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Poetics of Artificial Intelligence in Art Practice: (Mis)apprehended Bodies Remixed as Language

Bruce Gilchrist

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Abstract

With a focus on the last five years, art employing artificial intelligence (AI) has been defined by a spectrum of activity, from the deep learning explorations of neural network researchers to artists critiquing the broader social implications of AI technology. There is an emergence of and increasing access to new tools and techniques for repurposing and manipulating material in unprecedented ways in art. At the same time, there is a dearth of language outside the scientific domain with which to discuss it. A combination of contextual review, comparison of artistic approaches, and practical projects explores speculation that the conceptual repertoire for remix studies can open up to art enabled by AI and machine learning (ML).

This research contributes a practical, conceptual and combinatorial approach for artists who do not necessarily have a grounding in engineering or computer science. A bricolage methodology—described by Annette Markham as combining serendipity, proximity and contingency—reveals the poetics of AI-enabled art in the form of an assemblage of techniques that understands poetics as active making (poiesis) as well as an approach to manipulating language.

The poetic capacity of AI/ML is understood as an emergent form of remix technique, with the ML at its core functioning like a remix engine. This practice-based research presents several projects founded on an interrelation of body, text

and predictive technology enabled by a human-action-recognition algorithm combined with a natural language generator. A significant number of artistic works have been made around object and facial recognition, while very little (if any) artist activity has focused on human-action-recognition. For this reason, I concentrated my research there.

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1 Introduction

1.1 Background to Research

“Alle apparate ausschalten”—switch off all apparatuses. (Friedrich Kittler)

The subtitle of this thesis is inspired by the volume, *Sensualities/Textualities and Technologies: Writings of the Body in 21st-Century Performance* (Broadhurst and Machon, 2009), in which Tracey Warr has contributed the chapter ‘Texts from the Body’ (2009, pp.22–37). Warr’s chapter responds to a series of collaborative, performance, installation and process-based artworks instigated by myself in the period from 1994–2006. She describes how the work “combines poetic strategies with customised brain imaging and biofeedback technologies to draw ‘texts’ from the mute body and to image and manifest these texts for audiences” (2009, p.23).

The volume is an exploration of the relationship between three principal themes: bodies, technologies and texts. Ric Allsop, in his foreword, defines a *text* as anything that can be read, ranging from gesture to drawing, from dance to poetry, and it is *how these texts are read* that he defines as “textuality” (2009, p.xii). Allsop describes poets as being inside both language and the various modes of textuality, not as in a control centre but rather as an environment. Within this environment—understood as technology—he envisions bodies writing themselves.

Being inside technology is considered part of the condition of being human, according to Bernard Stiegler, who explains via the anthropologist André Leroi-Gourhan that the appearance of the human is the same thing as the appearance of the technical (1998, p.141). Stiegler questions the relationship between humans and raw material and the concept of invention when he says, “it is the tool (...) that invents the human, not the human who invents the technical” (p.141). Drawing from this, Allsop posits that “as with our being inside bodies, our understanding of the world depends on the technical means by which we apprehend it” (2009, p.xiii). It is through technics that the human can access what Stiegler has referred to as “the already-there” (1998, p.236), a Heideggerian reference to the philosophical problem of understanding how to be in a world that always precedes human existence and how to engage with it practically.¹ For Stiegler, it is the technical conditions surrounding access to “the already-there” that denote distinctive periods of history.

I have interpreted the idea of a relational database—with its ability to communicate across thresholds—as a poetic evocation of “the already-there”. The engines of the art projects described by Warr were databases that hosted organised collections of structured information able to probe into “the unconscious, unlanguage parts of consciousness, into prehension and preconsciousness” (2009,

¹ The hypothesis of “the already-there” as related to the existential concept of “Dasein” (translated as *being there* or *presence*) was developed by Heidegger in *The Concept of Time* (1924).

chap.2). These databases addressed various kinds of texts, many biometric and therefore open to interpretation as “texts from the body”. Typically using the body in live performance (Figure 1) as part of a biometric interface connected to a local area network (LAN), the databases were open to interrogation. Creative records were retrieved and remixed in the manner of a search engine.² By virtue of a database aesthetic, the texts had the potential to be ‘disinterred’ as part of an artwork, but more often than not they remained buried, undisclosed and never seen again.

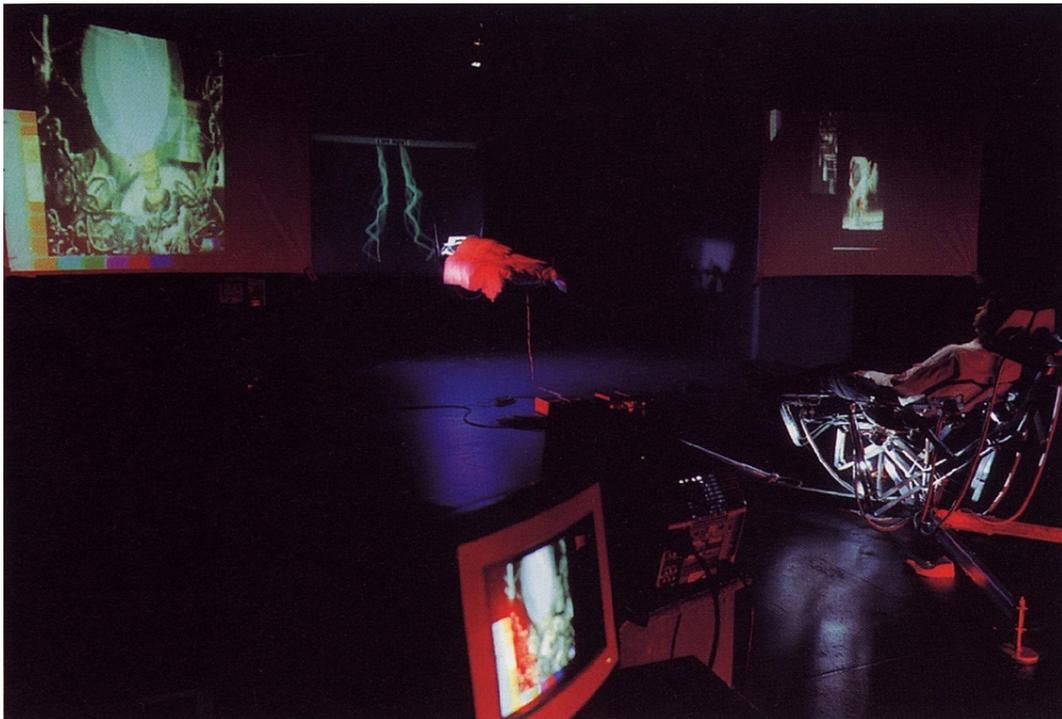


Fig.1. Bruce Gilchrist and Jonny Bradley (1996) *Divided by Resistance*, ICA, London. A Toshiba Art and Innovation Commission as part of Totally Wired. Photo: Bonnie Venture.

² From Francis Hunger’s perspective, the database emerges “as a decentralised, fragmented, potentially always combinable bio-power.” He introduces the concept of remix when he discusses the ability of the database to “interconnect pieces of information, put them in relation to each other and constantly re-arrange this epistemic arrangement according to a query” (Hunger, 2017).

In the mid-1990's, inspired by the Human Genome Diversity Project (HGDP),³ I regarded the burgeoning role of databases across all conceivable sectors of society as a harbinger of a new form of governance via data. Over two decades later, modelled on Google's extractive architecture, the relatively benign symbolism of the database has been superseded by the exploitation of "data exhaust": behavioural data being ingested by corporate machinery and rendered for exchange in behavioural futures markets.⁴ I have come to understand the term "data exhaust" as a body-text destined to be read by machines in a new form of textuality. Equating "data exhaust" to body-text has informed my current art practice, where the poetics of the relational database is replaced by a human-action-recognition algorithm (HAR) that can apprehend texts from bodies without the use of a search query.

The following chapters of this thesis will consider how and why these body texts have come to be apprehended, showing there is plenty of latitude for erroneous inference in the HAR's translation of action into recognition. As indicated in the subtitle, bodies are both apprehended and misapprehended. For example, when film footage of a schoolchild "riding a bicycle" is interpreted as "abseiling"⁵

³ There is a correspondence between the most important tenets of the Human Genome Diversity Project (HGDP) debate and the current AI debate concerning the social and ethical implications of data harvesting.

⁴ Shoshana Zuboff describes the monetisation by Google of people's search activity on the internet as a behavioural by-product, which she describes as "data exhaust" (Zuboff, 2019, p.67-70).

⁵ The labels named "riding a bicycle" and "abseiling" are two of the four hundred labels that have been assigned to classes of human actions in the Kinetics 400 dataset that is used to train the human-action-recognition algorithm (HAR) used in this project.

by the HAR (Appendix A.2: Three Examples of Misclassification), it has patently been ‘misunderstood’, but it has been apprehended nevertheless. In this way, a misapprehension constituted through dataset bias, inadequate labelling and training, is conceived as a chance operation. Uncertainty is introduced into the artistic procedure, making links to a long history of the aleatoric in art.⁶

Friedrich Kittler has suggested that “[w]hat remains of people is what media can store and communicate” (1999, p.xl). When he orders his life support apparatus to be switched off—“Alle apparate ausschalten” (McCarthy, 2011)—he invites further reflection on the connections between bodies, technologies and texts.

