode of predictability through the mathematical reduction of complexities. Therein lies potential for the unpredictability of a material embeddedness to recognize the ramifications of machine learning systems and challenge the knowledgeability of their output.

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SEEING THINGS

Mitra Azar

POV-MATTER, CINEMATIC POV AND ALGORITHMIC POV BETWEEN AFFECTS AND UMWELTEN

Abstract

The essay refers to affect theory as a conceptual toolbox to draw a genealogy of POV (Point of View) that goes from the formation of the first organic POV to the reinvention of POV by the cinematic apparatus up to the latest development of algorithmic POV in machine vision and AI. The essay engages with Bergson's conviction that there's no perception without affection, and tests it against a phenomenological, cinematic and machinic notion of POV. To do so, the essay introduces what the German biologist Jacob von Uexküll has called *Umwelt* — the ecological niche emerging from the affordances between organisms, space, and (when applicable) technology. Furthermore, fundamental categories of both phenomenology and psycho-analysis are put at work in relation to cinematic POV and to the algorithmic POV produced by Generative Adversarial Networks (GANs), which seems to re-invent the relationship between seeing/seen (Merleau-Ponty) and eye/gaze (Lacan). This re-invention confirms the category of *Umwelt* and affect as markers for understanding the transformation between a phenomenological, cinematic and algorithmic notion of POV.

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Could a machine think?
Could it be in pain?
(Wittgenstein, Philosophical Grammar*)*

I. POV, affects and *Umwelten* between phenomenology, cinema and machine vision

In this essay, I propose affect theory as the conceptual framework for analyzing the various regimes of visibility related to the formation of different forms of 'Point of View' (POV). The notion of POV is here approached as a phenomenological feature that in its fundamental understanding goes beyond the visual connotation it has been usually associated with, and can be defined as 'orientation' *tout court*. In this sense, matter is oriented despite the organic/inorganic divide, and can be defined as POV-matter, once framed by the concept of orientation. Orientation manifests already at an inorganic level, right down to the spinning of particles inside atoms that function independently from organic POVs and associated affects. POV-matter takes the form of inorganic POV-matter and organic POV-matter, and the notion of affect is presented as the conceptual tool to understand the differences between the two.

What happens to inorganic POV-matter since the formation of the first organic POV-matter emerging from the *pre-biotic soup*?[1] There, the first proto-stable organic forms of life produce both an orientation and a gap appearing between the immediate action/reaction schema characterizing instead inorganic POV-matter — as demonstrated by Gilles Deleuze is his first book on cinema, *Cinéma 1: The Movement-Image*. The notion of affect as 'gap' discriminates between organic and inorganic POV-matter. There exists, in other words, a form of inorganic POV-matter characterized by orientation but not by the gap associated with orientation when orientation relates to an organic living agent.

Building from these first considerations, the essay asks what happens to affect when POV becomes associated to more complex forms of life equipped with a visual sensing apparatus, such as in the case of human beings. Furthermore, what happens to affect when POV becomes technological and associated to a visual and technological apparatus? Although inorganic POV-matter lacks an organic form of perception and affect, human beings have been able to turn inorganic POV-matter into a technological apparatus capable of harnessing both perception (and by doing so the organic POV-matter associated to it), and the affective gap itself. The technological apparatus can be referred to as a POV-apparatus because it is constituted by POV technologies of vision, which means technologies designed to harness phenomenological POV. Via analog POV technologies of vision such as painting, photography and cinema, the POV-apparatus attempts to harness affection via perception. Via what Mark B. N. Hansen calls '21st century media' (266), POV-apparatus attempts to harness affection directly, and turns into a type of media which gains the capability of directly attacking the affective gap at the core of organic POV-matter, thus generating inorganic algorithmic POV capable of mimicking the functioning of organic POV.

In summary, the essay aims to investigate what happens to affect in relation to both the (pre)phenomenological and the technological (specifically cinematic and algorithmic) definitions of POV. By questioning the becoming of different forms of POV and their corresponding affects, the essay aims to engage with the French philosopher Henri Bergson's conviction that there's no perception without affection (Bergson 17-76). To do so, the essay introduces what the German biologist Jacob von Uexküll has called *Umwelt* ("The new concept of Umwelt" 111-123), understood as the affordances generated by the interaction between organisms, space, and – when applicable, such as in the case of human beings — technology: "everything a subject perceives belongs to its perception world [Merkwelt], and everything it produces, to its effect world [Wirkwelt]. These two worlds, of perception and production of effects, form one closed unit, the environment [Umwelt]" (Uexküll, *A Foray into the Worlds of Animals and Humans* 42). Furthermore, the mutation of affect in relation to the transformation between a phenomenological, cinematic, and algorithmic notion of POV are finally approached in relation to the reversibility between *seeing* and *seen* (Merleau-Ponty, *The Visible and the Invisible* 130-155) and the relation between the notion of *eye* and *gaze* (Lacan 67-79). These fundamental categories of both phenomenology and psycho-analysis (Merleau-Ponty, *The Visible and the Invisible* 130-155; Lacan 67-79), are put at work in relation to a specific form of algorithmic POV produced by Deep Convoluted Generative Adversarial Networks (DCGANs, or simply GANs), which seems to re-invent the relationship between *seeing/seen* and *eye/gaze*. This re-invention invites rethinking the category of *Umwelt* and affect as markers for understanding the transformation between a phenomenological, cinematic and algorithmic notion of POV.

II. From inorganic POV-matter to affects, organic POV-matter and *Umwelten*

In a fundamental way, POV can be understood as orientation. After the Big Bang, fundamental blocks of matter organized themselves by producing orientations, technically referred to as 'spins' within electromagnetic fields.[2] In other words, despite the organic/inorganic divide, matter is always orientational: matter is directional, and can, hence, be characterized as 'POV-matter'. Inorganic POV-matter indicates that orientation manifests itself in the inorganic world, and only afterwards turns into the orientation of organic POV-matter. Organic POV-matter exists from the simplest organisms deprived of a visual sensing apparatus, but yet capable to orient via other senses (such as the 'tick'[3]) to more complex living beings developing the sense of vision, among them human beings. In contrast to inorganic POV-matter, organic POV-matter perceives. Thinking generally of matter as POV-matter is not trivial, because it allows us to not only think of orientation or POV as pivotal ontological and phenomenological concepts, but also and more importantly because it allows to re-articulate the agential relation between the organic and the inorganic. In this non-trivial sense, a POV is not something that comes exclusively with the human or with the technological. Rather, POV as the production of an orientation has cosmological origins which not only predates the appearance of human POV but also the appearance of the first form of simple organic POVs in the prebiotic soup.

What then happens to orientation when orientation becomes embedded into organic living being inhabiting a *Umwelt*, understood as the *ecological niche* of a living organism? If inorganic matter is, in a way, always inorganic POV-matter, *Umwelt* is in a way always POV-*Umwelt*, because it always refers to an oriented *subjective* experience (although not forcibly human). Every *Umwelt* "has its own spatial and temporal dimensions" (Uexküll, *A Foray into the Worlds of Animals and Humans* 49), and " [they] intersect in many ways without disturbing each other" (Uexküll, "The New Concept of Umwelt" 117). As Uexküll further explains: "every action […] that consists of perception and operation imprints its meaning on the meaningless object and thereby makes it into a subject-related meaning-carrier in the respective Umwelt (subjective universe)" (Uexküll, "The Theory of Meaning" 31). Otherwise expressed, when (according to different evolutionary survival criteria) inorganic POV-matter develops into organic forms that orient themselves in space, the various forms of POV-matter produce their unique *Umwelten* — of which the organism's regime of visibility represent the visual counterpart. Orientation, or POV — in the form of a perceptive agent — produces *Umwelt*. At the same time, in turn, *Umwelt* produces POV. Furthermore, the formation of the organism's *Umwelt* is specifically related to the affective quality of organic POV-matter, because it is in the affective gap between action and reaction that an orientation is produced, and together with it the beginning of an *Umwelt*. In this sense, affect establishes itself as the inner engine of orientation, and orientation as the inner engine of *Umwelt*.

Inorganic POV-matter turns into the technological and cultural expression of complex organic POVs such as human beings, and becomes a cultural and technological product. In their technological instantiation, spins and fields of atoms' particles are geared towards the construction of technologies able to reproduce the regime of visibility correspondent to the *Umwelt* of a given organism. Inorganic technological POVs, attempt to mimic the functioning of organic POVs, and by doing so they manage to overlap and ultimately bridle human POVs and their *Umwelten*. Inorganic POV-matter becomes technological POV-matter, or POV-apparatus. A POV-apparatus of analogue technologies (such as painting, photography and cinema) is a form of visual governmentality developed to ultimately harness humans' POV and subsume affection via perception. A digital or algorithmic POV-apparatus (such as the one enforced by artificial intelligence and GANs) bypasses perception, and operates at the affective gap to predict the emerging affections and related affordances of organic POVs within a given *Umwelt.*

III. Organic POV-matter and affects

In this section, I argue that organic POV-matter is defined as a form of orientation co-emerging with the affective gap during the formation of the first proto-stable organic forms of life. As mentioned earlier, according to Bergson, there is no perception without affection (17-76). In other words, there is an intrinsic relation between organic POV and affects. Bergson's statement is adopted by Deleuze, in *Cinéma I: The Movement-Image*, to categorize cinematic images: "The thing is the image as it is in itself, as it is related to all the other images to whose action it completely submits and on which it reacts immediately. But the perception of the thing is the same image related to another special image which frames it, and which only retains a partial action from it" (Deleuze, *The Movement-Image* 64).

From a universe composed by images that "act and react on all their facets and in all their parts" (Deleuze, *The Movement-Image* 61), Deleuze unfolds the image-perception to name a type of image which "only receive[s] actions on one facet or in certain parts and only execute reactions by and in other parts. […] the image reflected by a living image is precisely what will be called perception" (Deleuze, *The Movement-Image* 62). In other words, image-perception is the image reflected by organic POV-matter. This "image reflected" coincides with the regime of visibility of a given *Umwelt* for a given organic POV-matter. Nevertheless, how does inorganic POV-matter turn into organic POV-matter?

Affect — understood as the production of a gap between action and reaction — is the catalyst for the production of affects and for the formation of organic POV-matter(s) and their respective *Umwelten*. *Umwelt* is here understood as the selective interaction between organic and inorganic POV-matter (e.g. a species and their environments, also considered in their inorganic composition). Orientation is what emerges together with affects from the gap, producing both a POV and a *Umwelt*. In the affective gap between action and reaction POV-matter orients itself according to the elaboration of the input (action) from the surrounding environment and towards an output or reaction — this circuit being what Uexküll refers to when he says that "everything a subject perceives belongs to its perception world [Merkwelt], and everything it produces, to its effect world [Wirkwelt]. These two worlds, of perception and production of effects, form one closed unit, the environment [Umwelt]" (Uexküll, *A Foray into the Worlds of Animals and Humans* 42).

Orientation is the fundamental resolution of organic POV-matter(s) to their specific *Umwelten* — and emerges from the affective gap at the foundation of organic POV-matters to harness the affordances appearing between organic POV-matter(s) and their *Umwelten*. Affects fill the seemingly empty gap between action and reaction defining the emergency of organic POV-matter: "the interval is not merely defined by the specialization of the two limits facets, perceptive and active. There's an in-between. Affection is what occupies the interval, what occupies it without filling it in or filling it up" (Deleuze, *The Image-Movement* 65). This is how the difference between inorganic and organic POV-matter comes into being. Organic POV produces a gap between the continuous action-reaction characterizing the functioning of inorganic POV-matter. The gap is where the action-reaction circuit is interrupted. "Even at the level of the most elementary living beings one would have to imagine micro-intervals. Smaller and smaller intervals between more and more rapid movements" (Deleuze, *The Movement-Image* 71).

Once reduced to its essence, the affective gap can be intended as the figure for the coincidence between organic POV-matter and inorganic POV-matter, or, for simplicity, between subject and object. This is what happens, for instance, when the subject is automatically driven to bring attention to their body — such as in the case of hunger. Hunger happens in the gap between action (the action of the environment on the subject in the form of the presence of food) and reaction (the movement towards food by the subject) because of a moment of self-perception during which the subject becomes the object of their own attention, before enacting the appropriate reaction. Self-perception sprouts from the affective gap, short-circuiting the relation subject/object. This is interesting because cinematic POV produces something similar by perceptively overlapping the subject (audience/actor/director) with the object (camera/screen). By doing so, cinematic POV manages to access the affective gap at the core of organic POV-matter or phenomenological POVs. To put it simply, the functioning of cinematic POV mimics the way the affective gap functions at the level of phenomenological POV, and subsumes the affective gap via perception. Generally speaking, analogue POV technologies of vision such as painting, cinema and photography harness organic POV and the affective gap on the side of perception, aiming at shrinking the distance between technological and organic POV. Because of movement, the cinematic figure of POV operates this shrinking flawlessly and in doing so manages to short-circuit subject and object by giving to the audience the illusionary (self-) perception of breaking through the screen and of moving inside of it on behalf of the character. As a consequence, cinematic POV manages to harness the affective gap via the subject's activity of self-perception which emanates from it. Digital and algorithmic POV technologies in the form of AI and machine sensing — what Hansen refers to as 21st century media — instead, attempt to harness organic POV and perception directly on the side of affection. Before looking at the role of the 'gap' in relation to machinic POVs, I will now discuss the form that inorganic POV-matter takes once it becomes cinematic apparatus, and more specifically, cinematic POV.

IV. POV in cinema and phenomenology: Reversibility between seeing/seen and split between eye/gaze

In the field of cinema, POV is an acronym which refers to a type of image that allows the viewer to see what the character sees from the character's perspective (or orientation) (Braningan 55). POV cinematic images simulate the movement of an actor within a space, creating a sense of continuity between viewers and what is viewed, as if viewers are 'embodied' in the images they're looking at. In this sense, cinematic POV images generate the *seamless* overlapping between camera, actor's body and spectator's body, thus producing a form of *seamless* overlapping between the human and the technological. If technology and human have been overlapping since 'hominization',[4] with cinematic POV the overlapping is *seamless* because of the capacity of cinema to reproduce movement, a quality other medium before cinema couldn't attend to. Cinematic POV articulates the relation between the spectator's POV intended as the phenomenological orientation produced by an embodied human agent in a physical space and the regime of visibility produced by the cinematic machine. The very collapse and overlapping between the embodied agent's POV and the regime of visibility generated by the cinematic machine is the main feature of the cinematic technics of POV. Cinematic POV harnesses the embodied POV on the side of perception, and aims at shrinking the distance between technology and body, or between object and subject.

The possibility of generating the *seamless* overlapping between camera, actor's body and spectator's POV gives to cinematic POV the ability to intervene into the affective gap at the core of organic POV by re-articulating the relation between the phenomenological categories of seeing/seen and eye/gaze. From a phenomenological perspective, one of the main features of human POV is that of expressing a "worldly sensitivity" (Hansen 266) visually characterized by the reversibility between the coupling of seeing/seen: I'm seeing the world around me but I'm also seen simultaneously by others, and this reversibility (together with the reversibility between touching/touched) is what defines my *being in the world*, my embeddedness into an intersubjective world: "the seer is caught up in what he sees, it is still himself he sees" (Merleau-Ponty, *The Visible and the Invisible* 139). This coupling is molded on touching/touched, for which "I can identify the hand touched as the same one which will in a moment be touching […]. The body [… tries] to touch itself while being touched and initiates a kind of 'reflection'" (Merleau-Ponty, *Phenomenology of Perception* 106).