The impetus for this research has primarily come from an earlier project, *Automatic Cinema* (2017–2018), a collaboration with London South Bank University (LSBU), funded by Arts Council England, a proof of concept that aimed to link performance, robotics and machine learning (ML) as part of an automated filmmaking proposition (Figure 2). It was imagined that this would occur in the context of an installation of human participants, autonomous robot cameras and artificial intelligence (AI), making reference to a trend driven by the warehouse robotics of logistics companies in e-commerce and the internet of things (IoT). It reimagined a blend of

⁶ “(...) avant-garde strategies for disrupting the artist’s conscious aim and introducing unexpected effects have been deployed in modern art since Dada” (Walwin and Krokatsis, 2006, p.7).

factory and warehouse to transform arrangements of labour, capital, media and information into a new space of cultural production.

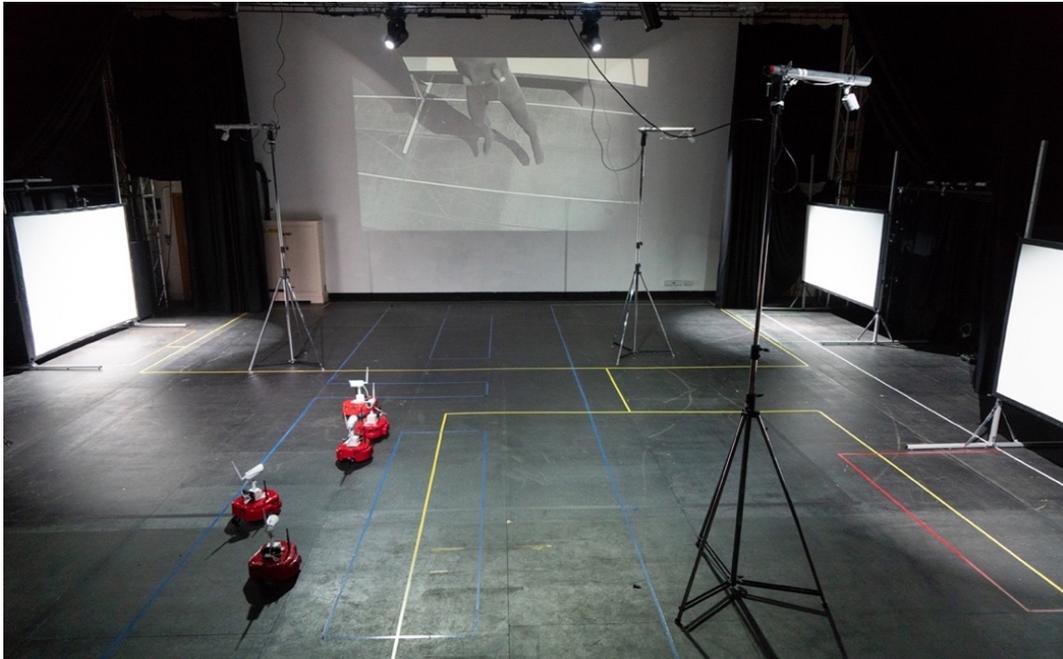


Fig.2. London Fieldworks (2018) *Automatic Cinema*. Work in development, Centre for Research in Digital Storymaking at LSBU. Photo: Bruce Gilchrist.

The project drew conceptually from J.J. Gibson's ecological psychology, which shows how certain types of behaviour are elicited from subjects via the affordances of an environment. Amigobot robots programmed with a map of the space navigated towards an 'active' participant and, on arrival, streamed live CCTV footage of the participant activity (Figure 3). The intention was that within the local area network (LAN), a human-action-recognition algorithm trained on the Google AVA dataset of human actions would parse the incoming stream and return textual

predictions of participant action as an element that would be acted upon somehow.⁷

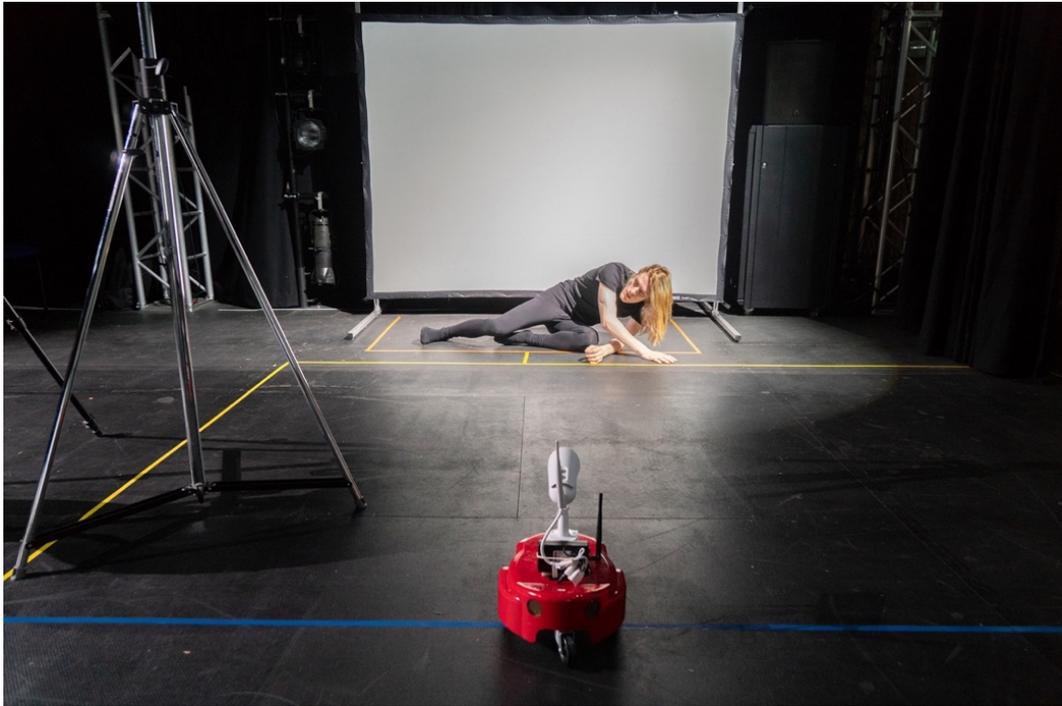


Fig.3. London Fieldworks (2018) *Automatic Cinema*. Work in development, Centre for Research in Digital Storymaking at LSBU. Photo: Bruce Gilchrist.

Most of the technical aspect of the proposition regarding human-robot interaction was successfully covered; however, we were at a loss concerning aspects of the AI component and how to develop it conceptually. The expertise we anticipated from the robotics and computer science informatics labs at LSBU was not there. In stark contrast, I had experienced the lab vibrant with research culture

⁷ Google AVA (Atomic Visual Actions) provides audio-visual annotations of video aimed at improving understanding of human activity via computer vision. Each of the video clips has been annotated by human annotators to represent a variety of scenes. The mission statement of the Perception Team at Google AI is to imbue computers with “social visual intelligence”: what are humans doing, what might they do next, what are they trying to achieve? Available at: <https://research.google.com/ava/> (Accessed 17 August 2021).

several years before in 2010 when the department commissioned me as a filmmaker. It eventually became apparent that many of the best researchers had migrated off-site to TWI Ltd, an independent research and technology organisation based in a technology park on the outskirts of Cambridge.

(...) in academia, what used to be a carefully maintained reserve, a research facility in which processes that could be subject to *later* capitalisation had to be given some room to unfold, is now mined much more directly, without delays (Lütticken, 2016, p.13).

At the time, a febrile demand for AI builders with the ability to apply ML techniques set off a trend of technology companies “plundering academic departments to hire professors and graduate students before they finish their degrees.” An article describes the phenomenon of researchers being lured away from academia with lucrative contracts as a “frenzied rush for human talent”, an academic brain-drain (The Economist, 2017, p.61). After the *Automatic Cinema* proof of concept phase in 2018, as one of the lead artists, I was left still contemplating the potential of AI technology in art-making.

1.2 Research Questions

The mass media has typically represented cultural AI via the trope of the “dreaming machine” (Hern, 2015) or what Dieter Mersch has described as the myth of the “inspired machine”, perpetuated by the continued opacity and mystery of the

algorithmic black box (2020, p.14). It became evident that the hype and mystification came from and contributed to a lack of language to discuss AI technology. It seemed that the language and understanding needed to discuss art enabled by AI had yet to be fully formed, pointing to a need to address the gap in understanding concerning this new kind of art production, where emergent tool-sets for digital artists are relatively poorly understood. As will be seen from the contextual review chapter (Chapter 2), a definition of AI in art expanded to include the AI subset machine learning (ML). The expanded definition contributed to the formation of research questions based on the experience of making the *Automatic Cinema* proof of concept:

- 1) How can AI/ML be combined with a poetic strategy to enable the making of an artwork?
- 2) How can current developments in AI, including machine learning (ML) contribute towards a new model of interactivity within art?

Later, as a technique developed out of the practice-based methodology, another question emerged, aimed at addressing the lack of language with which to discuss AI in an art context:

- 3) Can AI/ML in art be considered as a remix technique?

1.3 Methodology

A practice-based research methodology is initially followed as the background to the research is based on practice. Like many other practice-based PhDs, a contextual review is conducted that informs a series of practical projects, with reflection on each project informing the intent of the next project (Bradbury, 2015; Freeman, 2018; Smith, 2011). A working definition of AI is discerned from the contextual review, alongside what is perceived to be dominant artistic approaches to AI-enabled art. Comparisons were made between these different approaches, and in the case of interactivity in art, correspondence is sought between previous taxonomies and conceptualisations.