The horizontal relation identified by Maurice Merleau-Ponty between seeing/seen turns vertical once framed by the *originary asymmetry* between the eye and the gaze defined in the context of Lacanian psychoanalysis: "I'm seeing only from one point [an eye, or a POV], but in my existence I'm looked at [by the *gaze*] from all side" (Lacan 72). Cinema does something pretty interesting to these phenomenological and psycho-analytical categories: if it seems possible to say that cinema enforces the vertical relation between the eye and the gaze – the eye being the eye of the spectator and the gaze being the director's "all-seeing" (Lacan 75) — in the case of the cinematic technic of POV, eye and gaze collapse into each other. Thus, POV re-establishes the horizontal reversibility between seeing and seen (in this case between the seeing/seen of the viewer and director via the mediation of the actor). This reversibility of POV is at the root of its pharmacological nature, of its capacity of being both poison and cure.[5] In mainstream media, this capacity has been deployed to "disseminate ideology" and to enforce "consumer's behaviors" the way Adorno and Horkheimer explicate in their 1944 *Dialectic of Enlightenment*. The reversibility between eye and gaze produced by cinematic POV generates perceptive immersion and embodiment beyond the surface of the screen. The audience falls into the screen, embodied into the character's body, and the spectator's self-perception — understood as the state emerging from the affective gap the way it has been described in the above section III — can be directed by engineering the intertwining (Merleau-Ponty, *The Visible and the Invisible* 130-155) between seeing/seen — I'm seeing the actor/character moving in the scene and I'm seen (perceived) by myself as the very actor/character. This is the way in which POV-apparatus functions — by manipulating affects via perception. Thus, the immersivity produced by the figure of cinematic POV is harnessed to disseminate ideology and enforce consumer's behaviors. At the same time, the collapse between the eye and the gaze operated by cinematic POV re-arranges the relation between the coupling seeing/seen and can produce the emergency of new forms of political agency. For example, POV mobile phone images recorded in the context of social unrest and protests and uploaded online (such as in the case of the so-called 'Arab Spring'), became the available format for revolutionary subjects to perform their political agency. The Egyptian Revolution has been an experimental ground for such grassroot emancipatory media practices.[6]

Finally, after having attempted to provide an understanding of the functioning of phenomenological POV and cinematic POV, I now turn to how the phenomenological *intertwining* of *seeing/seen* and *eye/gaze* is played out in the context of algorithmic POVs. This will be the focus of the last two sections of this article, where I will try to unpack the functioning of algorithmic POVs and their interaction with phenomenological POV and affects via two case studies: one referring to the "Arkangel" episode in the fourth series of *Black Mirror*, the other to the operationality of GANs (Generative Adversarial Networks).

V. POV and algorithms

"Now object perceives me" stated Paul Klee in his diaries, as cited by French philosopher Paul Virilio in the opening of his *Vision Machine* (1994), somehow prophetically envisioning a world of objects that learn how to see — and to “sense” — the surrounding space and the bodies occupying it. New technologies of vision oriented towards new forms of ‘data-veillance’ (Clarke 254-271) such as machine vision, seem to give technological consistency to Klee’s intuition. Moreover, these technologies seem to confirm the a-symmetry Lacan locates at the very heart of our phenomenological *intertwining* with the world, making visible the encompassing visual power of the (technological) gaze against the localized and punctual vision of the (human) eye. This a-symmetry is currently taking new forms that extend the capability of the gaze to *all-seeing*: for example, tracking technologies based on AI aim at quantifying a number of qualitative *inputs* that go from facial features and facial expressions to breathing pattern and heart beats — inputs that are the embodied manifestations of the affective patterns emerging from the affective gap. By quantifying them, algorithmic technologies points at accessing the very affective gap between action and reaction defining organic POV-matter — or its emergency as an affective, embodied POV. The technological gaze tries, thus, to vicariously access the eye by accessing the affective body right at the very moment where it emerges as a POV. In this sense, new technologies of vision based on AI — part of what Hansen calls 21st century media — attempt to locate themselves at the very gap where the formation of a *worldly* sensitivity, or perception, emerges. Thus, algorithmic POV technologies invite us to re-think the notion of affect and *Umwelt*. In cinematic POV the overlapping between human and technology produces the overlapping between the regime of visibility of an embodied POV and the regime of visibility of the cinematic machine behind the surface of the screen: the audience feels inside the screen, inside the cinematic machine, and breaks through the so called fourth wall which technically separates the actors from the spectators.[7]

With algorithmic technologies the process looks similar but inverted. They produce the overlapping between the human and the machine by inserting the machine into the human, and not vice-versa, as in the case of cinema. To do so, they attempt to access human POV by accessing the very affective gap where it emerges from: first breaching through the *screen* of the body, and secondly extracting worldly data beyond the human conscious threshold. Thus, machines access vicariously a bodily dimension, while humans are exposed to a quantified version of their very affective fabric, which — datafied — contributes to the constitution of new forms of human-machinic *Umwelten* with complex political implications. One of the most significant change in relation to these new forms of *Umwelt*, consists in the fact that the affordances between the human and the surrounding space are *technically* anticipated by a capture which re-defines affordances as such and which claims to design them in ways that fulfil the subject’s expectations better than the subject’s agency could possibly achieve. This is what happens in relation to the creation of POV data-doubles and the consequent formation of filter bubbles within social networks based on the anticipation of users’ affects[8] emerging from the affective gap. “Anticipation made possible by algorithms […] become increasingly active, to the point of displacing or marginalizing active directedness” (Hui 144). Algorithmic POVs manufacture an “automatic future, in which our selections will be to a large extent, if not completely, predefined according to a specific schema and index” (Hui 150). This is what happens in “Arkangel” directed by Jody Foster — the second episode of the fourth season of *Black Mirror* — where a mother implants her daughter with a device which allows her to see what she is looking at from a POV perspective in real-time. The mother is provided with a user-friendly interface that gives her the possibility of deleting images from her daughter's sight stream that she thinks could traumatize her – such as images of conflicts or violence. As a consequence of this technology, the daughter grows incapable of recognizing conflicts or violence and indeed becomes incapable of behaving appropriately in such circumstances. In "Arkangel", algorithms implement a reality-bubble around children, one perceptively different from the material reality lived by others. In this example, the direct capturing of affects by algorithmic technologies goes beyond perception in the sense that perception appears here as a malleable context to fully engineer, to anticipate and design affects.

These algorithmic technologies attempt to anticipate the affordances that define the relation between organic POVs and their *Umwelten* by designing POV-data doubles retro-actively producing the affective subjects they're generated from. Algorithmic POV handles the relation between seeing/seen by directly harnessing the gap between the two: anticipating the subject's affordances and projecting back into the subject an algorithmic POV data-double which informs the way the subject operates within her own *Umwelt*. This is the only way algorithmic POV technologies can currently and vicariously access affects despite their incapability of producing the gap at the core of organic POVs. In doing so, the (algorithmic) gaze attempts to access the (phenomenological) eye and to control it by vicariously accessing the affective gap, and bypassing perception.

VI. Towards a phenomenological understanding of GANs

Are there any other ways in which algorithmic POVs attempt to reproduce the affective gap of phenomenological POVs? The operationality of GANs provides an exemplary case study of new forms in which algorithmic POVs try to approximate the functioning of phenomenological POVs. GANs mimic the very *intertwining* between seeing/seen and eye/gaze to which Merleau-Ponty and Lacan refer when pointing to the *enworlding* of phenomenological POVs. GANs are the most advanced form of algorithmic simulation of a phenomenological *enworlding*, as I hope to illustrate during the course of this last section. What exactly is a GAN, and why am I saying that GANs provide an example of a new radical way to attempt the simulation of the affective gap at the core of phenomenological POV?

GANs are a form of unsupervised machine learning able to access raw data from the world and to build an *understanding* of them without the mediation of any linguistic labeling applied by humans, or "mechanical turks" (Wikipedia), which tag huge datasets of images and prepare them to train "supervised machine learning algorithms" (Wikipedia). GANs build an *understanding* of raw data by establishing an antagonistic relation between two neural networks, one generating data (generator), the other discriminating the data generated on the basis of a model (discriminator).

In a sense, generator and discriminator constitute each other through an algorithmic *exchange* that closely resembles both the *intertwining* of the coupling seeing/seen and the split between the eye and the gaze. Generator and discriminator see each other and in doing so establish each other's (inorganic and algorithmic) POV, while at the same time enacting the distinctive roles of the eye (generator) and of the gaze (discriminator). At the same time, a form of technological *Umwelt* appears as the place of the emergency of GANs' affordances. GANs' *Umwelt* emerges at the intersection of generator and discriminator's affordances, and takes the form of what is technically addressed as *latent space*. Latent space is defined as the space where a "generative network learns to map […] a particular data distribution of interest, while the discriminative network discriminates between instances from the true data distribution and candidates produced by the generator" (Wikipedia). The latent space can be addressed as an algorithmic *screen* where an algorithmic recognition happens — a recognition based on the interplay between generator and discriminator's different algorithmic POVs. This algorithmic recognition produces a form of algorithmic perception where the complexity of the *intertwining* between embodied POVs is reduced to a task-oriented statistical capability of pattern recognition — a feature typical of AI in general, according to Matteo Pasquinelli (2017). The latent space is the algorithmic screen where a form of algorithmic gap emerges between the images produced by the generator, and the model on which the discriminator has been calibrated, when generator and discriminator's POVs mismatch. There's no affect in this gap which emerges with the emergencies of the *intertwining* between generator and discriminator's mismatching POVs. Furthermore, the gap is filled once the generator and discriminator's POV perfectly overlap – which happens when the generator produces a closer enough version of the model capable of fooling the discriminator. In this algorithmic *intertwining*, subject and object coincide when the gap is closed, not when it appears such as in the case of organic POV-matter. In brief, the phenomenological *intertwining* between organic POV-matter(s) is rooted in the affective gap from where self-perception – understood as the coincidence between subject and object – emerges. The *intertwining* between generator and discriminator in a GAN, in contrast, is rooted in the algorithmic gap emerging from the mismatching between generator and discriminator's POVs. In other words, if in phenomenological POV the coincidence between subject and object emerges from the affective gap, in GANs the coincidence between subject and object happens when the gap is closed and generator and discriminator POV coincides. This happens when the generator generates an image which fools the discriminator and closely matches the model.

If, according to Bergson, there's no perception without affection, when it comes to GANs and algorithmic POVs in general, we can only metaphorically refer to perception — as much as to POVs and *Umwelt*. Nevertheless, GANs re-invent the relation between POV, affects and *Umwelt*, and do so by deploying algorithms that mimic the phenomenological *intertwining* that is characteristic of embodied POV. If GANs reproduce the phenomenological *intertwining* between seeing/seen and eye/gaze, other types of algorithmic POVs access the body by harnessing the affective gap from within, constituting POV data-doubles and retro-projecting them on the affective subject they have been generated from, bypassing perception (as in the case of Arkangel). These forms of intensive or molecular algorithmic capture of the affective gap, differ from the functioning of earlier media which, instead, operate at a molar level, and subsume affection into perception. Cinematic POV does so by collapsing the eye of the audience and the gaze of the director via the body of the actor-character. The common feature between cinematic and algorithmic POV consists in the shrinking of the distance between the eye and the gaze. This shrinking happens in parallel to the shrinking between inorganic POV-matter and organic POV-matter. Once the former turns into technological inorganic POV-matter, it turns into a POV-apparatus which tends to operationalize the reduction of the distance between the interface and the body, and as a consequence between the (technological) gaze and the (phenomenological) eye. This is the common feature between cinematic POV and algorithmic POV, despite the fact that they operate this reduction differently, the former subsuming affection via perception, the latter subsuming affection *directly*, bypassing perception. By doing so, the POV-apparatus produces both new regimes of visibility — with related affects and *Umwelten* — and new regimes of truth. From the differences between a phenomenological, cinematic and algorithmic form of POV, my argument moves towards defining the techno-phenomenological conditions for the emergency of both new regimes of '(post-)truth',[9] and a new form of visual governmentality, which I refer to as 'POV-opticon'.[10]

Notes

[1] 'Pre-biotic soup' is an expression related to the unstable state of matter in which chemical compounds were about to generate the conditions for life over the planet Earth at a certain stage of its evolution (CERN).

[2] Spins describe electrons spinning around nuclei of protons and neutrons forming the first atoms some 380,000 years after the Big Bang (Cern.com).

[3] The 'tick' is a famous example emphasized by both Uexküll and Deleuze. See Uexküll's *A Foray into the Worlds of Animals and Humans*, and Deleuze's *L'Abécédaire de Gilles Deleuze*.

[4] See Stiegler's *Technics and Time I. The Fault of Epimetheus*.

[5] The pharmacological nature of technology is highlighted by Bernard Stiegler throughout his philosophy. See Stiegler's "Pharmacology of Desire".

[6] I have been writing about media activism in Egypt during the revolution while being based in Cairo and collaborating with activist collectives. See Azar,"The Revolution will not be Tweeted (?)".

[7] The 'fourth wall' mirrors the a-symmetry Lacan refers to the relation between the eye and the gaze: if the spectator can see the actors behind the fourth wall, the actors act without seeing behind the fourth wall that somebody is seeing them. And yet the seeing of the spectator is driven by the seeing of the actors.

[8] I have previously explored this topic in relation to the production of a new type of selfie aesthetic in a paper published last year in *APRJA*; see Azar's "The Algorithmic Facial Image (AFI) and the relation between truth value and money value". Another example of these forms of prehension is a new MIT prototype that allow users to control basic functions of a computer through an ergonomic wearable interface able to record the micro-movements of the subject's lower jaw as a way to infer brain activity - the jaw moves slightly when the brain formulate a decision even without the production of a verbal utterance – and before the awareness of the subject: "Electrodes on the face and jaw pick up otherwise undetectable neuromuscular signals triggered by internal verbalizations". See Herdesty's "Computer system transcribes words users 'speak silently'".

[9] See Azar's "The Algorithmic Facial Image (AFI) and the relation between truth value and money value". The paper is forthcoming as a chapter of G. Lovink and D. Della Ratta (eds), *Online Self*. Palgrave and McMillan, 2021.

[10] I've started investigating the relation between POV, regimes of truth and games of truth in a paper presented at the 2018 *After Post-Truth* conference in Barcelona. See Azar, "From Panopticon to POV-opticon: drive to visibility and games of truth" (draft version of the paper can be found on academia.edu).

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Daniel Chávez Heras

SPECTACULAR MACHINERY AND ENCRYPTED SPECTATORSHIP

Abstract

This paper argues certain types of contemporary computation have a spectacular dimension which is consumed today as magic. Using popular images created through Generative Adversarial Networks (GANs) as a case study, I analyse the conditions of production and consumption of imagery generated through machine learning as a type of popular culture, I then compare this creative use of computing with magic shows and the cinema of attractions of the early twentieth century. This approach combines notions of digital cultural materialism with theories of early film spectatorship to suggest an emergent cultural trend: monstrative global computation as a form of spectacle.

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What you are about to witness is not magic, it is purely science.
— Robert Angier

Techniques are like seeds which bore fruit in the soil of magic.
— Marcel Mauss

We need to talk about GANs

Machines for automatic learning are neither creative nor intelligent devices themselves, but they are indeed awesome. While attributions of machine agency in most academic circles are fraught, at least for now, there is undeniable enthusiasm about the possibilities that these technologies appear to enable in and beyond academia. It is therefore surprising to find that very little attention has been paid to the one aspect about automated learning where there seems to be wider social consensus, which is the affective dimension of these systems: that these machines are awesome.

They are awesome in the literal sense, in that they can be awe-inspiring, cause feelings of reverential respect mixed with fear and wonder. But why? How can, for example, images produced through these techniques be as emotionally affecting to a general audience when the mechanisms for their creation are based on notoriously dry and emotionless statistics? And why has this affective quality been overlooked in many areas of scientific machine learning research?

Machine learning techniques have captured the imagination of researchers and practitioners in seemingly disparate fields, to the point where news outlets are now struggling to make sense of the cornucopia of literature on the subject, which finds its way into the public domain under the broad conceptual umbrella of *artificial intelligence*, coming from all fronts, pitched at many different levels of detail, and applied to an equally diverse set of problems, from diagnosing and treating cancer (Cruz and Wishart 59-78) to playing *Starcraft* (Vinyals et al.). Agreement about the sense of wonder produced by these hitherto obscure algorithms is not always explicit, but it is clearly there.

My first intuition as to how to investigate the affective powers of machine learning was to look at how it has spilled into the arts. And perhaps the best example of this is the recent wave of enthusiasm for generative adversarial networks (GANs).

GANs are a type of unsupervised machine learning algorithm comprised of two neural networks pitted to outperform each other. The idea was first introduced by Jürgen Schmidhuber (1990) and was further developed and made popular by Ian Goodfellow et al (2014). The technique has since engendered several applications, most notably in synthetic generation of photo-realistic imagery (See for example: https://github.com/nashory/gans-awesome-applications), and in the process it made Goodfellow somewhat of a celebrity in machine learning circles. The MIT's Technology Review described him hyperbolically as "The man who's given machines the gift of imagination" (Giles), and as of today his original GAN paper has over seven thousand citations in Google Scholar. Granted, this academic celebrity is far removed from actual celebrity, but still, for a technical paper this is remarkable: "GANs have come from an exotic topic to the mainstream and an exhaustive list of all GAN papers is no more feasible or useful" — summarises Holger Caesar, who until 2017 maintained an online list of papers on just this one machine learning technique (See: https://github.com/nightrome/really-awesome-gan).