Similar to Bradbury and Smith, the methodology incorporated the hosting of a themed discussion for the CRUMB discussion list,⁸ which enabled opening up the research questions to invited respondents as well as the wider CRUMB community, with the most salient responses included in Appendix C.1–C.9.

This research was funded by an Arts and Humanities Research Council NPIF DTP1 award in partnership with Open Data Institute (ODI) Data as Culture, and D6: Culture in Transit. Dialogue with directors and curators from both organisations helped identify the importance of critical approaches to AI in art, while attendance at the ODI's Summit conferences was a valuable source of information concerning

⁸ Curatorial Resource for Upstart Media Bliss (CRUMB). Available at: <https://www.crumbweb.org/> (Accessed: 9 August 2021).

data and society. Representatives from both organisations were invited to participate in the CRUMB discussion list. The ODI's Data as Culture art programme engages audiences with work by artists who critically and materially explore data, code and network culture. I contributed to the Data as Culture *Copy That* programme (2019), which inspired a proposal for development with both organisations: a participative, data gathering performance—*Real People* (Section 3.5.2). I was able to draw from D6's socially engaged expertise and participate in dialogue with their artist in residence programme. Unfortunately, due to COVID-19 restrictions, the development of *Real People* was postponed but is something that can hopefully be developed in the near future.

AI-enabled art involves computer technologies that, although complex and proscriptive, offer a space for conceptual, formal, and aesthetic experimentation. However, artists have varying degrees of technical knowledge and skills for working within the AI-art space, from artist-engineers to engineer- and scientist-artists to *bricoleurs* (Grba, 2021, p.248):

The qualitative researcher as bricoleur, or maker of quilts, uses the aesthetic and material tools of his or her craft, developing whatever strategies, methods, and empirical materials are at hand (Denzin and Lincoln, 1999 in Rogers, 2015, p.5).

Lévi-Strauss describes how, working in the opposite way to science, the method of bricolage “creates structures, in the form of its artefacts, by means of

contingent events” (as cited in Markham, 2018, p.44). Lévi-Strauss’ description is an apt way of summarising the methodological approach to this research, where “contingent events” are understood as a combination of contextual review, skillset development, practical projects and serendipity, which lead to artefacts.

In discussing bricolage in relation to serendipity, Markham (p.45) distinguishes between the accidental and the incidental. Whereas the accidental implies a form of mindlessness, the *incidental* implies a more critical readiness of mind. Concerning Markham’s distinction, the more critical state is understood to be substantiated by a practitioner’s repertoire.

On addressing the unknown or unexpected, the idea of repertoire becomes pertinent, where the practitioner has built up a store of concepts, images, actions that can be called upon and applied. According to Mark K. Smith in his book *Local Education*, this idea of repertoire originates from Donald A. Schön’s approach to reflective practice (1994, p.71). However, the consideration of a repertoire as central to reflection has been previously articulated by Claude Lévi-Strauss in *The Savage Mind* when he discusses the expression of mythical thought:

It expresses itself by means of a heterogeneous repertoire which, even if extensive, is nevertheless limited. It has to use this repertoire, however, whatever the task in hand because it has nothing else at its disposal (1966, p.17).

John Dewey anticipated the use of repertoire in *How We Think: A*

Restatement of the Relation of Reflective Thinking to the Educative Process:

We do not approach any problem with a wholly naïve or virgin mind; we approach it with certain acquired habitual modes of understanding, with a certain store of previously evolved meanings or at least of experiences from which meanings may be educed (1933, p.125).

The research method is also informed by Ally Bisshop's PhD *Articulating Thresholds~Artistic Techniques for More-than-Human Sensitivities*, which engages with Erin Manning and Brian Massumi's artistic process of research-creation.

Reading Bisshop's PhD thesis helped to appreciate *thinking and doing* as a "generative threshold for the invention of techniques" (2018, p.v).

The contextual review was initially expected to be limited to the first year, but as the AI-art space expanded, the review of developing tools, techniques and practitioners continued. A bricolage approach to research methodology allowed for emergence and created the opportunity to respond to continuous reflection on that process. Mark K. Smith's (1994, p.164) contention that "[r]eflection requires space in the present and the promise of space in the future" highlights the significance of "reflection-on" practice as originally conceived by Donald A. Schön in *The Reflective Practitioner* (1983). This form of reflection took place within the space afforded by further contextual review, conversation with supervisors and peers, the writing of milestone reports, and iterating outcomes, all to advance the research questions.

1.4 Structure of Thesis Including Narrative of Methodology

The thesis is organised with the contextual review in chapter 2. Practical projects are described and reflected upon in chapter 3. Finally, chapter 4 covers the interpretation of results and conclusions. The following series of steps describes the chronological narrative:

- I. The research begins with the search for an accessible working definition of AI, something that has changed over time from an original vision in the 1950s to a much looser term, more of a catch-all label than an exact name for a single, specific technological ability.
- II. An established working definition of AI in an art context incorporates machine learning (ML), which informs the contextual review—a survey of contemporary artistic uses of AI-related technology. This review contextualises artistic activity in a binary way: a practice referred to as the Google affiliated, DeepDream cohort, which initially entered the mainstream public imagination as being representative of AI-art; and a looser grouping of independent artists who demonstrate critical approaches based on questioning the construction of AI technology and its effects on society.
- III. A practical encounter with an artist whose work belongs to the second grouping provided the initial inspiration for practical projects. The encounter gives rise to the speculation that AI/ML-enabled art can be considered a remix technique.

- IV. An invitation to create a work for a radio broadcast provided the impetus to initiate a practical project. The method used to create the work began to explore the idea of a poetic strategy for production: a Python script remixed an avant-garde text, which resulted in the appreciation of words as linguistic reality active within a 'remix space'. This method eventually led to an interest in natural language generation (NLG).
- V. Contextual review introduced human-action-recognition algorithms (HAR) and video datasets employed in the training of neural networks. It was learned from the review that there had been much artistic work made around object and facial recognition, and very little (if any) work focused on HAR, and for that reason, the research focuses on the creative use of HAR.
- VI. To generate material to stimulate the HAR algorithm, the intention was to build a resource of recorded human actions using motion capture (mocap) techniques via a participative performance project. Unfortunately, a performance project became unfeasible due to COVID-19 restrictions, so a pre-existing mocap database from Carnegie Mellon University (CMU) was used. Digital human puppets are animated by assigning mocap files, and used to stimulate the HAR algorithm.
- VII. Combined knowledge and insight gained from practical projects led to discovering an assemblage of three main components, understood as an embodiment of a poetic strategy. The assemblage converts human action

into language and is used to produce a number of small projects. With the addition of an outcome from a collaborative artist residency at Baltan Labs, Eindhoven, these projects are employed to address the research questions.

1.5 Definition of Key Terms

Artistic Research

Henk Slager describes three conceptual spaces that fundamentally determine what is meant by *artistic research*:

Creative practice (experimentality, art making, potential of the sensible); artistic thinking (open-ended, speculative, associative, non-linear, haunting, thinking differently); and curatorial strategies (topical modes of political imagination, transformational spaces for encounters, reflection and dissemination) and to comprehend these spaces in their mutual, dynamic coherence as a series of indirect triangular relationships (2020, p.3).

Artificial Intelligence (AI)

AI is a suite of technologies that includes machine learning, computer vision, reasoning, and natural language processing, among others. It exists in an awkward and unique space as technology, metaphor and socio-technical imaginary (I. Ganesh, 2020).

AI-art

AI-art is made using any AI technique. However, there is no real consensus on what is included or excluded from AI-art (McCormack, Gifford and Hutchings, 2019, p.4).

Autoencoder Neural Network (ANN)

An autoencoder neural network enables the distribution of a task over a network, which can 'learn' from examples without being programmed to do so. The processing in each layer is combined to represent the objects that need to be identified, such as faces or handwriting. Within the multilayer network, the desired output is set to be equal to the input, with fewer hidden units in the intermediate layers than there are in the input. From the input to the hidden layer, the first part implements an encoder stage where a high-dimensional input is compressed and represented by the values of the fewer hidden units. From the hidden layer to the output, the second part implements a decoder stage that takes that low-dimensional representation in the hidden layer and reconstructs the higher dimensional input back again at the output (Alpaydin, 2016 p.102).

Computer Vision (CV)

The goal of CV is to extract useful information from images, to describe the world that humans see in one or more images and to reconstruct its properties, such as shape, illumination, and colour distribution (Szeliski, 2010, p.5). From the biological science point of view, CV aims to develop computational models of the human visual system. From the engineering point of view, CV aims to build autonomous systems which can perform some of the tasks which the human visual system can perform (Huang, no date).

Cut-Up

A cut-up is the cutting up and subsequent rearranging of media forms as part of a creative or critical practice. Only recently has this culminated in the well-known digital technique by which text, image or data is transferred from one place to another via cut, copy and paste keyboard commands. The cut-up is a method of writing that has been adopted by the avant-garde (historical and neo) where

narratives are created out of the cutting and splicing, the rearranging and juxtaposing of various texts in a random way (Adema, 2018, p.105).