What is also interesting is how artists more than scientists were among the first to whole-heartedly embrace the use of GANs in their practices, and with very successful results too. German artist Mario Klingemann, now a self-styled *neurographer*, for example, had an interesting but mostly niche career until he started using GAN and GAN-esque algorithms between 2015-16 to produce portraits, or perhaps more precisely, *ectypes* (See: Floridi 317-321). Public interest in his work grew dramatically thereafter, as evidenced by the artist's own collection of press clippings, which had increased tenfold by 2018 (See: http://quasimondo.com/)

Almost at the same time that year, a painting created by a trio of French students using the same technique auctioned at Christie's for $432,500 USD. The auctioneer's website promoted the piece with the question: "Is artificial intelligence set to become art's next medium?" (Christie's; Cohn). The elevated price and some clever marketing put the technique and its practitioners in the public spotlight, to the delight and dismay of some of its proponents, including Klingemann himself, who commented disparagingly at the time:

> *To me, this is dilettante's work, the equivalent of a five year old's scribbling that only parents can appreciate […] But I guess for people who have never seen something like this before, it might appear novel and different. (Vincent)*

Klingemann's own work would go on auction a few months later, in early 2019, this time at Sotheby's, which promoted his piece *Memories of Passersby I* as eliciting: "an aesthetics that shocks and disturbs as much as it appeals, a mix of attraction and repulsion whose principal effect is to present a surprising new perspective." (Sotheby's)

Figure 1: *Memories of Passersby I* by Mario Klingemann.

Whether we like it or not GAN-art has gone mainstream, and in the sciences as in the arts, machine learning has never looked so awesome. And yet, descriptions like the ones above, journalistic articles and editorials in specialised art publications, are frustratingly unhelpful in directly questioning why these images are emotionally affecting for the wider audiences they are clearly begetting, people who for the most part neither understand nor care about neural networks, loss functions or backpropagation.

Even when artists were quick to adopt these techniques (or perhaps because of it), their critics and them seem to lack the language with which to address the immediate affective quality of the images produced through techniques like GANs. These limitations, I believe, come from artists and art critics persistent understanding of machine learning as a medium of sorts: a conjectural space that affords stylistic diversity and the potential for aesthetic experience; a new material and social surface for artistic expression. The problem with this view is that it very often implies an unquestioned over-reliance on what Noël Carroll (13) calls the medium-specificity thesis: the requirements of differentiation and excellence that supposedly afford mediums their autonomy and their unique powers of expression — injunctions such as films show, do not tell; games enact, do not show, etc.

Going by this logic, the discussions about images produced through machine learning have focused on issues of originality, authenticity and authorship, and this preoccupation with finding the unique artistic affordances of machine learning and how authors deploy it in their practice tends to devolve into claims of different degrees of machine autonomy as the defining feature of the medium: the quality that makes imagery produced through this type of machinery original, and ultimately different from, say, a Photoshop filter. The artists themselves have been either incapable of dispelling these claims or actively complicit in perpetuating them. And critics too, as Carroll remarks, have confused history with ontology (13), asking audiences to endorse an *AI style* under some questionable assumptions about the nature of the medium, i.e. its alleged deployment of non-human agencies.

This is not only the case with opportunists and outsiders, even well-established artists like Klingemann, who publicly and vehemently rejects claims of machine autonomy, struggle to defend their turf in terms other than style and mastery of the *GAN medium* and are unable or unwilling to articulate non-essentialist views of their production. In late 2018, when Klingemann won the gold award at the Lumen Prize, the event publicized it as: "For the very first time, a portrait created by a machine has won a major global art prize." (Lumen Prize)

From this quick romp through the early history of GAN-Art it is evident that imagery produced through some of these machine learning techniques struck a chord beyond the research communities from whence they came. It is also apparent, however, that general discourse about machine learning in the arts contributes little to our understanding of why (or even how) this is the case.

In what follows I propose a different approach. I suggest that images produced through machine learning techniques like GANs are not awesome because they are the differentiable production of an artistic *avant-garde*, but on the contrary, that they are awesome because they are recognisable *en masse*; because they are consumed not as art but as a particular type of popular entertainment. My central argument is that machine learning is emotionally captivating not because the machinery is intelligent or creative, but because it is spectacular, and in this, I argue, the way we consume imagery created through these techniques today has much more in common with stage performances in the early twentieth century, with the cinema of attractions, and particularly with magic.

Anatomy of a magic trick

Around the same time GANs burst into the scene, cinema put our fears and wonder about these technologies on screen in films like *Her*, *Transcendence*, and *Ex Machina*. These three films deal with the possibilities and consequences of a synthetic intelligence indistinguishable from ours, they are interesting and in many ways enjoyable films, but like the headlines of auction houses they also significantly misrepresent the nuts and bolts of contemporary machine learning in science and engineering research.

A glance at the current flurry of papers on machine learning easily confirms that they are overwhelmingly about applying techniques from computational statistics (classification, clustering, regression, rule inference) to specific problems, like credit card fraud detection, playing chess, or style transfer. Progress has been made for the most part by going narrow, rather than general.[1] The recent breakthroughs in the field, Daniel Dennett writes,

> *have been largely the result of turning away from (what we thought we understood about) human thought processes and using the awesome data-mining powers of supercomputers to grind out valuable connections and patterns without trying to make them understand what they are doing.[2] (Dennett 87)*

This narrow or weak AI paradigm suggests that we should not look to science fiction but to history, and also that perhaps it is not that films get it wrong, but that we are looking at the wrong films. If we want to understand machine learning not as synthetic intelligence or creativity, but as magic, I suggest we take our cue from a film about magicians, a film like *The Prestige* (Christopher Nolan, 2006).

The Prestige portrays the misadventures of two rival illusionists in 1890s London, Robert Angier and Alfred Borden, who try to outperform each other in obsessive and increasingly dangerous ways. Borden develops a magic trick called *The Transported Man*, in which he appears to teleport instantly to opposite ends of the stage. Intrigued and frustrated, Angier spies on Borden and tries to replicate the trick, first using a double, and eventually commissioning a cloning machine from American scientist Nikola Tesla. After much speculation, personal drama and murder, it is revealed that the way Borden performed the transported man was by concealing from everyone the existence of a twin brother, with whom he shared not only the stage but also his wife (eventually driven to suicide because of the inconsistent personality of what she presumed to be an individual but were in fact the twins).

The plot of the film is structured as a series of flashbacks in which the magicians take turns at reading the other's stolen diary. Much like the generator and discriminator modules in a GAN,[3] their rivalry pushed the boundaries of magic, albeit in very different ways: Borden and his twin accomplish the illusion by concealing a lifetime of duplicity,

Figure 2: ***The Transported Man*****, magic trick - A.**

while Algier achieves it through a scientific machine that actually duplicates him. In the film, scientific machinery and social performance are seen as two constituent traditions of magic; two ways of producing the same magic trick.

Semantic echoes aside, I also like this example because it allows us to think seriously about how magic implicates labour and technology for spectacular effects. Magic, writes Marcel Mauss in his *General Theory of Magic*, "is the domain of pure production, *ex nihilo*. With words and gestures it does what techniques achieve by labour" (175). A magician, he continues, "does nothing, or almost nothing, but makes everyone believe that he is doing everything, and all the more so since he puts to work collective forces and ideas to help the individual imagination in its belief" (175). Despite being over a hundred years old, Mauss' anthropological account of magic illuminates a forgotten link between technique and showmanship, or in other words, of how magicians play with social expectations of what is technically possible. In the case of *The Transported Man*, for example, the magic occurs not because the magician cannot be at either end of the stage, but because he appears to travel this distance at an impossible speed. The trick only works if we, the audience, believe the person who vanishes from one place appears to be the same person that reappears instants later elsewhere — that Borden somehow manages to travel in ways that defy common experience.

But consider, following Mauss, how disbelief is always historically situated. We can imagine for instance how nineteenth century audiences would have probably found equally incredible that a person could fall asleep in London one day and wake up in Manila the following day, and how before air travel became common in everyday life this too could have easily been construed as magical. From this perspective, the illusion of teleportation is only a function of our perception of the time needed for the necessary transformations required to displace matter in space. Consider then, how the illusion of travelling at *the speed of light* is profoundly connected with the social imagination about technologies like electricity, radio, the telephone, and indeed the kinematograph, in the early twentieth century.[4] John Cutter, the *ingenieur* working with Angier (played by Michael Caine in the film), at one point advises the performer: "if you need some inspiration, there's a technical exposition at the Albert Hall this week. Engineers, Scientists,

Figure 3: ***The Transported Man*****, magic trick - B.**

you know […] That sort of thing catches the public imagination." (*The Prestige*)

The originality of Mauss' approach was to show how magic worked by regulating the social interfacing with technologies, his work is not only a description of ritualised magical practices, but an analysis of how these practices are specifically designed to amplify weak collective beliefs and disbeliefs so as to render them effective at specific moments in history:

> *Magic protected techniques; behind magic they were able to make progress. […] Magic is linked to science in the same way as it is linked to technology. It is not only a practical art, it is also a storehouse of ideas. It attaches great importance to knowledge — one of its mainsprings. (175)*

In my view, some aspects of the current technological moment with regards to machine learning deeply echo those of the early twentieth century: once again we are, like Angier says in the film, "on the brink of new terrifying possibilities," and once again the boundaries of what is technically possible are softened enough so as to present and sell technology as magic. My argument here is that machine learning is being presented to us as a series of magic tricks: instant retrieval, disembodied cognition, as creative or intelligent machines, all of which bear the clear social hallmarks of the magical: they are deployed as forms of alchemy[5] (with the right algorithm you can convert your data into gold), animism (the machine thinks and speaks for itself), divination (big data and predictive analytics), and healing (genome decoding and editing). Symptomatically, corporations who wield these powers even present themselves as overtly magical, even in their nomenclature, think for example of *Oracle* or *Palantir*.[6]

Echoing electrical technologies of the early twentieth century, machine learning too disrupts our relationships with perceived time and labour in powerful ways. Indeed, it is my contention here that the main magic trick performed through machine learning systems consists in using statistical computation for the compression of time through what Matteo Pasquinelli calls "the ideological encryption of labor within technology" (321). Pasquinelli argues, albeit in a wider context, how classical energy theories of labour[7] have "failed to recognise the new forms of *technified labour* and *technified subjectivities* that have lost any resemblance to the new labour struggles of the past" (321). If we admit his revision of classical Marxist economics, we can easily see how through vast infrastructures of planetary computation different kinds of subjectivities can be encoded, harvested, packaged and sold back to us, through machine learning, as instantaneous projections of "artificial" knowledge or creativity. But of course, there is nothing artificial about these subjectivities, it is our perception that is being surpassed since we cannot yet grasp the encryption of labour at a global scale. As with *The Transported Man*, we could also understand GAN imagery in these terms, as magic protecting technique: the trick being, to present the results of encoded subjectivities and encrypted labour all at once.

Think for example of the thousands of images of European portraits Klingemann fed to his *Old Masters GAN* in terms of encrypted labour, and one can then appreciate how he is compressing a thousand years of European portraiture tradition into an instant of release.

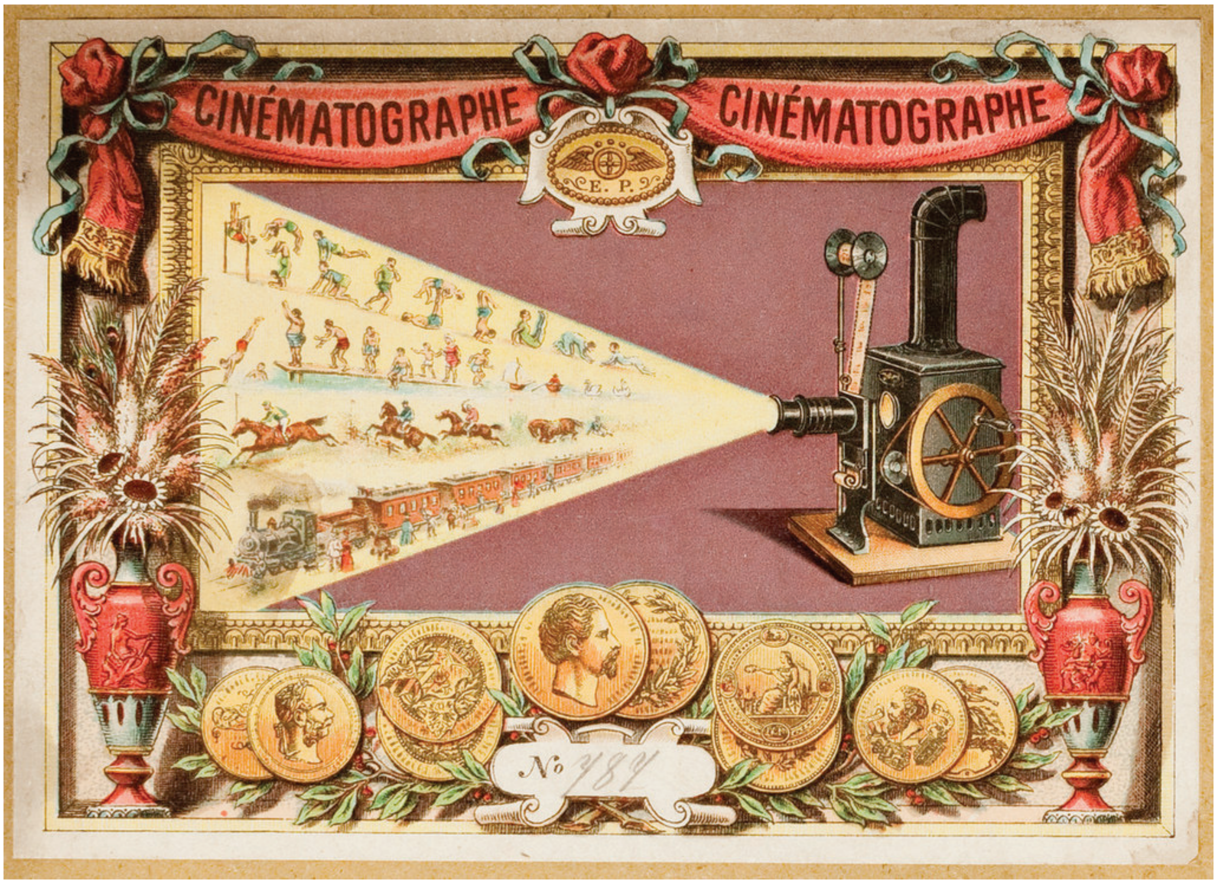

Figure 4: Cover to the box for a *Cinématographe*.

Spectacular machinery

Having dissected the magic trick, let us come back to our original question: how are general audiences affectively bound to the pictures created through machine learning such as GANs?

Like a magic show, for the trick to be successfully carried out the audience needs to actively participate with their beliefs and social imagination of what is possible. We need to have the disposition to be deceived and to be amazed; we need to buy the trick as entertainment. My claim here is that we consume pictures created through machine learning today in a similar way to how film scholars have characterised early twentieth century audiences consumed cinema: not as cinema, but as attractions; as spectacular demonstrations of technological achievements. In his influential essay on the cinema of attractions, Tom Gunning referred to this type of spectatorship as popular exhibition of *trick films*:

> *Nor should we ever forget that in the earliest years of exhibition, the cinema itself was an attraction. Early audiences went to exhibitions to see machines demonstrated (the newest technological wonder, following in the wake of widely exhibited machines and marvels as X-rays or, earlier, the phonograph), rather than to watch films. It was the* cinématographe*, the biograph, or the vitascope, that were advertised on the variety bills in which they premiered, not [LE DÉJEUNER DE BÉBÉ] or THE BLACK DIAMOND EXPRESS. (383)*

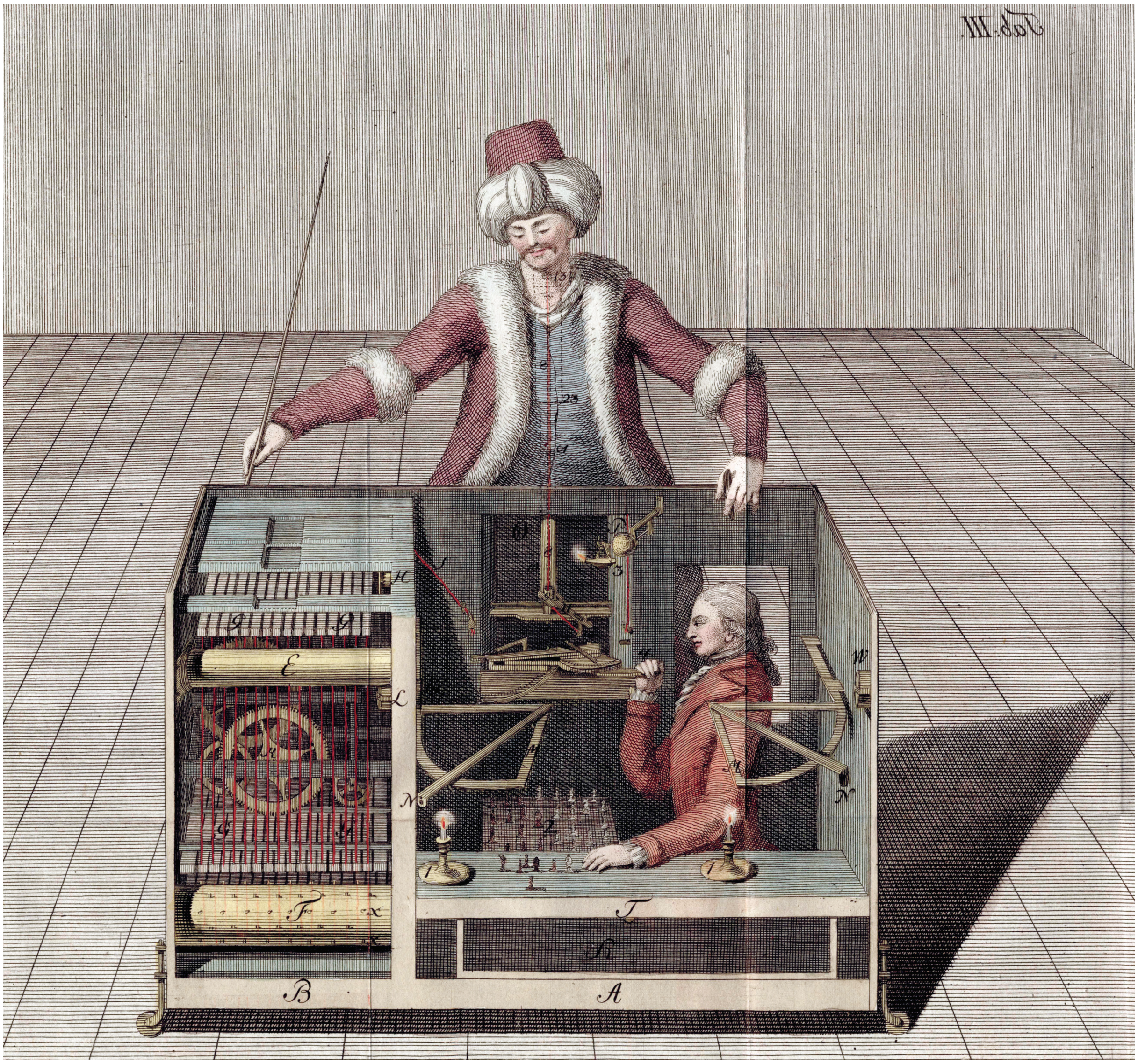

Figure 5: Cross-section of the Turk.

André Gaudreault, who worked closely with Gunning, went as far as to suggest a revisionist history of the birth of cinema, a version in which neither Edison in 1890, nor the Lumières in 1895, invented cinema, but only the devices later used for it: the Kinematograph and the Cinématographe.[8] According to the film historian, cinema came into existence more than a decade later, in the 1910s, when the conventions of theatre and performance were assimilated into films as institutionalised products with a recognisable narrative form. Gaudreault describes the twenty years between 1890 and 1910 as a period of "kine-attractography" whose practices greatly differed from what was later called cinema:

> *Between the time of the invention of the basic device (between 1890 and 1895) and the period of institution (beginning around 1915), kinematography was a wide-open field of experimentation. This was when artisanal manufacturers of animated pictures took various initiatives, almost all of which tended to modify the initial project inscribed, so to speak, in the 'genes' of the apparatus (or, if you prefer, in the various patents filed by its many inventors. (39)*

Both Gunning and Gaudreault described this *cinéma des premiers temps* in terms of its capacity to *show* the new techniques: slow motion, reverse motion, multiple exposure, and even the close-up, which we now take for granted as part of narrative cinematic discourse, but which, Gunning argues, at the time was seen “in itself [as] an attraction and the point of the film” (384).

Furthermore, already in the early twentieth century, these machine attractions — kinematography included — conflated notions of the *showable* and the *knowable* under the logic of spectacle. The shows that invited audiences to suspend disbelief, as we saw through Mauss, also served as ways to deploy new technical intellectual regimes. And there is, of course, a rich older history of automatons being exhibited as “intelligent” attractions[9]: Wolfgang von Kempelen’s *Mechanical Turk*,[10] for example, which was presented as a mechanical chess player to impress the Habsburg court in 1770 (Schaffer et al. 154), or even John Bowes’ *Silver Swan* of 1872, which Mark Twain described as having “a living grace about his movement and a living intelligence in his eyes” (Twain in Holledge 13). Automata were symbols of the enlightenment, writes Simon Schafer, they “were both arguments and entertainments, designed seductively to place craft skill within the setting of power, and to allow the selective entry by that power to the inner workings of art and nature” (135–36).

From the courts of Europe to the burgeoning urban elites of industrialised cities, this model of spectatorship based on attractions historicise these moments of rapid technological development when societies find the machines themselves as mystifying; when technologies have not yet been tethered to particular usages, captured by specific sectors of society, or institutionalised into coherent social discourse, and audiences are therefore still able to project their own fantasies onto the machine’s raw potential more or less freely.

Spectacular machines can in this way be presented as immediately awesome, they seduce by showing, rather than persuade through reflexive absorption. And technologies for observation are particularly alluring in this regard for their capacity to create trickery that reveals: distorted ways of seeing (like the microscope or the kinetoscope), that simultaneously implicate intellect and imagination, and that give both the production of knowledge and the creation of fiction an immediate, often spectacular visual manifestation. Viva Paci calls this, in the case of early cinema, “the attraction of the intelligent eye” (121–38).

I argue machine learning too embodies this double function today: it can be understood as a set of observational technologies that affords us with spectacular *trucages qui révéler*. This is, I believe, the best way to understand how we currently consume GAN imagery, not as expressions of a medium but as spectacular demonstrations of the GAN itself.

The advantage of this analytical approach inspired in the cinema of attractions is that it allows us to bypass the idea of *AI style* altogether, since the attraction of the intelligent eye operates equally on the gooey portraits of Klingemann or in the photorealistic *deepfakes* which are created through the same technique but look entirely different. What attracts us is not the style, but the workings of the machine. And this is not the self-reflexive aesthetic modality of an art that is questioning and testing the limits of its own medium, but a much more general allure, one that accounts better for the popularity of this form of picture-making. Furthermore, I want to advance the idea that this is also a viable way to more generally characterise the current affective resonance of machine learning in visual culture: not as a tool for representation, but as a magic show contingent on the mystifying process through which computation at a planetary scale can encrypt subjectivities and labour.

To be clear, I am not suggesting all imagery produced through machine learning is designed as a magical attraction, there are of course a multitude of configurations of machine learning systems, processes, intentions, and a rich melange of techno-social palimpsests, some of which will surely find new ways to negotiate their way into broader areas of visual culture. And similarly, we have to distinguish from the relatively small group of artisans of technoscience trying to outdo each other's tricks in academic machine learning research and the business of big data analytics, which is already institutionalised into large corporations mostly concerned with extending their encroachment in society at large through sophisticated forms of digital governance and wealth extraction.[11]

My argument is, rather, about consumption. I submit that there is at this moment a popular appetite to consume these images as the magical results of *monstrative global computation*, much like there was in the early days of kinematography for tricks and effects with moving pictures, and that besides novel ways of creating and analysing imagery, machine learning systems afford us with novel ways of enjoying imagery; they fetishise calculation and the statistical apparatus that makes it possible, and they turn the datafication of society into its own form of spectacle: *spectaculum ex computatio*. I believe we are living the early days of these forms of computational spectatorship. Goodfellow may have invented GANs, but the medium which will allow us to enjoy sequencing without continuity, narrative without authorship and, ultimately, presence without subject, has not yet been invented.

Notes

[1] There is research in so-called strong AI or General AI, but practice in this field has been dwarfed into a sub-field in the past decade. Other significant related areas in computer science and philosophy include computability and computational complexity.

[2] First emphasis is mine, second one is the author's.

[3] "The magic of GANs lies in the rivalry between the two neural nets," states Martin Giles in the same piece where he calls Goodfellow "the GANfather."

[4] This theme of time relativity and how it has profound effects on social relations features heavily in other films by Christopher Nolan, for example in *Interstellar* (2014), where a cosmonaut and the young daughter he left behind on earth live their lives in different temporalities, and he is later able to re-encounter her as an elderly woman. Or *Inception* (2010), where a crew of specialised dream bandits go through nested dream levels, each with a temporality relative to the level above and below. In these films Nolan knowingly references the origins of cinema and seems to be acutely aware that one of the greatest powers of cinema as a technology was to afford us with new social understandings of duration.

[5] See: http://supercommunity.e-flux.com/texts/the-alchemic-digital-the-planetary-elemental/.

[6] *Palantir Technologies* is a US software company specialised in big data analytics. The *Palantíri*, or seeing stones, are a set of interconnected magical orbs in J.R.R. Tolkien's *Lord of the Rings* mythology. They

allow their users to communicate and have visions of future or past events across the world:

> *The palantír replied to each, but all those in Gondor were ever open to the view of Osgiliath. Now it appears that, as the rock of Orthanc has withstood the storms of time, so there the palantír of that tower has remained. But alone it could do nothing but see small images of things far off and days remote. Very useful, no doubt, that was to Saruman; yet it seems that he was not content. Further and further abroad he gazed, until he cast his gaze upon Barad-dûr. Then he was caught!*
> *(Gandalf, in* The Two Towers*, Chapter 11.)*

[7] Pasquinelli mostly refers to Marxist notions of labour as transformation through energy, and he argues this view has ignored the latent productive potential of information.

[8] These two are similar but not exactly the same device, although they were developed almost in parallel, one by Edison in the US and the other by the Lumières in France.

[9] *Musée de la Magie* and *Musée des Automates*, in Paris, are adjoining twin-museums for which one can purchase a single ticket.

[10] von Kempelen's Turk was initially presented alongside magic tricks, and travelled through the courts of Europe playing exhibition matches and igniting speculation in scientific circles about its mysterious functioning. There was for a time a strong belief that the Turk operated through magnetism. After the death of von Kempelen, the Turk was uncovered as a hoax: a small man was inside the cabinet, and the gear noises served to conceal his presence. Amazon named named its "Human Intelligence Tasks" marketplace after this automaton, see: https://www.mturk.com/.

[11] Corporations pluck techno-artisans from academia whenever necessary, of course. Big tech in effect buys out the results of a more malleable field of experimentation. Once engineers and scientists are turned, so to speak, data fencing becomes an issue that then separates them from their original research communities. Marx may have called this the subordination of techno-scientific labour to capital.

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Tomasz Hollanek

NON-USER-FRIENDLY: STAGING RESISTANCE WITH INTERPASSIVE USER EXPERIENCE DESIGN

Abstract

User-friendly design makes our use of emerging technologies intuitive and seamless, but it also conceals the new solutions' influence over how we act, think and plan. In this paper, I analyze the logic of our newly developed 'touchscreen sensibilities' to speculate on alternative, 'non-user-friendly' design practices that, by invading intuitive interfaces, could make the users aware of their reliance on invisible algorithmic operations to learn and to feel. I revisit Žižek and Pfaller's conception of 'interpassivity' to explore its potential as a means of resisting interactivity and inciting consciousness in contemporary speculative design. The critical interface I envision must defamiliarize consumption, prevent participation, and de-frame perception — make the user experience what lack of control feels like, and do so to encourage resistance.

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I am using my iPad to edit this article. The Google doc is available anytime and anywhere, so I can always apply changes, jot down new thoughts on-the-go. I use the same device to access anything online, from bank accounts and YouTube clips to my memories stored as data in the cloud. The experience of navigating between these different modes is completely intuitive. It feels natural. The device belongs to me and so does, as it seems, the universe fashioned out of data. The device ensures that my sense of orientation is closely tied up with an illusion of control. While visualization masquerades as comprehension, touch colonizes space. Wandering off course is not possible in this world with a home button.

But immediacy comes at a price as user-friendly design that makes our use of new technologies intuitive and seamless also aims to misdirect our attention from what is happening behind the scenes. The industry's ambition to personalize our experience of media via ever more adaptive interfaces might lead to a future in which planning is entirely delegated to the machine — one that employs AI-enhanced analytics to anticipate our needs and desires. This delegation of responsibility will likely happen surreptitiously, as technologies have already begun to preempt decision-making without us noticing. The act of purposeful selection on the part of the user might eventually become obsolete — indeed it might disappear from the menu of options made available by the future UX (user experience) design. If choice is essential to autonomy, then the question we are facing today is whether — in the age of automated decision-making, optimization of options, and ongoing surveillance of actions — we can still conceive of design strategies that allow the user to perceive the technology at work: to become aware of the algorithmic operations and invisible infrastructures that are shaping our experience of the world.

What if design was to pose a challenge to the logic of immediacy? Deny the viewer-user the power to manipulate the image and register reactions to it? Stage an experience that cannot be immediately turned into data? What if 'non-user-friendly' design had the potential to transform the existing feedback loops into a new system of commentary — to de-automatize choice? In what follows, I describe the logic of our newly developed 'touchscreen sensibilities' and speculate on alternative design practices that, by invading intuitive, user-friendly interfaces, could cause 'cognitive glitches,' exposing our reliance on invisible algorithmic operations to learn and to feel. I suggest there is potential in 'interpassivity,' if it were inscribed into the user's experience of media, to resist interactivity, to incite consciousness and encourage change.

Touchscreen sensibilities

In the late 2000s, Apple released the original iPhone, a new kind of apparatus equipped with a sensory system of its own — a touchscreen, a built-in camera, an accelerometer, a proximity sensor, a gyroscope, and other sensors; a device that could at once display and register images, connect different users across a distance, and react to light intensity, movement, and speed; it was both a screen — but one that could gaze back at the viewer, respond to his or her touch, heartbeat, and position in space — and a controller, a remote for executing tasks. The controller-screen seems like the ultimate 'remediation' (to use Bolter and Grusin's term), realizing our desire for instantaneity and immediacy, mobility and interactivity, manipulability and control — a device that can respond to its master's voice, recognize his or her face, or track its user's steps. It not only determines what and how we see, but indeed how we 'calibrate' our bodies, how easily we orient them in the new, augmented reality.

Mark Hansen has recently remarked that the "becoming topological of culture" — the forging of topological relations among "elements of worldly sensibility" by contemporary media machines (Hansen 34) — demands both our reconceptualization of sensibility and phenomenology (37), as today's topological machines "provide artificial access to a domain of sensibility that exceeds what humans can process as sensations" (39). Users have become dependent on their devices, personal touchscreens and other wearables, to process signals that no human body part can detect on its own. To sense is to register; to feel immersed in reality is to manipulate it through swipes, taps and pinches. This is how touchscreen sensibilities have become the dominant perceptual norm of our time. A decade after Apple introduced its first iPhone, my personal touchscreen is always there, always at hand. And yet, it remains imperceptible. Because touchscreen sensibilities necessitate a design that obfuscates mediation; 'good' design must feel intimate and natural to allow the interface to erase itself and pass as an extension of the organic.

The controller-screen moves with us, transforming our perception with its machine vision and optimization of experiences. But its influence remains concealed through what designers call 'user-friendly design' — the kind of design that makes the use of new technologies intuitive and seamless. User-friendly in the age of big data profiling means tailored to the individual. Ulrik Ekman argues that in the reality of ubiquitous computing, even environments begin displaying "intelligent attention" to individuals and social groups: "natural setting turns highly artificial as it appears attentive rather than neutral or non-caring" — it constantly interacts with the viewer-user, responding with a directedness "coming not from distant otherness," but "intimate sameness" (Ekman 1). Ongoing developments in user experience design rely on dynamic, fully customizable interfaces that automatically adapt to the viewer-user's needs, seemingly responding to his or her desire before it is consciously articulated. With advances in user profiling, a process of generating statistical models from large amounts of user data, diverse mobile applications can now predict, and attune their messaging to, the users' sexual orientation, political affiliations, or even their menstrual cycle. As the interface facilitates not only the consumption of digital goods, but also self-tracking, it invites the viewer-user to become self-conscious through the technology; self-tracking, however, serves only as a prosthesis of the project, an illusion of individuation aiming to collect ever more data.