Generative Pre-Training Transformer (GPT-2)

In Feb 2019, the AI research laboratory, OpenAI, announced that they had trained a large scale language model called GPT-2 that generates coherent paragraphs of text, performs rudimentary reading comprehension and machine translation, among other text-based tasks. The model was released in Nov 2019 and is available to non-experts via the RunwayML platform, which provides a subscription to cloud-based GPU computing to train the GPT-2 model with bespoke training data. The linguistic philosophy that drives the natural language processing (NLP) technique of OpenAI is “distributional semantics”, where words derive their meaning from finding patterns by counting how often and how closely words are used in relation to one another. Based on the training data, the model ‘learns’ to imitate and ‘understand’ the text patterns or writing style, and given a sequence of text as a prompt, will essentially predict the next word based on the existing text in the prompt (Radford et al., no date).

Human Action Recognition (HAR)

HAR aims to automatically examine and recognise the nature of action from unknown video sequences. Due to the growing demand for automatic interpretation of human behaviour, HAR has caught the attention of both academia and industry. Analysing and understanding a person’s behaviour is fundamentally required for a wide range of applications such as video indexing, biometrics, surveillance and security (Jegham et al., 2020, p.1).

Machine Learning (ML)

ML is algorithmic knowledge discovery: the automated detection of knowledge expressed as patterns and relationships in data. In a basic sense, supervised machine learning (SL)—detecting information patterns represented with a predefined collection of data—is a kind of search function that only detects what is already inherent in a dataset (Carvalhais et al., 2021, p.16). In SL (for example, in classification), structure is imposed by the supervisor who defines the different classes and labels, putting the process at risk of becoming a source of bias and artificial boundaries. There is also the risk of error in the labelling, called “teacher noise” (Alpaydin, 2016, p.117). In contrast, unsupervised machine learning (UL) exhibits self-organisation (clustering) that captures patterns from untagged data, and through mimicry, hopes to build a compact internal representation of the world from which to generate content (Hinton and Sejnowski, 1999). UL is an important research area because unlabelled data is a lot easier and cheaper to find (Alpaydin, 2016, p.117).

Markov Chain

A Markov chain is a stochastic model describing a sequence of events where the distribution of possibilities for the next event is dependent only on the current state of the sequence up to that point. Markov processes are also used to generate superficially real-looking text given a sample document. A Markov chain model predicts a sequence of datapoints after a given input data based on the probability of each occurring immediately after the test data. For text generation, a list of unique words (a vocabulary) is made from the training dataset. A key-value pair is created for each word, where the key is the word itself, and the value is a list of all words that have occurred immediately after this key in the training dataset. The entire collection of key-value pairs constitutes the Markov Chain model (Chapekar, 2020). The Markov chain will model a probability of transition function between the

current word and the next one, between a key and a value; it will then randomly generate a text by using this probability function.

Model

A model is a template formalising the relationship between an input and an output in relation to machine learning. Its structure is fixed, but it also has modifiable parameters; the parameters are adjusted so that the same model with different parameters can be trained on different data to implement different relationships in different tasks. A language model defines the lexical, syntactic and semantic rules of the language (Alpaydin, 2016, p.68).

Poetics

The term poetics is understood to draw from a semantically tangled cluster of words: poetic, poetics, poiesis/poesis. The Oxford English Dictionary (OED) defines poetic in multiple ways.⁹ The majority of definitions are characteristic of poetry and poets. Only one of these definitions offers a broader meaning, emphasising production that relates to artistic creation or composition. Along with the definition of *poiesis*, from the Greek word meaning active making (Bordwell, 2008, p.12), to make or produce, there is a history of use and understanding of poetic in relation to concepts of creating and imagining.

⁹ "poetic, adj. and n." OED Online, Oxford University Press, June 2021, www.oed.com/view/Entry/146532. (Accessed: 17 August 2021).

Remix

Remix has become culturally relevant due to its function as a *binder* concept for the constant recycling and repurposing of material and immaterial things, helping to develop an awareness of the constant exchange of ideas across specialisations and cultural niches for different purposes. A basic definition of remix is directly linked to music and not culture at large. By developing Creative Commons to promote the open sharing of information, Lawrence Lessig helped deploy the remix concept across cultures beyond the music realm. The OED defines an expanded use of remix to mean a reworked version; a revamp or a remake.¹⁰ Eduardo Navas speculates that if there is a consensus among those who have theorised remix, it is that remix is a peculiar form of cultural production that points to constant change, defined by its very own process of constant becoming in terms of practice and criticism (2018, pp.246–254).

Natural Language Generator (NLG)

NLG is a software process that automatically transforms structured data into human-readable text. NLG is the technology behind text content automation to convert data into words, sentences, written articles etc. (Dilmegani, 2021). NLG is defined as the systematic approach for producing human understandable natural language text based on non-textual data or from meaning representations. The rapidly increasing need for human interaction with technology has formed the need for machines to generate language rather than work only on understanding the natural language that humans have uttered. NLG was first considered as a subfield of Natural Language Processing (NLP). However, it was later turned into a major research area and a discipline, which empowers human-computer interaction (Perera and Nand, 2017).

¹⁰ "remix, n." *OED Online*, Oxford University Press, June 2021, www.oed.com/view/Entry/246356 (Accessed: 17 August 2021).

2 Contex

2.1 Introduction

This chapter leads to a contextual review of contemporary artists working within the AI-art space. A comprehensible working definition first had to be found to help a general understanding of AI. Considering artistic work with the working definition led to a perceived binary split regarding how artists appear to relate to AI and its broader context.

2.2 Demystifying AI

The following sub-sections describe approaches towards conceptualising AI technology to find a working definition of AI to apply to art practice.

2.2.1 A Brief History of the Term Artificial Intelligence

Alexa Steinbrück points out that when people outside the field attempt to discuss AI in public debate, conferences and the media, they often have different understandings that can render the conversation meaningless as there is a lack of consensus around the terms and definitions.¹¹ There was also lack of consensus

¹¹ Alexa Steinbrück in discussion with Daniel Leufer about making the *AI Myths* project: *The Top Myths About AI*. Available at: <https://open.spotify.com/episode/5qSKMF0L5q1ablnpyRY4tN> (Accessed: 5 October 2021).

around adoption of the term “artificial intelligence” when the field began to emerge in the 1950s.

Cybernetics—the idea of automatic, self-regulating control laid out by Norbert Wiener’s foundational text (1948)—has been considered as the progenitor of AI and Computer Science. Under Wiener’s direction, an informal group called the Teleological Society began meeting in the 1940s, later formalising as the Macy Conferences. The new technology of digital computing was a topic of conversation at these gatherings, which began to create analogies between computers and human minds (Mindell, 2000, p.3). However, it was considered by some that Wiener’s vision was missing the critical factor of cognition—mind, thinking, intelligence—which led prominent researchers at the Macy Conferences to argue for the inclusion of the cognitive element into the conversation (Brockman, 2019, p.xx). The AI researcher Kate Crawford identifies the moment where the assumption was made that computation is analogous to human intelligence, as the making of a “terrible error, a sort of original sin of the field” (2021, p.7) where minds started to be thought of as computers, and computers as minds.

The coining of the term artificial intelligence is often mistakenly attributed to Alan Turing, who is considered a pioneer of the field, but never actually used the term in either of his seminal papers *Intelligent Machinery* (1948) or *Computing Machinery and Intelligence* (1950).

In a logical genealogy, Turing would be central to the seminal workshops and conference at Dartmouth College (1956), which is widely considered the inauguration event of artificial intelligence as a field. Turing held what was to be some of the central ideas of AI very early, but according to Marvin Minsky and Allen Newell, Turing's work had practically no influence on most people at the Dartmouth gathering (McCorduck, 2004, p.143). Perhaps contributing to this lack of influence, is the account of how Britain lost its early dominance in computing by systematically discriminating against the women who were its most qualified workers. Women were a major and pivotal part of Britain's war-time intelligence community as code-breakers and programmers. Nevertheless, post-war, in a 'gender flip', women's roles as the original computers from WW2 were negated through a gendered technocracy. In 1944, Britain led the world in electronic computing. By 1974, the British computer industry was all but extinct (Hicks, 2017).

The term "artificial intelligence" appears for the first time in "A Proposal for the Dartmouth Summer Research Project on Artificial Intelligence" (1955), which was co-authored by John McCarthy, Marvin Minsky, Nathaniel Rochester and Claude Shannon—Shannon had participated in the Macy Conferences several years before. It is well documented how the overly ambitious Dartmouth research project proposed a machine simulation of human intelligence, which included, as "aspects of the artificial intelligence problem", how to programme a computer to use language and how to control randomness and creativity (McCarthy et al., 1955,

pp.2–4). During the Dartmouth workshop in 1956 there was considerable disagreement over the use of the term “artificial intelligence”. Many participants were discomfited by the term, which was allegedly invented by McCarthy. Immediately preceding the Dartmouth conference, McCarthy had worked with Shannon assembling a book of collected papers called “Automata Studies” (1956). McCarthy had wanted to use a different term for the collected papers, but “Shannon objected that any other phrase was simply too flashy, that the theory of automata would be sober and scientific” (McCorduck, 2004, p.145). McCarthy was subsequently disappointed in the collection of papers for “Automata Studies”, as they did not reflect his growing interest in the “relation of language to intelligence, or the ability of machines to play games” (p.145). In attempting to distinguish between the summer Dartmouth project and “Automata Studies” he argued strongly for the use of the term “artificial intelligence”. Alan Newell has recollected that “John [McCarthy] makes up that name partly out of real frustration, his terrible difficulties in dealing with Shannon and all these other guys” (1991, p.11). McCorduck notes that Newell objected to the term and continued to refer to his work in the field as “complex information processing” (2004, p.145). It has been

suggested by Leslie (2019) that McCarthy favoured the term “artificial intelligence” because it had marketing value.¹²

Underpinning the problem of adopting the term “artificial intelligence” is the dilemma of defining human intelligence, summed up by Marvin Minsky’s view that *human intelligence* “is more of an aesthetic question or one of a sense of dignity, than a technical matter...a complex of performances which we happen to respect but do not understand” (Nilsson, 1964, p.8). Likewise, McCorduck (2004, p.156) has stated that “he wasn’t necessarily convinced that human and artificial intelligence needed to resemble each other.”