Bernard Stiegler argues that the contemporary media draw "the time of consciousness" into production to manufacture our desires. His conception of individuation in the age of "hyper-industrial" capitalism revolves around the paradoxical relationship between the illusion of personalization and the massification of cultural consumption — the ways in which audiovisual technologies control "the conscious and unconscious rhythms of bodies and souls," by exploiting the aesthetic and treating consciousness as "raw material" in the process of production (Stiegler, *Symbolic Misery* 2). Broadcast media, Stiegler argues, function as pervasive systems of synchronization, relying on temporal objects such as TV programs or songs (objects whose affective potential is inscribed in their very duration), that standardize the time of consciousness to format the consumer's behaviour. While in the era of broadcast media standardization (the synchronization and 'averaging' of individuals) disguised itself as personalization (pervading the home), in the era of asynchronous viewing, personalization (the profiling of users and the filtering of information) poses as standardization (foregrounding the 'social media' features of the design, concealing the algorithmic processes and convincing the viewer-user that he or she is seeing what everybody else is seeing). While broadcast media have laid the groundwork for drawing the time of consciousness into production, personalized interfaces of the digital era might complete the project by soliciting our attention on a full-time basis.

Although user-friendly experience design in the era of ubiquitous computing seems to realize the promise of control vision, unlimited mobility and haptic immediacy, it also becomes a means of capturing information about the preferences and habits of users and turning the collected data into profit for corporations like YouTube. And as the techno-extensions of the human sensory system take on the role of imperceptible intermediaries between corporate agenda and our consciousness, they may inhibit our ability to plan. The device may feel personal, but it has never been truly mine.

Alternative design would have to call our new, machine-enabled feelings into question. It would have to free cognition from the mobile 'frame' of the controller-screen and prove a means of paradoxical 'de-framing' of contemporary perception. It would have to revert the logic of touchscreen sensibilities — for the idea of the project to re-emerge. Can we conceptualize UX design that reconnects the viewer-user with his or her time of consciousness, or — in other words — attunes consciousness to the lived body? Could 'non-user-friendly' design successfully harness the feeling of confusion and dissatisfaction to raise political awareness, to cause a cognitive glitch?

Cognitive glitching

Non-user-friendly UX design is not necessarily synonymous with counterintuitive design. Different iterations of counterintuitive solutions are being adopted by online platforms either to draw the users' attention to their actions by breaking with prevalent design patterns, or, the exact opposite, to manipulate their decisions by introducing confusing interface elements. Google Chrome, for example, has experimented with counterintuitive solutions to warn users about insecure connections. To proceed to a website marked up as suspicious, Chrome's user has to click on a grey hyperlink displayed below the warning message rather than on a blue button, ensuring that he or she is taking the risk consciously and not clicking out of habit. Other companies (such as low-cost airlines) incorporate confusing, illogical procedures into their web design to trick users into buying extra services. In any case, counterintuitive design, however unfriendly, prompts the user to interact with the system as it is — something non-user-friendly design should strive to prevent.

Non-user-friendly design would have to become what Anthony Dunne and Fiona Raby describe as "critical thought translated to materiality" (35) — design that combines speculation and futurology in order "to change reality, not merely describe it" (6). For Dunne and Raby, design has become "so absorbed in industry, so familiar with dreams of industry, that it is almost impossible to dream its own dreams" (88). Critique, they argue, must be "a refusal, a longing, a desire" (35). In their book on speculative design, they contend that a project's potential lies not in:

> *what it achieves or does but what it is and how it makes people feel, especially if it encourages people to*

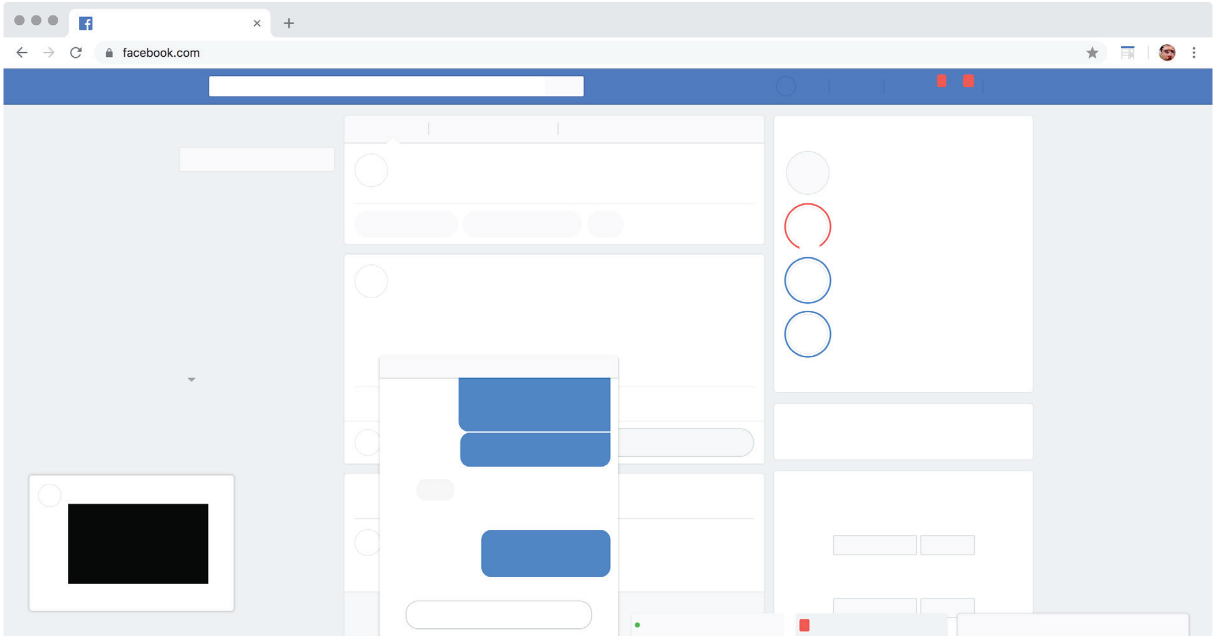

Figure 1: Facebook News Feed modified by *Safebook* (https://bengrosser.com/projects/safebook/).

> *question, in an imaginative, troubling, and thoughtful way, everydayness and how things could be different. To be effective, the work needs to contain contradictions and cognitive glitches. Rather than offering an easy way forward, it highlights dilemmas and trade-offs between imperfect alternatives. Not a solution, not a 'better' way, just another way. Viewers can make up their own minds (189).*

Design as critique must "invade the everyday," (43) and that is why non-user-friendly design is not necessarily meant as a mere inversion of user-friendliness, but rather an invasion of intuitive interfaces that exposes their underlying structures, uncovering the apparatus to reveal an aperture, a way out.

Various digital artists and designers have toyed with seemingly unfriendly interface elements to foster critique. Benjamin Grosser's *Safebook* (2018) serves as a particularly evocative example of the trend: as a plugin available for download from the artist's website, *Safebook* aims to reinvent Facebook as a space free from persuasive algorithmic curation by automatically redacting virtually all content — text, images, videos — from the website. After installing *Safebook* on Chrome or Firefox, the user is left with a layout of blanks and omissions, with only the framework of Facebook's user interface intact and recognizable. The user can still interact with the website, but 'liking' an invisible image by clicking one of the concealed reaction buttons invariably proves a shot in the dark.

Safebook defamiliarizes the experience of ingesting information through social media, as Grosser's software takes on the form of a *sui generis* AdBlock — targeting all content made available through Facebook — to suspend direct consumption. The browser extension obfuscates the results of Facebook's personalization to diminish the influence of algorithms over what we see, and thus seemingly allows us to *take back control* over what we do with our time online. This is also how *Safebook* indirectly reinforces the idea that the danger posed by contemporary technology relates to the users' compulsive tendencies: that more software can lead to more control or, specifically, self-control, and that the challenge for designers in the age of the continuous stream is to search for new design strategies that enable digital temperance. *Safebook*, however provocative, shares more with the likes of ScreenTime (one of Apple's latest solutions that allows the user to schedule time away from the screen or set time limits for individual apps) than it initially appears to — realizing the conception of new design as a means of extending control over any previous design. The 'unfriendliness' it stages turns out superficial, as the logic of the interface-as-controller remains unchallenged. And since it is precisely the interface, not the stream of content, that makes us believe we have control over our life online, *Safebook* fails to embody non-user-friendliness as a means of disturbing the illusion of technology that merely serves its master.

Grosser does gesture, however, towards the idea of software that prevents rather than encourages interaction. Instead of making the content invisible to the user, perhaps critical design could do the reverse to bring the concept of non-user-friendly design closer to fruition: render the user imperceptible to the system. An interface that remains oblivious to the user, not reacting to touch, voice, or any other well-known commands, could also interrupt the false sense of control that a user-friendly interface aims to generate. Writing about the limitations of cinema, Dunne and Raby point out "it can deliver a very powerful story and immersive experience but requires a degree of passivity in the viewer" (75), contrasting film with speculative objects as invitations for "the viewer to actively engage with the design rather than passively [consume] it" (90). Dunne and Raby think primarily of physical objects, but if we transpose their argument to digital environments, the opposite may prove to be true: putting the user in a seemingly passive position, turning to older patterns of engagement, may enable the mental process of cognitive estrangement the designers are aiming at. Perhaps in the age of touchscreen sensibilities, only non-user-friendly design based on the performance of technological indifference — enforcing the user's passivity via an interface usually meant to maintain a continuous interaction — could cause a cognitive glitch.

"When people's participation becomes someone else's business," argues Jonathan Sterne, "the social goods that are supposed to come with it can be compromised." He suggests that "the bad things that media critics have been saying about passivity" seem applicable to contemporary media's "demands to interact, to participate." Active participation fails to renew commentary and bring about agency, as interactivity "also encompasses the 'agree to terms' button" (Sterne). Perhaps any form of UX design based on interactive engagement is complicit in the dreams of the industry? Perhaps to generate a cognitive glitch, to open up "all sorts of possibilities that can be discussed, debated, and used to collectively define a preferable future," (Dunne and Raby 6) design speculations in the age of touchscreen sensibilities should reconsider the potential of passivity, of standardization, of the screen that cannot gaze back?

Interpassive interfaces

If Sterne is right and interactivity is indeed the new passivity, then could 'interpassivity' become the new activity in the age of touchscreen sensibilities? Interpassivity was conceptualized by Slavoj Žižek and Robert Pfaller in the late 1990s to describe the relationship between a subject and objects that have inscribed in them their own reception: they anticipate reactions and thus fulfill their role on their own, supposedly not relying on the subject to interact with them. The use

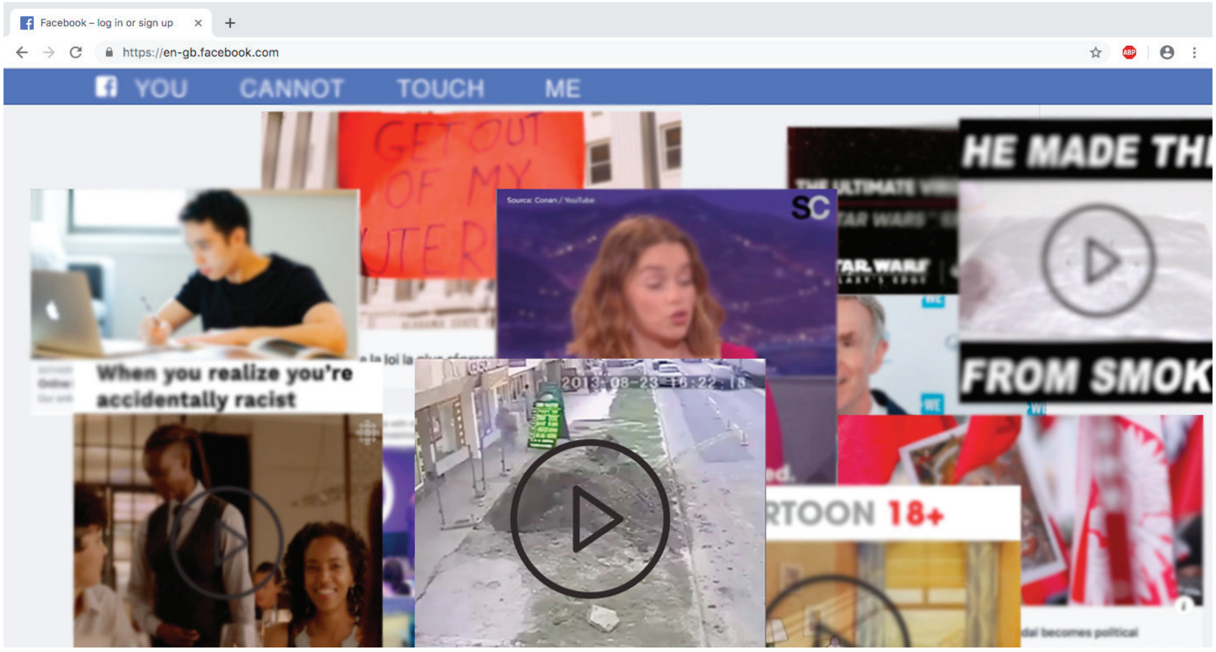

Figure 2: Visualization of an 'interpassive' interface (by the author).

of 'canned laughter' in sitcoms is one of the most common examples of interpassivity, relating the phenomenon to the delegation of enjoyment to objects themselves: a sitcom episode seems to be 'enjoying itself' independently of the viewer's presence.

Perhaps the term, as defined by Žižek and Pfaller, is not directly applicable to contemporary digital environments, since, as Gijs van Oenen points out, interpassivity "refers more specifically to the period of modernity, when subjectivity is 'haunted' by the expectation of incessant activity" (van Oenen 8). Van Oenen argues that interpassivity, understood in the context of modernity, becomes a delegation of activity, not passivity — "a delegation necessitated by an acute sense of being overwhelmed by interactive engagements and obligations" (11). Can we argue, therefore, that new design solutions, as they aim to preempt conscious decision-making, establish an interpassive, rather than interactive, relationship with the user? The contemporary viewer-user indeed seems to unwittingly delegate his or her activity to the automated system to remain passive — to enjoy the effects of personalization without having to take an active role in the process of selection. And yet, the canned laughter in the form of incessant recommendations, automated playlists and algorithmically curated feeds is not 'canned' at all, as the interface maintains a never-ending exchange of information with the user; the user is, ultimately, the necessary component of the system, the key (re)source of click-throughs, likes and other sorts of data. The process of active selection on the part of the user might eventually become obsolete in the age of AI-enhanced personalization — but only because the user has participated in a continued interaction long enough for the system to predict his or her needs and desires in the future. The user-friendly interface employs elements that overtly encourage interaction only to enable a form of interpassivity — it masks our reliance on the algorithm and our delegation of decision-making to the machine with a seemingly controllable, interactive layer of intuitive software.

While interpassivity has been theorized in relation to the modernist notions of activity and passivity, scholars such as Hagen Schölzel have looked beyond this framework to gesture towards the reinterpretation of interpassivity as a way of "backing away from circles of control" (187) in our current political culture of participation. I refer to these theoretical framings that push Žižek and Pfaller's ideas forward to suggest there is potential in interpassivity-as-resitance realized through contemporary critical design. Most recently, Alex Gekker has referred to the genre of idle games on YouTube (recorded by gamers and uploaded to the platform to be watched by other users) as a way of examining "the system as a whole" that allows the interpassive actor to inspect it "without responding to [its] always-on logic" (219). Building on van Oenen and Schölzel's observations on interpassivity as a form a resistance, he argues for interpassivity's liberating potential as "an alternative to straightforward consumption" (221). Gekker's optimistic interpretation of consumption of specific YouTube videos as a liberating, interpassive practice has its apparent limitations — after all, how many users who subscribe to gaming channels are capable of distancing themselves from the viewing and becoming aware of the system as a whole? — but his and Schölzel's framing of interpassivity as a way of resisting interactivity proves useful in thinking about alternative, critical strategies of UX design.

The viewer of interpassive gaming videos might be escaping the demands of interactivity, but this still happens through the user-friendly, interactive frame of the personal screen — there is no cognitive glitch. If we redefine interpassivity as non-participation in the face of interactivity, then an 'interpassive' interface would have to intentionally disregard the viewer-user, openly reject his or her involvement, essentially prevent the user's participation. While *Safebook* renders the content shared via Facebook invisible to halt consumption, an interpassive version of Facebook would aim to do the opposite — overwhelm the user with an overflow of content, while denying him or her the option of navigating the flood of information with recognizable interface elements. Perhaps, instead of redacting the content, a truly non-user-friendly software should obfuscate Facebook's interface design and confront the user with an assemblage of images, text messages, and videos that suddenly begin to feel uncontrollable — indeed out of reach. Only then would touch fail to colonize data. Only then would design reveal the ultimate lack of control the user has over what he or she experiences through the interface. This kind of non-user-friendly software would make the user feel ignored, invisible — to eventually redirect his or her desire for immediacy, control and omnipresence, satisfied by the illusion of user-friendly software, from the manipulable data universe to the real world. The critical interface I envision must defamiliarize consumption, prevent participation, and de-frame perception — make the user experience what lack of control feels like, and do so to encourage resistance.

Staging resistance

When a touchscreen — an interactive map in a shopping mall, an information board at an airport, a ticket machine — fails to respond to your touch (or turns out a regular, non-interactive screen), it can feel awkward and cause frustration; this kind of mismatch of expectations is something user-friendly design aims to avoid. But designers could harness the negative feeling to transform dissatisfaction into disillusionment, and disillusionment into distance. Perhaps non-user-friendly interfaces must appear out-of-order to create disorder. Perhaps only a device that seems dysfunctional can originate a glitch that disturbs the hyper-industrial production line where the consumer's consciousness serves as raw material.

Stiegler defines films and songs as temporal objects because they are constituted by the time of their passing. The interface is also a temporal object, but it supplants the looped temporality of cinema with continuous change and never-ending updates. As the flux of human consciousness is intertwined with that of the interface, they remain in a reciprocal relationship, in passage together, affecting one another and adapting to each other. Stiegler has recently admitted that while the new, interactive screen could be “a threat, enacted through the mediation of the fully computational and automated system,” it could also “constitute a chance, an opportunity to renew commentary, to reconnect with the ‘gloss,’ through a completely rethought hermeneutics” (Stiegler, *The Neganthropocene* 173). To live a vita activa, he argues, we must hold on “to the promise of a new hermeneutic epoch borne by these screens” (174). Non-user-friendly design could realize that promise by embracing interpassivity, uncovering a gap between human and machine feeling. To be deemed successful, the experience of non-interaction must interrupt the illusion of control and personalization, create an opening that divulges our very technicity.

Speculations on non-user-friendly design modeled on interpassivity point to the potential of the existing touchscreen infrastructures to de-automatize choice. The relevance of the search for critical, alternative UX design practices is progressively becoming more evident, as the culture of ubiquitous computing moves on to more advanced sensors, AR/VR sets, holographic projections, etc. The aim of this provocation is to invite both users and practitioners to reconsider the potential of interpassivity in the age of total interactivity, to imagine a design strategy and design experience that reveals rather than covers up, that disturbs the illusion of user-friendliness and disengages the user from the system.

To call our new, machine-enabled feelings into question, non-user-friendly design would need to replace apparent mastery with enabling vulnerability. It wouldn’t allow the technology to gaze back at the user, respond to his or her touch, heartbeat, or position in space. It wouldn’t be personalized or interactive. While user-friendly design conceals the influence of the controller-screen, the everyday enhancer of sensation, non-user-friendly design would revert the logic of touchscreen sensibilities — without a complete erasure of hardware through software. This kind of design would have to elicit a sense of confusion; disorientation would form part of the experience.

I am using my iPad to edit this article. What if there was an app uploaded to my device that, once opened, would not allow me to navigate the unknown through automatisms and well-known gestures? What if this non-user-friendly software would transform — even if for a little while — the interactive touchscreen of my personal device into a classical screen — a non-interactive surface for receiving projections — and turn me into an (inter)passive spectator against my will? Would this kind of non-user-friendly design prove a means of paradoxical de-framing of contemporary perception and make the user aware of his or her own expectations of sensation, shaped by design that appears user-friendly? To succeed, non-user-friendly design would have to feel intrusive. It would have to make explicit the fact that the device doesn’t belong to the user, that it doesn’t merely serve its master. Non-user-friendly design would leave the user dissatisfied, perhaps even angry. It would demand resistance.

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Rosemary Lee

OPERATIVE IMAGE: AUTOMATION AND AUTONOMY

Abstract

Visual media is increasingly impacted by algorithmic approaches to image production, which introduce new modalities into existing notions of the image. Rather than a fundamentally new phenomenon, current methodologies instead expand upon the automation of image production described by previous theories regarding the technological character of the image. The "operative image" (Farocki) acts as a central theory to describe attributes of new forms of visual media engaged with algorithmic processes. Introducing and elaborating on the concept of the operative image, comparisons are drawn between existing notions of the image and new features which result from the use of algorithmic processes in the creation of images. This paper aims to develop an understanding of how algorithmic image production affects defining aspects of images.

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Introduction

The image has undergone a remarkable transformation over the past few decades, in large part due to the increasing role algorithmic processes play in image production. Harun Farocki's notion of the "operative image" has been especially influential in describing attributes of new forms of images which estrange the point of view from the human subject and eschew representation in favour of the performance of machinic operations. This draws upon changes in the nature of images which had already been ongoing for many years before they were highlighted by Farocki in 2001, but which reached critical mass in the military and governmental use of intelligent machines and surveillance technologies in the 1990s. This research invokes the operative image as a fundamental concept to understanding the paradigm shift toward algorithmic approaches to the image. Images are increasingly automated using machines, and more and more often this is done through opaque systems which obscure the process behind the production of the image from human oversight. The automation of visual tasks ultimately raises questions regarding not only how the image is to be defined in light of algorithmic image production but also as to the autonomy of artificial intelligence to produce images. The present investigation begins by introducing the concept of the operative image, which is then elaborated upon through examination of the historical context which has led up to current image production. Following the themes of automation and autonomy, the operative image is then elaborated upon with regard to these two historical tendencies in imaging technologies.

Operative Image

The operative image is central to understanding algorithmic forms of visual media, as it departs from previous notions of the image which have tended to prioritise the visual attributes of images. Instead, the operative image considers images in terms of the performance of spatial procedures. In Farocki's words, operative images "are images that do not represent an object, but rather are part of an operation." ("Phantom Images" 17) This kind of image is concerned with the performance of an operation, connected to the real by enacting a process, rather than representing something other than itself.

It's worth noting that the idea of the operative image was inspired by Roland Barthes' concept of the "image-at-one's disposal," which he uses to describe the potential for images and words to function in an instrumental (Parisi) capacity: "I 'speak the tree', I do not speak about it. This means that my language is operative, transitively linked to its object; between the tree and myself, there is nothing but my labour, that is to say, an action." (Barthes, *Mythologies* 146) The operation performed when "speaking the tree," as Barthes refers to it, is at once an act of conjuring, which performs a representational function, by bringing to mind the mental image of a tree by invoking it by name, but words also function as instruments, ways of interacting with reality. The tree, here, is an implement for performing the concept of a tree. The image, *tree*, conjured in the process of using that word is operative in the sense that it is a performative and functional conceptual image of a tree, which is not fixed. Metaphor allows words to perform with a great degree of variability upon the relations between the sensual properties of objects and the objects themselves (Harman). Language, in this instrumental sense, grants different access to interacting with the real tree one encounters, and may transform those encounters conceptually, as well as ontologically (González Valerio).

In his seminal essay "Phantom Images" and associated trio of video works, *Eye/Machine I-III*, Farocki introduces the terms "operative image" and "operational image."[1] An operative image, he explains, results from the performance of an operation ("Phantom Images" 6). Performing an operation through or as an image, Barthes notes, makes it into an action, rather than an object or mere representation. The operative image, thus, is not to be thought of as necessarily representative of something else. Rather, it exists for itself, to the degree that it is concerned with the execution of a spatial task, and may not point to something beyond itself. Additionally, the performance of an operative image tends to prioritise the machine as the producer of this kind of image. This takes a radical departure from the representational paradigm, as the outcome of the performance of an operative image may or may not be visible to humans. The point of view, thus, is shifted from the subject's eye, to being situated in a machinic performance of an operation. The 'I', as well, is displaced from the human subject to the viewpoint of an apparatus.

Farocki describes machines as possessing a "sightless vision" reliant on computational processes, such as the programmed navigation of robots and drones. In his video trilogy, *Eye/Machine I-III*, viewers are faced with several examples of what he means by *operative image*. One scene features a robot performing tasks autonomously, cutting between shots of the robot moving around in a room and shots taken from its point of view, highlighting written numbers in colour as if to indicate the robot's *reading* those as salient features. In similar fashion, video clips from what appears to be a navigational assistance system are overlaid with markings indicating what appears to be the system's assessment of features in its environment. Different coloured, crudely drawn marks on the video designate the edges of the road or various obstructions in the path of the vehicle. And in scenes which Farocki mentions in "Phantom Images," footage taken by drones navigating autonomously in search of targets is alternated with a human operator tasked with watching the footage and overseeing remote missile strikes. The contrast between human and machine vision is highlighted by these examples, which point to the autonomous quality of performing visual processing tasks automatically by computers, robots and drones.

Automation

While the process-oriented and non-optical aspects of algorithmically-produced images are contemporary issues, this shift is also deeply rooted in historical developments in the automation of image production. Automating aspects of the creation of images through various techniques and machinery has a long history, which has contributed to the context surrounding current forms of image production. In this section, a review of key examples helps to develop a background against which to compare current trends in image production.

Algorithmic procedures have come to be a defining aspect of current visual media, especially due to the amount of visual processing tasks are now commonly delegated to computers. They are encountered frequently, playing a role in the creation of content, in determining what is visible to whom on the web and in governance through mass-surveillance. In light of this shift, the nature of the image can no longer be solely understood in terms of previous formulations which frame the image as a fixed, visual outcome, such as a developed and printed photograph. A digitised version of the same photograph, for instance, is easily recognisable, but it is a product of drastically different technological conditions, governed by computational processes in lieu of the mechanical, optical and chemical processes employed in analog photography. In this sense, algorithmically-produced images expand upon existing forms of automated production, placing emphasis on the execution of formal procedures in addition to their optical properties. An algorithm, it is worth noting, is a "process or set of rules to be followed in calculations or other problem-solving operations, especially by a computer" ("Algorithm"). The operative image takes a fairly broad interpretation of this definition, which is useful as we expand our approach to image-production processes that at first glance may not appear to be algorithmic in the more familiar, contemporary sense of complex computational processes, but instead embody procedural processes toward the execution of an image.

The problem that automating processes of image production posed to existing notions of aesthetic value in images was famously wrestled with by Walter Benjamin in his essay "The Work of Art in the Age of Mechanical Reproduction." Mechanising the production of images enabled multiples to be produced quickly via technologies such as the printing press and the photographic process, and also enabled the mass-dissemination of images. The facilitation of the serial reproduction of images undermined the aura of the original artwork, which had been a mainstay of artistic valuation up to that point. Artists including Andy Warhol and later the art and design group Superflex have played upon the aspect of seriality, making multiples of images to undermine the notion of the copy as inferior. In other developments in the mechanisation of the image, precursors to film, or "pre-cinema", saw the creation of a variety of optical gadgets and machines which activated images in various ways, from illumination to animation. Cinema set the image in motion through variations of multiple images, simulating movement: the "movement-image" and the "time-image" (Deleuze). Digital images allowed the electronic coding, display and circulation of images, and this was pushed even further with the use of the internet. Networked images, as Alexander Galloway points out (94), may be displayed on innumerable computers simultaneously, adding to the mass-transmissibility and intangibility of the image. Generative art went on to consider the artistic potential of employing autonomous systems to produce images.

In addition to the technical modes of the automation of image production previously described, formalising processes of artistic creation in terms of algorithmic behaviour also explored the dynamics of human-machine relations. Rather than a fixed outcome from image-production processes, the operative image may be performed or it may be transcoded as sets of instructions. Several artists who were early-adopters of using computers in their work also experimented with taking on a performative role in the production of images, placing the emphasis on process. Vera Molnár, for example, is known for her "machine imaginaire," which implemented instructions for the production of visual outcomes, the artist herself taking on the conceptual role of a computer, one which (or whom) computes, performing tasks based on a set of predefined rules ("Image Machine" 141-142). Taking on this kind of instrumental role has been a recurring theme in several avant-garde movements in the 20th century, importantly the Surrealists' engagement with the concept of *automatism*. They approached the mechanisation of art by advocating that artists relinquish conscious control over the artistic process so as to arrive at art produced by the subconscious mind. Automatic writing, drawing, and painting led artists to develop methodologies seeking to elude their own consciousness, often by employing highly systematised, rule-based techniques to surrender creative control by engaging with serendipity and randomness. In many instances, the artist expressly sought to hand over agency, intentionality, or control to a process, machine or system. One of the most famous and influential methods to materialise from this kind of aleatory approaches (Carvalhais) is the "cut-up method" which Brion Gysin is credited for,[2] a process in which a linear text would be dismembered at random and rearranged by the artist, influencing the creation of a new work from the rearrangement of an existing one. Conceptual artists such as Sol LeWitt, Yoko Ono, John Cage and Lawrence Weiner have similarly employed sets of rules in the creation of their works. Thinking of the process as a form of machinic or programmed image-production grasps the operative property of performing algorithmic processes. Implementing rule-based systems such as in LeWitt's instruction-based drawings, the artist gives directions for the construction of the work, which may be executed with some degree of variation.

Returning to the importance of text to the origins of the operative image, as was apparent in Barthes, several thinkers have explored how relations between images and texts contribute to their algorithmic qualities. In his enquiries into what he terms "image-texts," W. J. T. Mitchell demonstrates the various modes of interrelation between images and texts. Rather than merely referring to reality, as the image functions in representational terms, imagetexts consider the interrelation between objects, texts, and images, and their potential to be enacted through various forms of mediation. Similarly, Vilém Flusser explored textual aspects of images as being critical to their technical character. Flusser describes "technical images" as those images which have supplanted texts, not only those which owe their existence to technical apparatus in a direct sense (7). In addition to their technical mode of production, the codification and instrumentation of images also adds to their technical and textual character. Ingrid Hoelzl and Rémi Marie make a correlation between the algorithmic nature of digital images and the history of cartography (99), which shifted from thinking of maps as representations of the world in pictures to such a representation instead taking the form of a data set. Cataloguing the systematised coordinates marking the locations of geographic features and their relative spatial relations as an index of mathematical information made it possible for Ptolemy's atlas of maps, *Geographia*, to be saved, transmitted and later reconstructed. The process of transcribing a visual representation, in this case, a map, from image to numerical data and back into an image allows us to see a close parallel in other image processes, namely, the digital. Considering this index of coordinates as a set of instructions or source-code for the reconstruction of the maps, though simplified and analogue, is much like the instructional aspect of digital images. In a similar fashion, the canon of proportions outlined by Vitruvius in his *De architectura* describes representation of the human body geometrically, as if to function as instructions for its reconstruction: "The length of the foot is one sixth of the height of the body; of the forearm, one fourth; and the breadth of the breast is also one fourth." (Vitruvius)

In this and the previous pre-digital example, mathematical formulae and the systematic cataloguing of the internal relationships within images enabled them to be transcribed, stored, transmitted and reiterated. Not only did this enable a great deal of new possibilities, for instance making iterations of an image, it also allowed a degree of faithfulness to be maintained within the copies.

Discussion

To speak of automation begs the question of autonomy. In this case, one must ask what the operative image means not only for the production of images by machines, but also with respect to the sharing a viewpoint with the inanimate (Virilio 59). In what has been referred to as the “algorithmic turn” (Ulricchio, Hoelzl and Marie), what is visibly apparent on the surface of an image is only one aspect of the processes at work in algorithmic media. The information content of a digital image, for example, is largely unvisualised, acting as the code for its enactment, often through screens, and the image takes on a more dynamic quality than a static entity. The visible surface of the digital image is subjugated to the invisible “subface” (Nake) behind it, for instance, in contexts involving the automated processing of spatial data, where it may or may not be necessary to visualise the end result, in looking at the metadata attached to an image, or in comparing two seemingly identical images which were produced using different algorithms. The algorithmic processes responsible for what is eventually visualised as a digital image may vary greatly, whether or not those differences are visibly discernible to the human eye. But especially notable here is that when using algorithmic approaches such as machine learning to generate images based on vast amounts of training data, entire databases of images are subsumed by the resulting images. In a sense, such images are similar to composites merging the numerous images which an algorithm was trained on, yet much of that visual data, as well as the procedure which governed the end result is obscured.