According to Arthur Norberg’s interpretation of events, Minsky, although interested in simulating intelligence, “didn't care whether the underlying substrate that produced the result in a machine was the same as the way it is produced in a human being. And therefore, understanding intelligence is irrelevant to him” (Newell, 1991, p.18).

¹² Gilchrist, B. (2019). In: informal meeting notes. In a private conversation with the artist Scott Eaton, I asked if he could provide a working definition of AI that was relevant to his current practice. He responded that the term AI was not particularly useful, and went on to say that the main reason for calling his gallery exhibition at Somerset House (June, 2019) *Artist + AI: Figures and Form* was that it was more evocative for the public imagination, and might generate increased footfall. A meaningful, practical definition for him would have been “Supervised Image to Image Translation”, which is a machine learning technique; a sub-discipline of AI.

2.2.2 AI Myths

Daniel Leufer's Mozilla Fellowship (2019–2020) produced the *AI Myths* project, which aims to challenge, disentangle and debunk the myths that feed misconceptions of AI. From an initial survey, *AI Myths* identifies the most prevalent myths, including "AI has agency" and "the term AI has a clear meaning". *AI Myths* considers the vagueness of the term "artificial intelligence" to be the main culprit that leads to confusion and mystification.

The cumulative effect of these myths serves not only to confuse attempts at an accurate definition but reaches absurd levels of misconception and sci-fi fantasy. The vagueness surrounding descriptive terms reaches the highest levels, including the European Union's White Paper, *On Artificial Intelligence—A European approach to excellence and trust* (European Commission, 2020), a proposal on regulating AI technology and advancing AI development strategy. There are severe issues with how the technology in question is being defined in this EU paper when it says: "Simply put, AI is a collection of technologies that combine data, algorithms and computing power" (2020, p.2). As members of the Dutch Alliance on Artificial Intelligence (ALLAI) have pointed out, "this definition, however, applies to any piece of software ever written, not just AI" (Leufer, 2020, sec.the-term-ai-has-a-clear-meaning).

2.2.3 The AI Art Manifesto

The AI Art Manifesto, compiled by Fuchs et al., was presented as part of Futurological Congress, Transart, Bolzano, Italy. It makes the declaration that in the context of contemporary research, “Artificial Intelligence becomes a means of expanding self-awareness, criticism, creativity, and possibility, rather than confinement of our notions of humanity and the mind” (2020, para.1). Towards the aspiration of leveraging social good from AI, *The AI Art Manifesto* contains fifteen statements (included in Appendix B.1), with the most salient to this chapter of the research being:

4. Be informed about biased datasets and approaches, instead constructing our own frameworks and techniques.
7. Reveal AI as disembodied cognition, as an extension of human thought and culture, rather than promoting illusions [of] AI as autonomous where it is not.
9. Develop literacy around machine learning that extends to non-engineers and artists, as those new audiences make use of AI techniques.
10. Favour accurate and transparent descriptions of AI over misleading anthropomorphising descriptions.
11. Use AI as an expressive means of illuminating rather than mystifying the realms of science and data, so that artists can be more fluent in their use of data as medium.

The research aligns with the five selected statements above as they are most pertinent in apprehending a comprehensible and unambiguous working definition of AI. The selected statements from *The AI Art Manifesto* combined with knowledge gathered by *AI Myths* expand in the following sections into more complex perspectives to offer best practice to artists for how they understand, utilise and communicate what it is that they are doing; it also functions as a counter measure to the perpetuation of myths surrounding AI-art.

2.2.4 False Autonomy

The AI Art Manifesto statement (7) concerned with “promoting illusions of AI as autonomous”, and the top misconception in *AI Myths*—“AI has agency”, are understood in the following way. Where a false idea of autonomy is promoted within AI-art or AI in general, it can serve to conceal human attribution through the suggestion that there is an artificially intelligent entity with desires acting upon the world. A leading AI-artist has described his work using the following statement: “A deep neural network opening its eyes for the first time, and trying to understand what it sees” (Akten, 2017). Where there is allusion to “an AI making art”, there is obfuscation of the fact that an AI/ML system is a computational artefact¹³ used by artists to create something, where the artefact being used has been developed by

¹³ A computational artefact is an artefact with operations based on computation. AI researchers generally focus on a particular type of computational artefact, that is, those that mimic activities that are typically human, such as reasoning, making decisions, choosing, comparing, among other things (Johnson and Verdicchio, 2017, p.3).

engineers and programmers with many tributaries of contribution. Perpetuation of ideas of false autonomy coupled with naïve concepts of both art and creativity lead to the view that there will be such a thing as an independent “AI-artist” in the future, capable of generating art superior to that of the human artist (Verbist, 2019).

When the human agency involved in the process of AI is hidden from view, the AI system is perceived as a finished product that ingests data and outputs objective results. Dieter Mersch elaborates on this when he describes how “the opacity of the algorithmic and the mystery of its performance—has become larger, feeding the myth of the ‘inspired machine’” (2020, p.15).

False autonomy is theorised as “socio-technical blindness”: the essential role played by humans at every stage of the development and deployment of AI systems is hidden when AI products are conceptualised and presented to the public. The danger of this to society at large is in allowing the belief “that AI systems got to be the way they are without human intervention. As with confusion about autonomy, this blindness facilitates futuristic thinking that is misleading” (Johnson and Verdicchio, 2017, p.8).

2.2.5 Autonomy and Unpredictability

Technical definitions describe various degrees of autonomy, with increased autonomy characterised as artefacts that can establish the course of action at runtime as opposed to having already been established and compiled in the written

code. A course of action established at runtime without human intervention is made based on the environmental condition within which the artefact operates. Therefore, fitting an artefact with sensors will increase autonomy as the sensor will decrease the need for human intervention, and this can lead to a user not having full knowledge of the environment that the artefact is operating within. For this reason, the autonomy of artefacts is associated with their unpredictability: the user often does not know the input on which an artefact's operation depends. Linking autonomy with unpredictability makes it easier to appreciate the perception of AI as having autonomy. This perception is compounded by the fact that unpredictability is thought to increase when software can acquire new patterns of behaviour through 'learning' (Johnson and Verdicchio, 2017, pp.4–8).

The computational artefact is only a component of an AI system, which, in the performance of tasks on the behalf of users, is connected to many more layers of activity and human decision making external to the computational artefact. For instance, via the crowdsourcing website Mechanical Turk, a multitude of humans may have been involved in the process of annotating media to build a dataset for training a machine learning (ML) model, acting on instructions via bespoke interfaces (Figure 4).

In another example, as a critical real-time situation, human actors in a chain of command may be understood to be part of the external environment of an AI system, giving input to the computational artefact as part of military drone warfare.

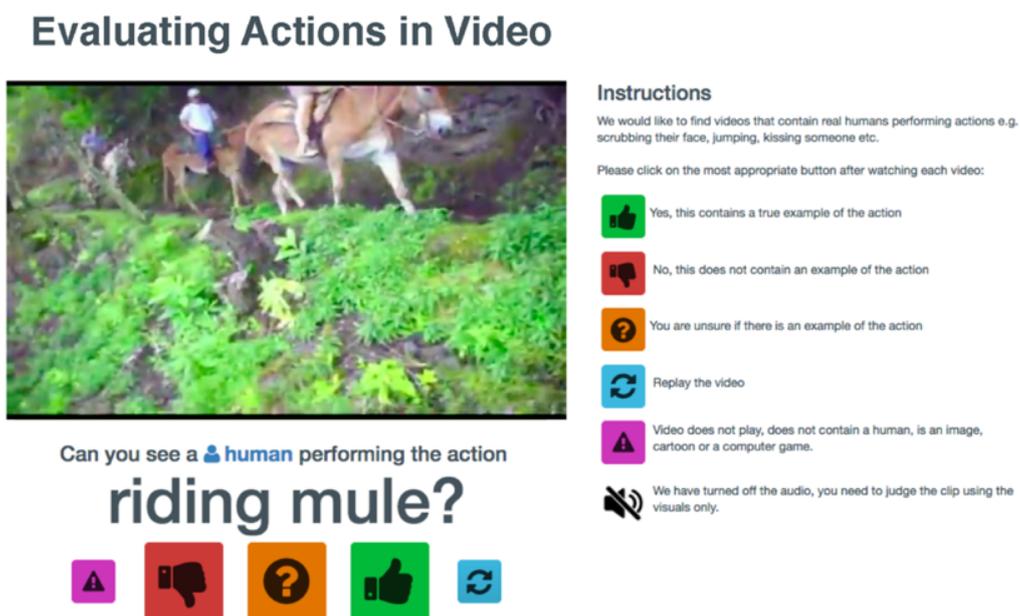


Fig.4. Labelling interface used in Mechanical Turk.
(Kay et al. *The Kinetics Human Action Video Dataset 2017*, Fig.2.)