In situations such as when a camera or other instrument serves as a stand-in, taking the place of the eye, technology enables humans to see in ways impossible to the naked eye, but also steals away other aspects one expects in an image. What is apparent to human viewers observing input intended for machines is that operative images function based on different parameters and are not necessarily burdened with any need to communicate with human vision. This quality makes them decidedly different from previous conceptions of images. Not only has the machine been thoroughly accepted as a surrogate for the eye, but in some cases, such as the instances covered by Farocki’s *Eye/Machine*, the eye may be dispensed of entirely. A consequence of distancing visual perception from the eye through apparatus is articulated through operative images as an ever more blurry boundary between human and nonhuman agency. Not principally of the human, by the human, nor for the human (Zylinska 5), nonhuman forms of images fulfil Virilio’s prediction regarding the automation of perception through cameras controlled by computers (59). The result of this automation of vision, a splitting of the viewpoint with the inanimate (Virilio 59), entails that these images are far from being self-evident. Looking alone is not sufficient to thoroughly grasp what is at stake in the output of algorithmic modes of image production. As a consequence of the operative image, the range of what may be considered to be an image is expanded to include non-optical, algorithmic processes, prioritising process over the image’s visible qualities.

The operative image is significant, not only because it alters what, ontologically speaking, may be defined as an image, but it also extends the role of image production beyond the human to autonomous (or semi-autonomous) enactment by machine. Automating aspects of the creative process calls into question some of the entrenched value systems surrounding images, namely authorship (Ward and Cox). The aura of authorship remains an enduring issue at stake in the production of images by machines, as evidenced by the current hype around works of dubious artistic quality (Obvious) which make claims to the autonomous creativity of machines. Concerns around authorship are never far behind discussion of automating the production of images by machine, the potential of autonomous artistic creation by machines threatening the "death of the author" (Barthes). Curiously, Harold Cohen alternated between signing images produced using the artificial intelligence software he created with his own signature (*Amsterdam Suite A*) and that of AARON (*20:28*). This lends the artworks a sense that Cohen may have either felt conflicted as to his role in creating the artwork, and that there may have been a feeling of competition for authorship. In a general sense, the images produced using machine learning, too, carry with them a spectre which has haunted technologically-engaged images throughout the past century, what Andreas Broeckmann calls the myth of the machine as artist. The persistent curiosity surrounding the creation of autonomous agents which in turn create art relies upon the tradition of conceptually separating science and the humanities. While machine learning enables the automation of certain tasks, it also lends itself to a mystification of the process of image production. Image production by intelligent machines offers new technical and conceptual possibilities, it also brings to light certain existing issues which have persisted throughout the past century, including automation, seriality, transcodability and human-machine relations.

Conclusion

Much as historical reckonings with technological modes of production such as the advent of the printing press, photography or cinema led to reevaluations of the image, the current gravitation toward algorithmic processes has led to new understandings of the defining attributes of images. Rather than a fundamentally new phenomenon, current methodologies instead expand upon the automation of image production which has been in progress for decades and even centuries. Reformulating the image as an operation which is performed as opposed to the fixed outcome of the creative process, the operative image offers an entryway to rethinking the context surrounding the automation of image processes which current media build upon. Developing the concept of the operative image through an overview of historically-significant theories and examples, this research aims to develop an understanding of how the concept of the operative image contributes to a reevaluation of the image in light of new modalities introduced by algorithmic media.

Notes

[1] Farocki uses the two words, *operative* and *operational*, for the most part interchangeably in his video work and writing. Other thinkers, including Trevor Paglen and Jussi Parikka have gravitated toward *operational*, but the author chooses to use the former, *operative*, as it indicates the sense of agency expressed by machines in the performance of operational images.

[2] William S. Burroughs is also known for popularising the practice of the cut-up method.

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Carleigh Morgan

CALCULATED ERROR: GLITCH ART, COMPRESSION ARTEFACTS, AND DIGITAL MATERIALITY

Abstract

This paper proposes a reconsideration of the aesthetic category of 'glitch' and advocates for a more careful theorisation around indexing — in the sense of both locating and naming — errors of a digital kind. Glitches are not as random as they seem: they are ordered and shaped by computational hardware and software, which impose a mathematical rubric on how glitches visually manifest and set ontological and technological constrains on glitch that limit how digital errors can and cannot be made to appear. Most crucially, this paper thinks about how one particular type of glitch — a compression artefact called a macroblock — can often appear as random, erratic, or unpredictable but is, in fact, materially constrained and visually conditioned according to the principles of computing and computer design. At its core, compression aesthetics can shed light on the operations of algorithms, the structures of digital technologies, and the priorities and patterns which occur as a function of algorithmic manipulation. The randomness, unpredictability, or messiness which glitch studies invokes around the glitch is in danger of overlooking the ways that the material architectures and algorithmic protocols structure the digital glitch by organising, constraining, and given form to its appearance.

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> *Bodies and machines are defined by function: as long as they operate correctly, they remain imperceptible.*
> *— Maurice Merleau-Ponty,* Phenomenology of Perception *(239).*

In 2005, Takeshi Murata released a short film called *Monster Movie*. This film showcased a swamp creature emerging from the muck that was noteworthy for its unique visual effects: blocks of mutating pixels that seemed to burst through the monster's body, deconstructing its image into a scattered and murky pixel array. Other glitch art, like David O'Reilly's *Compression Reels* and the net 2.0 aesthetics of cyberpunk art collective PaperRad, were sparked by similar interests in exposing the underlying algorithmic protocols and structuring interfaces of digital media. In the 2000s, glitch style migrated from its origins on niche punk-art message boards and underground websites to become incorporated into commercial music videos for both Kanye West and electro-pop group Chairlift. Directed by Ray Tintori, Chairlift's music video for Evident Utensil used glitch effects to create a visual aesthetic marked by an array of mutating colour blocks that fused the band with their surrounding environment and seemed to rupture the diving line between the environment staged in the video — its content — and the colours on the surface of the screen — its form. Kanye West's *Welcome to Heartbreak* achieved a more fastidiously controlled, choreographed style of glitch art that combined chromakey and green screen techniques to unsettle the grammars of commercial video editing. Starring West and featured singer Kid Cudi, the music video depicted the rappers 'melting' into each one another, alternating recognisable fragments of their faces with sequences of digital skids and bleeds that fractured the representational image and transformed it into an unstable landscape marked by fluctuating glitch effects.

All of these works owe at least one of their particular stylistic effects to the process known as compression hacking. This paper examines how compression hacking works as process of algorithmic manipulation and considers what the artistic practice of compression hacking exposes about the composition of digital images. The key argument is twofold: first, that the particular effects produced by compression hacking are determined by the computational processes and material properties of digital media; second, that the algorithmic functions that are used in compression hacking establish the conditions by which compression artefacts can appear, but that sometimes these compression artefacts remain invisible. Nevertheless, the production of compression artefacts as a result of compression hacking depends not only on certain level of algorithmic functionality, but also on the *matter* of digital technologies: compression artefacts, like all glitch effects, owe their various materialisations to technologies which are not entirely dysfunctional. In other words, malfunction is borne out of function: a digital error depends on the enduring functionality of the systems which give rise it, to make such an error legible as out-of-the-ordinary. One corollary to this argument is that the presence of what appears to be a glitch in a digital image does not always indicate the presence of an underlying technological error — a claim which unsettles the notion of technological troubleshooting and the heuristics underpinning a 'diagnostics' of technological failure.

To these ends, this paper proposes a reconsideration of the aesthetic category of 'glitch' and advocates for a more careful theorisation around indexing — in the sense of both locating and naming — errors of a digital kind. Most crucially, this paper thinks about how glitches — which often appear as random, erratic, or unpredictable

— are materially constrained and visually conditioned according to the principles of computing and computer design. Glitches are not as random as they seem; in fact, they are ordered and shaped by computational hardware and software, which impose a mathematical rubric on how glitches visually manifest and set ontological and technological constrains on glitch that limit how digital errors can and cannot be made to appear.

This paper will emphasise compression *hacking* for a few reasons. The first reason is to draw attention to the human labour and the activity of 'hacking' which generates compression artefacts. It also reinforces that this artistic practice is achieving by playing with the computational logics of compression — compression hacking requires a modicum of computational literacy and is an activity undertaken by someone who understands how to manipulate the information encoded in image or video files. With an emphasis on the 'hacking' of compression hacking, it is clear that this paper will not address compression artefacts or glitches as spontaneously occurring: the epistemic frameworks used to diagnose a digital error in the instance of a glitch's spontaneous occurrence would act as a confounding factor. Simply put, looking at the glitch generally, rather than at glitch *art* specifically, one is forced to contend with other variables pertaining to the origin of a glitch. To think of glitch as a homogenous aesthetic form rather than glitch art as a specific technological practice — or to begin with compression artefacts rather than compression hacking — means grappling with the notion that the glitch appears despite there being no known intervention from an outside agent (e.g. artist, hacker, programmer) who can testify to a glitch's cause or represent a reason for its occurrence.

There is another terminological clarification to make here. Although the term 'datamoshing' operates as an onomatopoetical descriptor which seems to describe the qualities of compression artefacts themselves — e.g. 'moshing' conjuring a pixel-based modularity and squishiness — it does not foreground the technological dimension of this artistic process as clearly as the term *compression hacking* does. 'Datamoshing' elides the role that the artist plays in reformulating the video files to produce visual compression artefacts, and in so doing introduces confounding variables into the discussion that this paper does not have the scope to address. Thinking about how to achieve compression artefacts as a product of compression hacking means that less technologically invasive methods for achieving its stylistic effects — so datamoshing done by applying a photo or video filter through the implementation filters via programs like Photoshop — can be set to one side. Although any file format can be compression hacked, this paper will focus on digital video/ moving images for two reasons: because this is the format which has mostly received the attention of compression hackers.

On compression algorithms

The law of information processing upholds that the "fewer states one needs to process a message, the faster and more efficient the system is" (Kane 220). Data compression follows this law by simplifying how data is stored. The purpose of data compression is typically to optimise storage space or increase data transmission rates, and it is often motivated by a desire to save both time and money. Compression algorithms record only the measurable changes in the image data. As a result, only areas of a moving image which describe differential motion or changing luminance values are captured by the compression algorithms (Arcangel).

According to this principle, images with fewer substantial changes from frame to frame are easier to encode. “The whole point of digital image compression,” Cory Arcangel writes “is to be able to reconstruct an image without having to send all the data.” Lossless compression, as the name might suggest, does not lose any information from the original source during any point of the compression (encoding) or decompression (decoding) process. In his short treatise “On Compression,” Arcangel develops a very clear analogy that captures this method of data-optimization in non-technical terms:

> *Let’s say we wanted to send this: ‘aaaaaaaaaba’ and we were going to send it over the phone by voice. As opposed to having to send all the information by reading out each letter one at a time, we could just tell someone ‘9a’s, one b, and one a’ and they would know we meant ‘a a a a a a a a a b a’ and we have saved ourselves a bit of breath. In computer language it means we have stored all the information using less space.*

Digital video files are composed of sequences of different types of frames: ‘i-frames’ or initial frames — commonly called keyframes — “are full representations of a single frame of a video” (Arcangel). In essence, a keyframe is simply a still image containing all the colour and luminance data of a particular frame and are typically used as reference points by animators. In digital animation as in hand-drawn animation, keyframes are important for determining where and when an animation sequence starts or stops. Predictive, or ‘p-frames,’ on the other hand, are reference files that inform the video player of changes to the image’s compositional arrangement that have occurred since the previous frame (Arcangel). In order to dramatically reduce the amount of data that needs to be stored, what is captured in a compressed video file is only the difference between the initial, or i-frame and the subsequent images, the p-frame, (sometimes called the delta Δ frames for this reason). These later frames contain the image’s transform instructions of the initial or keyframe. The illusion of object motion in an image or the appearance that the image itself is moving is determined by relationship between the p frames and the i-frames. If this relationship is thought of as the difference in motion interpellated over time, “subsequent frames could be described as a catalogue of pure differentiality” (Levin). In addition to keyframes and predictive frames, there are also b-frames: these are similar to p-frames but a b-frame references the frame both before and after it. Modifying b-frames leads to more unpredictable results than modifying only the keyframes and predictive frames (Arcangel). In short, compression algorithms control the behaviour of several kinds of frames. When combined, these frames act as a catalogue of movement, and therefore are functions of time — they measure the differences in image data from frame to frame.

Compression hacking creates a new merging reference between the elements of an original image frame and the successive frame. When compression hacking does yield visible compression artefacts, they occur as a direct result of ‘playing around’ with the relationships between the initial frames and the predictive frame to create digital images characterised by breaks, folds, ruptures, skids, mutations, and pixelated blots. “Macro-blocking, pixelating, checkerboarding, quilting and mosaicking” (Levin) are kinds of compression artefacts. These descriptors capture how these artefacts appear as geometric forms; their behaviours and appearances are visibly linked to organisation of a computational grid arranged by Cartesian coordinates, a point that will important to remember.

Compression artefacts are made visible through the use of lossy compression algorithms, whereby some of the information about an image is 'lost', although it is more accurate to classify the lost information as unnecessary, surplus, or disposable. Lossy compression can occur for a variety of reasons, but it is not bad — in fact, in instances of low bandwidth or limited storage space, lossy compression is desirable. Lossy compression removes or replaces the initial keyframes and/or predictive frames in a video file. It can also cause the "playback image and motion-vector data to distort the resulting moving image with unpredictable results" (Goriunova and Shulgin 91), but it is worth noting that the information lost during the compression process is not always detected by the human eye. Often the loss of information is of no great consequence, but the fact that data is lost during lossy compression means that it is limited in its application: lossy compression techniques applied to text documents, or "any application where all the information must remain intact" (Arcangel) would render the text file unreadable and unable to be restored to its original condition.

Despite the economic, temporal, and logistical advantages offered by lossy compression, images or data which undergo lossy compression are frequently thought of as a downgraded copy of the original image or data file (Brown and Kutty 168). These downgraded versions of an image or data set are optimised for easy storage and retrieval rather than for visual fidelity or clarity. But the central role of visuality in contemporary digital culture means that the aesthetic of lossy compression is often read as one typified by visual blemish or corruption on the surface of the image. These blemishes are read as evidence of a technological error which occurred at some point during the encoding and decoding process of compression, as a sign of the image's technological corruption. However, simply identifying that there are compression artefacts within an image is not sufficient evidence for diagnosing the presence of a technological error within the compression algorithm itself. The algorithmic behaviour of the compression algorithm and the creation of compression artefacts are, necessarily, behaviourally linked—but their behaviour is not identical. In other words, images that appear 'glitched' are not always produced by malfunctioning code. Particularly in the case of compression artefacts using lossy compression, 'corruption' within an image is a matter of artistic perspective. The next section will briefly examine how compression artefacts fit into longer theorisations about the visualisation of technological failure in modern and postmodern culture.

Locating the glitch

As a discipline, glitch studies are a relatively new area of academic research that has nevertheless furnished a prodigious amount of scholarship in recent years. Despite the high volume of cross-disciplinary contributions to glitch studies — from filmmakers, academics, programmers, and para-academic practitioners — very little academic work has directed its focus towards the artistic practice of compression hacking. Perhaps one of the difficulties in charting work on compression hacking is due to the fact that glitch studies is particularly prone to semantic inconsistencies, especially because the scholarship on glitch is often positioned as a history of the present. Keeping pace with the rapid aesthetic transformations ushered in by digital media may pose problems for glitch scholars, whose subject of study may fluctuate as rapidly as the internet and the aesthetic formations it produces. For example, some digital media scholars refer to compression hacking by another name — 'datamoshing'[1] — or simply subsume compression artefacts into larger historical and cultural considerations of the 'glitch' as a general aesthetic category.

While compression hacking can be situated within the domain of glitch as an artistic practice, it also fits into a longer cultural and historical practice of theorising the technological accident. The spectre of error — alien 'glitches' in a system — haunts this long era of the technological, invading everything from the industrial advances in steam locomotion to computer science to drone warfare. Like the character Wintermute in William Gibson's *Neuromancer*, glitches are frequently conceptualised as ghostly forces, malfunctions that interrupt the normal operations of technological systems by seemingly emerging "out of nothing and from nowhere," giving viewers "a fleeting glimpse of an alien intelligence at work" (Vanhanen 46). This theory traces its roots to anxieties that attenuated the industrial and technological shifts demarcating the late Victorian from the Early modern period, which were populated by stories of the technological gothic: "ghosts in the machine" depicted the "threat to the humans subject posed by an autonomous, uncontrollable technology" (Rutsky 125).