2.2.6 Socio-Technical Blindness

Socio-technical blindness separates the AI system from these layers of decisions and human agency. As a way of addressing this, Johnson and Verdicchio argue for AI systems to be considered as assemblages or socio-technical ensembles as “combinations of artefacts, human behaviour, social arrangements and meaning” (2016, p.6).

Viewing a system as an assemblage provides an appreciation of the interlaced character of domains that were previously thought of as separate, where the confusion around autonomy and blindness to human attribution is shown to be intimately linked. “When we speak about AI systems, it's important that we do so in a manner that makes them visible as socio-technical ensembles, imbued with human

decision making and human flaws, rather than as neutral technical systems" (Leufer, 2020, sec.ai-has-agency).

In *Reframing AI Discourse Minds and Machines*, the authors argue for a reframing of AI discourse that negotiates the potential pitfalls around false notions of autonomy and 'inspired machines' by describing AI research as what it is: "the design of computational artefacts that are able to achieve a goal without having their course of action fully specified by a human programmer" (Johnson and Verdicchio, 2017, p.2).

2.3 Towards a Definition of AI

As shown in Section 2.2.1, the provenance of the term "artificial intelligence" is less than clear, and since then, the definition of AI has changed over time. Based on an operational definition of intelligence determined by the Turing Test,¹⁴ the original vision from the 1950's concerned the idea of building machines capable of thinking like humans (disputed by Minsky), able to perform a range of cognitive tasks, and that could be thought of as simulating the capacity for abstract, creative, deductive thought, and particularly the ability to learn using the digital, binary logic of

¹⁴ "In order for a programmed computer to pass the Turing test, it would need to possess the following capabilities: *natural language processing* to enable it to communicate; *knowledge representation* to store what it knows or hears; *automated reasoning* to use the stored information to answer questions and to draw new conclusions; *machine learning* to adapt to new circumstances and to detect and extrapolate patterns" (Russell and Norvig, 2016, p.2). It has been claimed that the chatbot, *Eugene Goostman* passed the Turing test in 2014, but this is widely disputed (Falk, 2014).

computers (Nilsson, 2009, pp.61–66). Through making a core assumption about the nature of intelligence—that it is an objective property of a system—Nilsson states,

[r]esearchers began, during the 1950s, to explore various paths toward mechanising intelligence. With a firm belief in the symbol system hypothesis, some people began programming computers to attempt to get them to perform some of the intellectual tasks that humans could perform (2009, p.66).

The primary working proposition that has guided much research into artificial intelligence has been that “cognition, or thought processes, can, at some level, be modelled by computation” (Honavar and Uhr, 1994, p.2). The three approaches of Symbolic AI, Connectionism and Deep Learning have contributed to the development of AI, and can all be defined in their own way.

2.3.1 Three Main Approaches

The symbol system hypothesis, otherwise known as Symbolic AI, is rooted in the classical idea of logical inference and symbolic manipulation: the aim was to encode the world in symbols and then manipulate the symbols using logic. Within this framework, the equivalence of perception and cognition in a machine is “tantamount to acquiring and manipulating symbolic representations”, whereby “operations on representations can be used to predict the consequences of performing the corresponding physical actions on the environment” (Honavar and Uhr, 1994, p.3).

Connectionism supplanted Symbolic AI in the 1980s, which is regarded as the second major approach to AI. The main distinction is that unlike the symbolic approach that required the whole world to be encoded, connectionism can 'learn'. This approach gained momentum when researchers learned how to simulate neurons using simple mathematical equations to reverse engineer a limited understanding of how the human brain works, based on techniques of computational neuroscience and neuromodelling (p.3). Rather than manipulating symbols, the connectionist approach adjusts the strength of connections between artificial neurons (Domingos, 2015, p.52).¹⁵

The most recent approach to AI since the 2000s is Deep Learning (DL), which uses artificial neural networks fed on large datasets to solve complex problems and can 'learn' from 'experience'. DL is attractive to researchers as it requires relatively little manual interference through the use of large amounts of data (Alpaydin, 2016, p.108). As a result, DL has been producing rapid changes in text generation, image and speech recognition and is the main source of recent AI-enabled art.

AI has become a loose term. It is more of a catch-all label than it is an exact name for a single specific technological ability. Instead, what today is considered AI

¹⁵ However, as Ethem Alpaydin explains, the main problem with this kind of abstraction is that it is unlikely there is one neuron for every concept in the brain—this is the "grandmother cell theory", where a neuron in the brain is activated only when the grandmother is seen or thought about as a local representation. However, neurons die and are replaced, and so it is more likely that concepts are spread over clusters of neurons as a "distributed representation", with enough redundancy for concepts to survive underlying structural change (Alpaydin, 2016, p.96).

encompasses a diverse range of subfields that derive patterns, insights, and predictions from big datasets.

2.3.2 Artificial Intelligence: A Modern Approach

The leading textbook in AI, *Artificial Intelligence: A Modern Approach* (Russell and Norvig 2009) is the most used text in computer science. It presents eight definitions of AI organised into four categories: Thinking Humanly; Acting Humanly; Thinking Rationally; Acting Rationally (Figure 5). Furthermore, each category is divided into two sub-categories: one concerned with thought processes and reasoning; the other with behaviour.

<p>Thinking Humanly</p> <p>“The exciting new effort to make computers think...machines with minds, in the full and literal sense.” (Haugeland, 1985)</p> <p>“[The automation of] activities that we associate with human thinking, activities such as decision-making, problem solving, learning...”(Bellman, 1978)</p>	<p>Thinking Rationally</p> <p>“The study of mental faculties through the use of computational models.” (Charniak and McDermott 1985)</p> <p>“The study of the computations that make it possible to perceive, reason, and act.” (Winston, 1992)</p>
<p>Acting Humanly</p> <p>“The art of creating machines that perform functions that require intelligence when performed by people.” (Kurzweil, 1990)</p> <p>“The study of how to make computers do things at which, at the moment, people are better.” (Rich and Knight, 1991)</p>	<p>Acting Rationally</p> <p>“Computational intelligence is the study of the design of intelligent agents.” (Poole <i>et al.</i>, 1998)</p> <p>“AI ...is concerned with intelligent behaviour in artifacts.” (Nilsson, 1998)</p>
<p>Some definitions of artificial intelligence organised into four categories.</p>	

Fig.5. Some definitions of AI organised into four categories. (Russell and Norvig, 2016, 3rd edition, p.2, fig. 1.1)

The definitions on the left side of the quadrant measure the success of AI based on measuring against human performance; the right side is based on

measuring against an ideal performance termed rationality. If a system does what is expected based on the information it has been given, it is understood as rational. The authors make the distinction between human and rational to make the point that humans are not perfect, “not all chess players are grandmasters”, but that machines often do what is expected of them (Russell and Norvig, 2016, pp.2–5). In the preface to their book, Russell and Norvig unify all these themes into the idea of an intelligent agent, which is how they define AI, “as the study of agents that receive percepts from the environment and perform actions” (p.viii). This definition is located within the Acting Rationally quadrant in Figure 5.

2.3.3 AI Knowledge Map

An alternative approach in tracking the different ways of thinking about AI—perhaps of more use to artists as it alludes to technique—considers that “(...) many of the categorizations out there are either incomplete or unable to capture strong fundamental links and aspects of this new AI wave” (Corea, 2020). To address this, the data scientist Francesco Corea has produced the first draft of a map (Figure 6) that attempts to chart approaches used in AI in the last 60 years to capture the full range of problems that are faced—*AI Knowledge Map* (AIKM).

In order to categorise AI Problem Domains, Corea has drawn from Pedro Domingos’ concept of “AI tribes”, which clusters AI researchers into groups based on the methods they employ to solve problems: “Each tribe has a set of core

beliefs, and a particular problem that it cares most about” (Domingos, 2015, pp.51–55). Different tribes have different vested interests and so are bound to various definitions. However, in formulating his AIKM, Corea acknowledges that his classification might not be “large enough to capture all the spectrum of problems we are currently facing or whether more instances should be added (e.g., Creativity or Motion)” (2018).