Indeed, before 'glitches' came to be known as such, the ubiquity of the unnamed accident was a frequent source of terror for people of the industrial age who struggled to come to grips with the provenance and cause of technological catastrophe. Many industrial technologies did not have monitoring systems, failsafe options, or the emergency stops. As such, industrial machines were constantly threatening to malfunction — one way of treating the factory explosion is not just to read it for its catastrophic effects, but also to see in it a perverse rationality. Machinic explosions may have been one of the few ways that workers were given a glimpse into the structural and operational logic of the machines in their midst. By violently exploding, industrial machines dramatically exposed their interlocking mechanisms — the machinic accident might be understood a spectacle of the machine's operational logic. Error, malfunction, breakdown — these states presuppose a stability, a rationality, and order from which the accident can erupt. From this teleological perspective, the accident acts as a necropsy to dissect the malfunctioning machine — one need only be reminded of 'exploded-view-diagrams' today to consider how the accident testifies not only to the structure and teleology of a machine, but also how "every technology carries its own negativity, which is invented at the same time as technical progress" (Virilo 89).

The concern over an unpredictable or sinister machinic vital force persists today. As visual cultural theorist Carolyn L Kane writes: "computers and algorithmic systems are progressively given authority over human action and experience […] yet we have a dwindling capacity to recognize [sic] this" (219). Viewed from afar, she hypothesises that 'the entire history of modern art could be construed as a glitch and compression of Enlightenment epistemology" (Kane 219). In "Datamoshing as Syntactic Form," Thomas Levin articulates a theory of compression hacking that ties it to anxieties produced by "the miscommunication between sender and receiver". He cites this transcoding error as distinctively cybernetic, operating historically as an aesthetic that "exposes societal paranoia by illustrating dependence on the digital and fear of system failure [and] with the advent of video sharing sites like YouTube […] the glitch aesthetic has evolved into a pop culture artefact" (Levin). Casey Boyle advocates for an art theoretical approach to glitch that embraces it as a generative practice — and not merely as a materialisation of technological failure — because glitches can "render apparent that which is transparent by design" (12). Greg Hainge argues that the glitch foregrounds "how technology always relies on the successful inclusion or integration of failure into its systems" (27). Perspectives like those of Hainge valorise technological failure as necessary to technological function and recuperate the glitch from its negative associations. One ramification of Hainge's view is that the line between something which is 'noise' and something which is 'signal' is not an expression of a technological boundary at all. Instead, 'glitch' is a phenomenon which can call into question the very stability and determinability of the distinction between signal and noise.

Within this larger framework of glitch theorised as an emergent unpredictability in machine function, it is not surprising to see compression hacking described as a practice which brings to the surface of the image the operational failures of digital systems. But compression hacking is not the result of a technological accident. To consider compression artefacts the *result* of accident, or to think of the compression artefact as 'glitched' is to both deny the artistic labour which produces compression hacked images and to misunderstand the relationship between visual and technological malfunction.

Still, it is possible to situate compression hacking in what David M. Berry calls the 'new aesthetic' (NA) a form of "'breakdown' art linked to the conspicuousness of digital technologies" (56). Berry writes:

> *We might conclude that the NA is the cultural eruption of the grammatization [sic] of software logics into everyday life. The NA can be seen as surfacing computational patterns, and in doing so articulates and represents the unseen and little-understood logic of computation, which lies under, over and in the interstices between the modular elements if an increasingly computational society. (57)*

Calculated error

Rather than think of this breakdown in the sense of *dysfunction*, it can be understood in the sense of *take apart*. Although it may seem like metaphorical hair-splicing, reconsidering what is meant by such a breakdown may be a crucial avenue for exploration the aesthetic features of the digital glitch, which reveals itself at the fault-line between *breakdown* as an entropic activity and *break-down* as a structuring principle.

Consider one particular type of compression artefact: the macroblock, as shown in the image above. Macroblocking visually destabilises the representational legibility of a digital image while simultaneously rearranging it into ordered blocks. There are small sections where the outline of an object appears, only to be abruptly cut off by large blocks of colour. Macroblocking can unsettle the ability of a spectator to apprehend an image as representationally legible, even when traces of recognisable objects remain within the image. Macroblocking creates the impression of a carefully controlled digital schizophrenia in a moving image: the shifting location, luminance, and colour of macroblocks combine to create an impression of movement that seems to originate in the screen's pixels. These pixels *seem* to scatter, breakthrough, or penetrate the digital materiality of the screen, moving with regimental precision. Jeff Donaldson describes these kinds of artefacts as "a break from an algorithmic flow [whose] unanticipated appearance is simultaneously frustrating and mesmerizing".

Figure 1: GlitchTVbot (2019). _Image_[Twitter]/ Available at: https://twitter.com/GlitchTVBot/status/1141287271922110464 (Accessed 03 June 2019).

But a macroblock does not actually consist of migrating pixels. A macroblock, occasionally called a 'blocking artefacts,' is a distortion in a compressed image that appears as a collection of pixel blocks. It can occur for a variety of reasons, but what is most important about macroblocking is that it relies on the mathematical principles of compression in image processing and does not feature the motion of pixels themselves. Let's return to Arcangel's vernacular description of compression for a moment:

> *Let's say we wanted to send this: 'aaaaaaaaaba' and we were going to send it over the phone by voice. As opposed to having to send all the information by reading out each letter one at a time, we could just tell someone '9a's, one b, and one a' and they would know we meant 'a a a a a a a a a b a' and we have saved ourselves a bit of breath. In computer language it means we have stored all the information using less space.*

Using a lossless compression algorithm yields no loss of data; whether one reports 'aaaaaaaaaba' or '9a's, one b, and one a', the information remains unchanged. But if the example above used lossy compression, 'aaaaaaaaaba' would be simplified to 'roughly 10 a's'. A similar process, called quantisation, occurs to create macroblocks. Instead of capturing all of the detail in a particular region of an image using a detailed range of values, the compression algorithm encodes only a single value for a particular region. If an image undergoes a great deal of lossy compression, the amount of information that is reduced during the compression process may be significant; in the case of macroblocking, the information the remains after lossy compression may only pertain to the average colour of a collection of pixel blocks, thereby rendering an area that was formerly populated by multiple colours and luminance values into a block of a single colour.

Donaldson's description of the logic of computational failure is of particular significance in understanding how the architecture of digital devices shape the images which they manifest. His remarks are interesting to reproduce here for their emphasis on the pixel as a format which is defined by a specific set of algorithmic architectures and confined by the material makeup and organisation of the computer display:

> *It is a true type of machine art and a crude form of artificial intelligence inasmuch that once an algorithm is let go to run free, due to the architecture of digital systems, a break from routine creates an ordering of its own. The pixel grid of the computer display provides the framework and serves as the canvas for this manifested algorithmic hiccup. It's as if the computer is freed from its normal task and instead displays what it [sic] wants, the architecture of electronics giving shape to sudden random image data. (Donaldson)*

Following Donaldson, let's explore how macroblocks owe their particular appearance to the design and arrangement of the pixel grid. Pixel, which comes from a contraction of the words picture (pic, pix) and "either element or cell […] is basically the smallest element of a discrete and non-continuous dataset […] arranged via an address on a grid location (x,y)" (Baraklianou 305). A pixel is the matter of which digital images are formed and the medium through which an image takes shape. A single pixel's appearance is determined mathematically: electrical signals are converted into a "two-dimensional array of information. A pixel is a register of data that, in combination with other pixels in an array […] is a sample encoded in a long set of binary codes" (Baraklianou 306). Despite the usage of 'pixel' in the colloquial sense, typically used to suggest that they are the atomic components of a digital image which can be decomposed and rearranged, pixels are not building blocks. Furthermore, a single pixel is not mobile — despite the descriptions of swirling, mutating, or bleeding pixels used to characterise the glitch aesthetic, pixels remain fixed, and they are not visible to the unaided human eye. In fact, a pixel is a unit of data that is "fundamentally ambivalent to vision" (Baraklianou 306) tethered to its array, and intimately connected with it surrounding pixels. The pixel is arranged with others like it into a pixel array — always a geometric formation — and the visual qualities of this array depend on the behaviours of pixels which constitute it and surround it; colour and luminance are not determined by the value of a single pixel but are "assigned at a later stage" and depend strongly on the relationships between pixel elements (Baraklianou 306). Whereas the pixel element is anchored to the architecture of the screen and the Cartesian arrangement of the pixel grid, the appearance of a pixel is relational function. In other words, while the pixel is geographically fixed to an (x,y) position on the screen, its "function is based on relational value sets assigned through the matrix of the corresponding elements around it. This enables designation and manipulation of point-by-point values in the image, which renders the image mutable" (Baraklianou 307). Hence, macroblocking appears as the moveable, mutating arrangement of pixels, but the material architectures of the pixel grid and logics of the compression algorithm act as boundaries on this visual chaos and keep the pixels fixed in place. The movement of pixel blocks from one location on the (x.y) plane to another is simply a visual illusion, one which appears due to the way that macroblocking allows a spectator to observe the geometries of the pixel grid as an emergent property of the compressed image.

At its core, compression hacking can shed light on the operations of algorithms, the structures of digital technologies, and the priorities and patterns which occur as a function of algorithmic manipulation. “Machines,” writes Liam Young, “see the world through coded sets of rules. Whether through a camera lens, sensor, or scanner, they search for particular configurations of data, sets of predefined relationships, patterns, and geometries” (125). The characteristics of macroblocking, and by extension other kinds of compression artefacts, can offer clues about the way that computer architectures, such as the pixel array, are structured. The appearance of a compression artefact is constrained by the logics of compression, and by the geometries confining computer hardware, such as the pixel array, to a particular gridded orientation. So while it may seem like pixels are moving in regimental blocks, this is an illusion that is shaped by the material architectures of the pixel grid and the way that the appearance of a pixel array is a product that is relationally determined, mathematically constrained, and materially fixed.

Detecting glitch

In the early 2000s, art collective !Mediengruppe Bitnik released *Download Finished - The Art of Filesharing*. Described by the artists as “an online resource which transforms and re-publishes films from P2P [peer-to-peer] networks and online archives,” *Download Finished* is a part digital performance, part post-structuralist critique of the hidden technological protocols and underlying architectures that give colour, form and shape to digital signal and digital noise (!Mediengruppe Bitnik). Speaking both metaphorically and matter-of-factly, the artists describe the project as an attempt to “make hidden the data structure” of digital technologies visible: the original images and moving images shared across these peer-to-peer networks are run through “a transformation machine,” whose oblique name functions like a black box, with its refusal to confide in the specific technological process of translation that causes a shared file “to dissolve into pixels” (!Mediengruppe Bitnik). The language used to describe *Download Finished* invokes images of technological systems that are impenetrable and unknowable except through the form of their spectacular malfunction. In this way of thinking, the mystifying commands and obfuscating structures that allow computer technologies to work can only be visibly foregrounded through an error in these very commands, a breakdown in these very structures.

Glitch artist Rosa Menkman also believes that glitch art functions to reveal the obfuscated logics of computer processes. She considers her practice a political one because it interrupts the function of computer systems by introducing malfunction into a “highly complex assemblage that is often hard to penetrate and sometimes even completely closed off” (Menkman 12). Menkman’s perspective on glitch art as a radical critique of technological determinism is echoed by critics like Hainge. On Hainge’s formulation, glitching materialises the ‘noise’ that lies dormant or unseen within the operations of digital systems. Some media scholars view glitch art as the latest instantiation of the “aesthetic use of discarded and deleted data (i.e. errors)” (Kane, “Compression Aesthetics”) or as a reaction against the impenetrability of computational systems.

New media scholars like Casey Boyle also adopt this viewpoint. Boyle’s “Questions Concerning Glitch” explicitly expands on the work of Katherine Hayles and Bruno Latour to argue that a responsible rhetorical practice for glitch art would involve understanding "all mediation and any glitches as generative and not as errors to be corrected" (Boyle 12). In *The Wretched of the Screen*, Hito Steyerl champions this feature of the glitch, too, calling them the bruises of images that are "violated, ripped apart, subjected to interrogation, and probing" (5). And as Donaldson writes:

> *The artist's hand no longer dictates the outcome the way it does with conventional fine art. Instead, conditions are created to bring forth something unpredictable, inasmuch as the set parameters are capable of producing.*

Compression hacking aligns with these considerations of the glitch. Compression hacking works to distorts the sleek, seamless look of the digital image and to create an aesthetic that "allows insight beyond the customary, omnipresent […] computer aesthetics" and sheds light on "software's inner structure, whether it's a mechanism of data compression or HTML code" (Galloway 25). To be sure, compression hacking still requires interpretation: it does not reveal the operations of the compression algorithm without some work behalf of the viewer and a modicum of computational literacy. However, compression artefacts like macroblocking can draw attention to the computational conventions by which digital images and rendered visible and by which "digital spaces are organized" (Galloway 25). The glitch is a fissure that allows one to peer into the hidden operations and invisible structures of digital technologies: "Whether its cause is intentional or accidental, a glitch flamboyantly undoes the communications platforms that we, as subjects of digital culture, both rely on and take for granted." (Manon and Temkin)

These theories gesture to an important question that has so far gone explicitly unasked: is macroblocking a glitch? In brief, no. To label this compression artefact a 'glitch' is not a perception, but a judgement. That is, to always read compressed images — or visual indecipherability more generally — as a symptom of technological malfunction is to assign a creative intentionality to the compression algorithm, which is in fact indifferent to the representational clarity of the images it produces. It also supposes that the visual layer of digital images mimics the behaviour of the algorithmic one. But the compression algorithm has no stake in maintaining representational sensibility for its viewers. Compression hacking can give rise to "random image data" (Donaldson) but it can only use the data available to the compression algorithm — and the data can only ever be preserved or lost, never rendered more detailed than its original source. Furthermore, any 'chaos' is bounded by the computational limits of the compression algorithm and the arrangement of the pixel grid. Finally, the appearance of macroblocking relies on the smooth operations of lossy compression; it cannot occur without the successfully completion of the lossy encoding and decoding process that is part of the overall process of compression. The compression algorithm must be functional in order to generate macroblocking effects; if macroblocking were to be considered an error, or as signal of one, then its antecedent would not be the lossy compression algorithm. After all, macroblocks are a product of lossy compression. If anything, the manifestation of macroblocks in an image would testify to the successful completion of lossy completion, not act as an indicator of its failure.

In *The Interface Effect*, Alexander Galloway writes that glitch art "recuperates and even relies on failure to succeed. It is primarily a systemic relation" (25). Likewise, Michel Serres, in his meditation on functional 'alongsidedness' writes, "Systems work because they don't work. Nonfunctionality remains essential for functionality" (in Galloway 25). This perspective, however, does apply to compression artefacts in the narrow case being examined here. Although compression artefacts may give the appearance of being glitched, they still rely on the smooth operations of the compression algorithm for their materialisation. Serre's axiom needs to be modified slightly in this case. As compression hacking demonstrates, sometimes *functionality remains essential for the appearance of non-functionality*. Galloway's observation can be similarly adjusted for compression hacking, which can foreground how images that appear to expose technological failure relies on an underlying technological 'success' for their production. One can amend Galloway: compressed images show how glitch *art imitates failure successfully rather than relying on failure to succeed*. Ultimately, rather than resigning compression artefacts to the domain of glitch and its related nomenclatures, glitch theorists should think seriously about how compression artefacts might depend on precisely the opposite of technological failure for their materialisation.

Conclusion

Digital media are optical and algorithmic in composition: however, the behaviour of these two dimensions does not always correspond. The non-representational character and unpredictable behaviour of compression artefacts trouble a human tendency to collapse the optical and algorithmic dimensions of digital images at the level of the visual: specifically, at the visual interface of digital media, where one can *see what's happening*. Compression hacking produces compressed images which mimic the appearance of technical corruption while not relying on technical corruption at all to produce these visual effects.

Compression artefacts like macroblocks, then, are not materialisations of an underlying technological failure — as the argument goes within glitch studies — but they do visually *simulate* the effects of a technical failure that has not occurred. Compression artefacts indicate that there is a subtle but significant difference between the *visualisation* of a technological error and its *aesthetic simulation*. In a way, compression artefacts are a pastiche of glitch style. By thinking carefully about how compression hacking affects the different strata of a digital image, one can see how the relationship between the algorithmic dimension and the visual dimension of these images are *interdependent* but *not behaviourally identical*. An error in the algorithmic layer does not always manifest at the visual interface; conversely, the appearance of a visual error is not a reliable indicator of a technological malfunction. In other words, the 'glitch' is in need of more careful theorisation: one should not confuse an aesthetic of technological failure with an aetiology of technological malfunction or conflate the visualisation of a technological error with its aesthetic simulation. Finally, it is imperative to keep in mind how much the randomness, unpredictability, or messiness which glitch studies invokes around the glitch is in danger of overlooking the ways that the material architectures and algorithmic protocols structure the digital glitch by organising, constraining, and given form to its appearance.

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Notes

[1] See Brown and Kutty; Schultz-Figueroa; Manon and Temkin; Levin; and Kane "Error." The term 'datamoshing' was coined by internet art collective PaperRad.

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