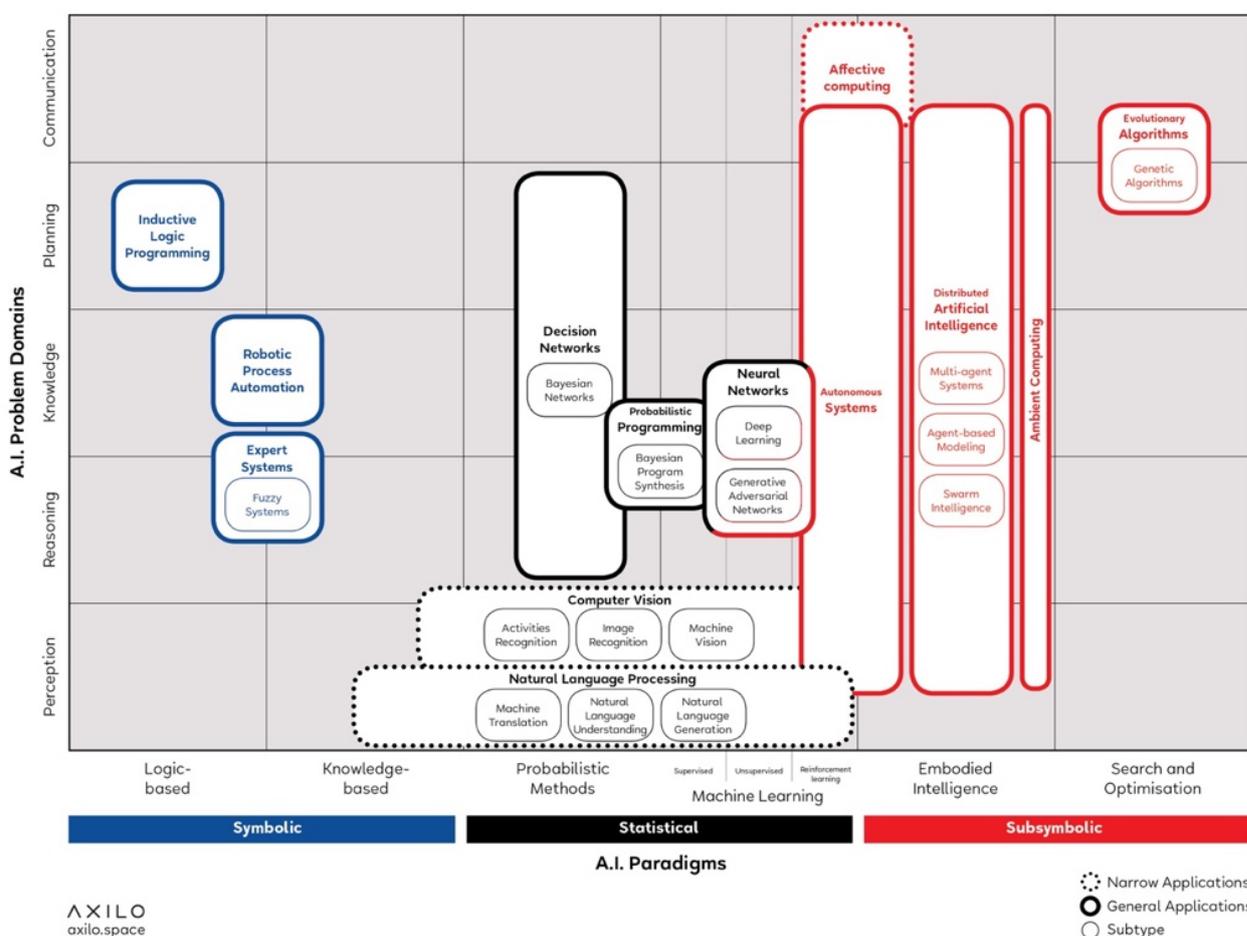


Fig.6. Francesco Corea AI Knowledge Map (AIKM) 2018.

As Corea’s map currently stands, the contemporary artistic work I have focused on falls predominantly within the Statistical AI Paradigms, spanning the AI Problem Domains of Perception, Reasoning and Knowledge. By way of contrast, the

computer art pioneer Harold Cohen (1928–2016)—whose long-standing preoccupation with the psychology of art motivated the development of the computer drawing program *AARON*¹⁶ since the 1970s—occupies the Symbolic AI Paradigms but similarly spans the AI Problem Domains of Reasoning and Knowledge.

2.3.4 A Working Definition of AI in an Art Context

When making the *AI Myths* project (2019–2020), Daniel Leufer considered it to be “peak hype cycle”,¹⁷ with the current boom fuelled by the success of machine learning (ML), broadly accepted to have started in 2012. The success of ML is built on earlier developments that included the creation of the ImageNet dataset of over 14 million hand-annotated images extracted from the internet. ImageNet is considered the canonical training set and a benchmark for the field of image recognition (Crawford and Paglen, 2019). The dataset was used by computer scientist Geoffrey Hinton and his team to win the ImageNet Large Scale Visual Recognition Challenge (ILSVRC), launching ML and neural networks into broader awareness (Krizhevsky, Sutskever and Hinton, 2017).

¹⁶ For a comprehensive description of *AARON* in the context of computational creativity, see: *The Creative Mind Myths and Mechanisms* (Boden, 2003, pp.150–166).

¹⁷ “(...) we seem to be right around the peak of the hype cycle”: Leufer, D (2020, para. 23). Available at: <https://www.aimyths.org/the-term-ai-has-a-clear-meaning#ai-today-the-hype-of-ai-enabled-everything> (Accessed: 6 October 2021).

The other main supporting factor for the success of ML was the availability of powerful graphics processing units (GPUs) that provided the computing power necessary for complex algorithms, such as neural networks, to analyse large data sets. Advances in ML since 2012 have led to considerable improvements in predictive text, image recognition, translation, and other domains that rely on finding patterns in massive amounts of data to solve problems. When AI is discussed after 2012, ML is usually the underlying technique; it is also typically the primary technique artists use in the current AI-art space. However, the vague terms of artificial intelligence or AI remain slippery, whereas ML as a subdiscipline of AI is more open to understanding. *AI Myths* suggests that swapping the term AI for ML is a productive way of cutting through the most evident and resilient hype.

In a joint discussion, as an affiliated PhD researcher with the arts organisations ODI: Data as Culture and D6: Culture in Transit, I raised the topic of uncertain definitions surrounding AI. Hannah Redler Hawes (curator of Data as Culture) agreed that there needs to be more clarity around definitions by saying, “Yes, Open Data is also slippery—they spend time convincing people that Data is not ‘the new oil’. COVID has made understanding ‘modelling’ important.” Clymene Christoforou (director of D6: Culture in Transit) offered her perception of events by

saying, "COVID 'the year of manipulated data'. So, curators as well as artists are interested in criticality and understanding."¹⁸

In order to provide clarity and a working definition of AI in an art context, reference is made to *AI Myths* as a guide to best practice to strip away rhetoric in terms of how artwork employing AI-related technology is described. In general, inaccurate descriptive practice can hide the human agency behind specific processes. For example, rather than using the misleading statement that "AI can now read your messages", it is understood as a better practice to state something like, "researchers can use natural language processing (NLP) techniques to scan your messages." It is also common in mass media to treat the term AI as a countable noun: one AI, two AIs etc. This belies the fact that AI is not a single, autonomous entity, "but rather a set of techniques and ideas"(Leufer, 2020, sec.'AI has agency').

Based on the preceding sections of this chapter, which have indicated the uncertain provenance of the term artificial intelligence, and the myths surrounding it, the most comprehensible definition comes from Maya Indira Ganesh who suggests that:

Artificial Intelligence, 'AI', is a suite of technologies that includes machine learning, computer vision, reasoning, and natural language processing,

¹⁸ Graham, B. (2021). In: informal meeting notes. Reflection meeting on AHRC NPIF studentships in partnership with D6 and ODI: Clymene Christoforou, Beryl Graham, Bruce Gilchrist, Hannah Redler Hawes, Catrina Ure. 13 July.

among others. It exists in an awkward and unique space as technology, metaphor and socio-technical imaginary (2020).

The next section of this chapter will discuss a contextual review of artists engaged in the AI-art space, whose practices are located within the ‘Neural Networks’, ‘Computer Vision’ and ‘Natural Language Processing’ clusters as part of the ‘Statistical’ AI Paradigms as illustrated in the detail of Corea’s *AI Knowledge Map* (Figure 7).

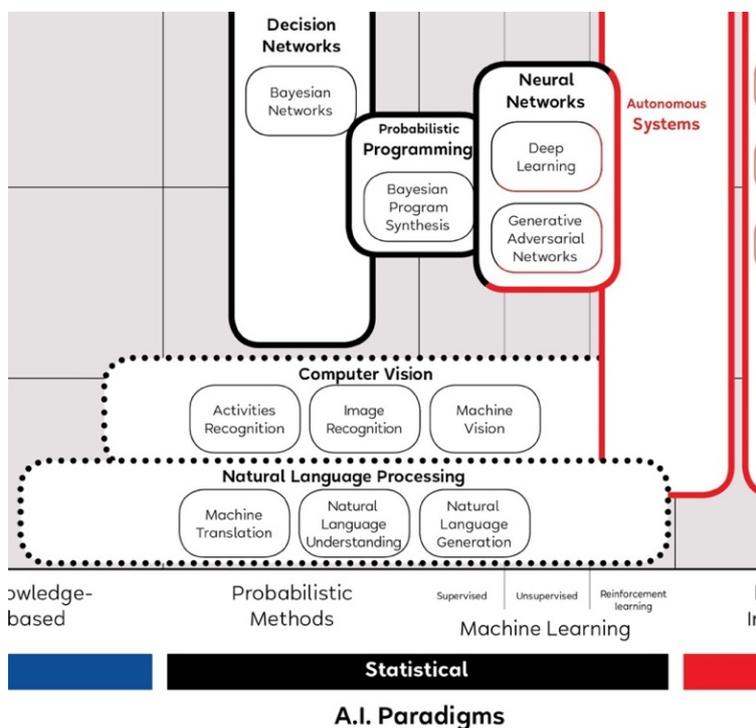


Fig.7. Detail of Corea’s *AI Knowledge Map* showing current artist focus.

The clusters mentioned above are based on machine learning (ML) techniques directed towards a particular focus medium: text, image and filmmaking. From this point onward, informed by the *AI Myths* project and Maya Indra Ganesh’s

working definition, the research will refer to artistic practice as AI/ML-art or AI/ML-enabled art. This combination of initialisms has been used in the CRUMB discussion list and there appeared to be consensus around its use. Where the term AI-artist or AI-art is used, it will largely refer to the DeepDream cohort described in section 2.4.1.

2.4 Some Definitions of Interactivity

A working definition of AI in an art context is established (section 2.3.4.), which is put to use in reviewing how AI technology is being employed by contemporary artists (section 2.5). In order to begin considering how current developments in AI can contribute towards a new model of interactivity in art (Question 2), there needs to be an understanding of how the term interactivity has come to be defined in general, and in non-AI-enabled art more specifically.

According to Dominic Lopes, the term interactivity is often problematic because it has too many meanings: “it means so many different things in so many different situations that it’s hard to come up with a one-size-fits-all definition” (2009, p.36). In the context of art, the problem of definition is further complicated by Marcel Duchamp’s famous remark: “Let us consider two important factors, the two poles of the creation of art: the artist on one hand, and on the other the spectator who later becomes the posterity” (1957, para.1). This is understood to mean that art “occurs in a creative act which is never fully determined by the artist alone, but

involves the spectator's participation" (Vella Rago, 2015, p.92). Duchamp's reflection has inspired some authors, including Lev Manovich to reason that all art, not just computer art is interactive (2002, p.56). Paul (2003, p.67) suggests that the experience of an artwork is interactive because it is based in "a complex interplay between contexts and productions of meaning at the recipient's end." She says that although this interaction remains at the mental level when experiencing traditional art forms, with digital art, however, "interactivity allows different forms of navigating, assembling, or contributing to an artwork that go beyond this purely mental event" (p.67).

What unites both traditional art forms and digital art is that they both have a 'display', which can be simply understood as "a pattern or structure that results from the artist's creativity and that we attend to as we appreciate it" (Lopes, 2009, p.37). The display can be appreciated via different forms of sensory modality, including singular manifestations and combinations of words, images and sounds. Sometimes, there is a demand or invitation that attention is paid to the display's social, physical or historical context. Traditional forms of art can have changing displays: an Alexander Calder mobile for instance, which might be appreciated differently by individuals because an air current has turned it. A work of architecture changes its display for individuals who traverse it and appreciate it from different perspectives by walking and turning the head. Lopes points out that the displays of interactive artworks are different from mobiles and buildings because of what is done in the act

of appreciation. For his study, the term “interactive” is used to capture the idea that the contribution of the participant or user changes the display of the work. He distinguishes between the interactivity of traditional forms of art and interactive art by suggesting that interactive art somehow communicates “prescribed user actions”. He consolidates this idea by saying that “interactive works prescribe that we act to impact the display, and we appreciate them by acting as prescribed” (p.39).

With regard to the second research question that considers how to approach AI/ML-enabled art and interactivity, Lopes's analysis of the display outlines the area of concern—how does the display change, what changes it and how does the participant apprehend the change?

The following dictionary definitions, although extremely limited, capture a popular idea of interactive art, where interactivity is conceived of as a transformation of the work over time, possibly along with the behaviour of the participant.

Interactive

1. Reciprocally active; acting upon or influencing each other.
2. Pertaining to or being a computer or other electronic device that allows a two-way flow of information between it and a user, responding immediately to the latter's input.¹⁹

¹⁹ "interactive, adj." *OED Online*, Oxford University Press, June 2021, www.oed.com/view/Entry/97521. (Accessed: 30 July 2021).

In order to consider the concept of interactivity as indicated by the dictionary definition above, it will also help to consider the means by which a user can input action, or for that action to be reciprocated.

Interface

1. A surface lying between two portions of matter or space, and forming their common boundary.
2. A means or place of interaction between two systems, organizations, etc.; a meeting point or common ground between two parties, systems, or disciplines; also, interaction, liaison, dialogue.²⁰

Interactivity and interface can be thought of as being coincident. By conceptualising the interface, Branden Hookway defines interactivity in the following way:

What occurs within the interface, the kind of relating across a threshold that is often described as interaction or interactivity, may also be described as a transaction, in the sense of a cost being extracted, and compensation being given in exchange (2014, p.7).

By referencing the OED definitions above, Benjamin Bratton has commented on how the term “interface”—although it has been in use since 1882 to define a surface that performs a common boundary—became associated as late as 1964 with

²⁰ "interface, n." *OED Online*, Oxford University Press, June 2021, www.oed.com/view/Entry/97747. Accessed 30 July 2021.

connections between pieces of scientific and technological equipment, and between humans and equipment. In the context of Software Studies, Bratton defines interface as “any boundary or point of contact between two complex systems, which itself governs the condition of exchange between those systems” (2008, sec.3:50).

Hookway is more specific with the nineteenth-century definition of the term “interface”, tracing it back to the engineer James Thomson and his work on fluid dynamics, denoting a “dynamic boundary condition describing fluidity according to its separation of one distinct fluid body from another” (2014, p.59). From Hookway’s research into interactivity, the interface can be understood as a conduit through a threshold. In other words the threshold defines the boundary condition, across which the mutual or reciprocal interactivity occurs. The suggestion here is that one cannot think about interactivity uncoupled from the interface, as one defines the other; interactivity becomes something that is co-constituted by the interface. The definition of interactivity—something that is mutual or reciprocally active—is mobilised by the interface; the agency of the interface alone merely “manifests the potential availability of that condition to control” (2014, p.11).

The fact also has to be taken into consideration that the interface changes as a reflection of its time, through technological development—from a physical, mechanical switch that governs signal or power-flow for instance, to an InfraRed (IR) proximity sensor whose primary operations are intangible to the human operator.

The fact of technical evolution over time goes hand in hand with the nature of discourse around interactivity, which, as Alan Peacock suggests, “shifts over time as familiarity develops and learning takes place” (2005, para.6). Peacock goes on to describe former spaces of interactivity as places of language and stories, where humans have become adept at making sense of the world “through storying it, sharing it in image, sound, action” (para.6). He compares former spaces of interactivity with forms of interactivity we now experience through the mediation of computer technology, and reminds us that it is a relatively new medium, unlike its predecessors in many ways.

2.4.1 An Early Example of Interactive Art

The concept of “Interactive Art” appeared around 1969 with Myron Kreuger’s responsive environment *GlowFlow*. However, an often-cited example of early interactive art is Marcel Duchamp’s *Rotary Glass Plates (Precision Optics[in motion])* (1920) (Figure 8). This seminal interactive work (although it was not called that at the time) came with an instruction: “turn on the machine and stand one meter away.” The instruction to operate a switch (the “prescribed user action” as described by Lopes in section 2.4) emphasises the viewer participation aspect of Duchamp’s machine according to Rush (1999, p.201) and Paul (2003, p.11). The direct engagement of the spectator connects *Rotary Glass Plates* with the giving-of-instruction and audience participation characteristics found in Fluxus events and the

1960s Happenings initiated by Allan Kaprow as part of the genealogy of performance art, digital art and new media art.

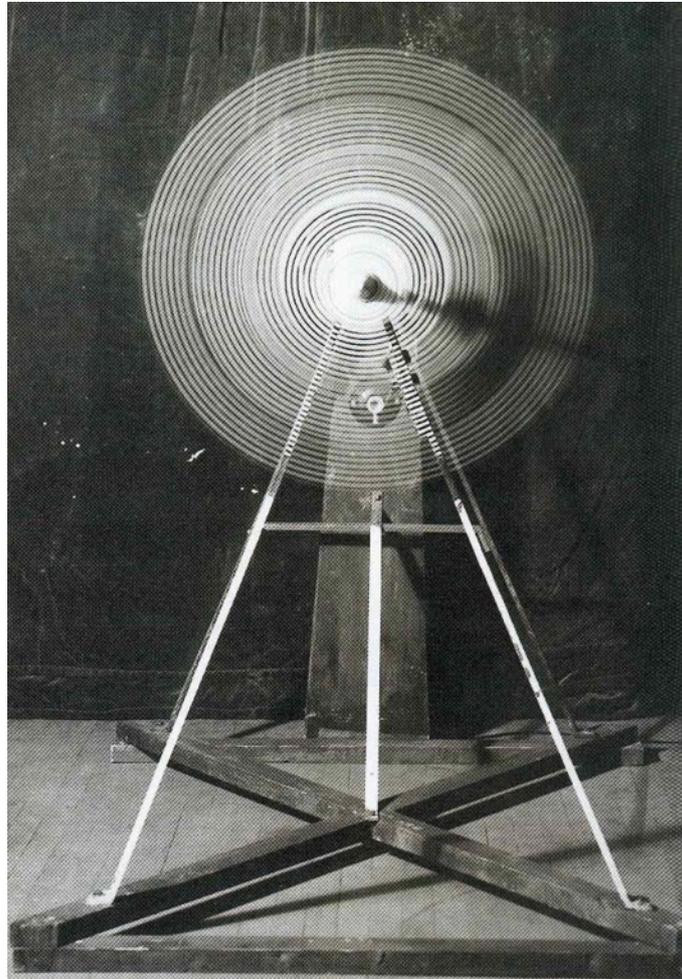


Fig.8. Marcel Duchamp (1920) *Rotary Glass Plates (Precision Optics[in motion])* *New Media in Late 20th Century Art*, Michel Rush, p.201.

As part of this history, the interactive work of art takes on the shape of an event: the artist does not make the final completed work of art, but instead “produces an area of activity for the receivers, whose interactive actions bring to life an artwork-event” (Kluszczynski, 2010, p.2). The participative behaviour of the audience determines the final formation of the interactive artwork. With

participation in mind, but with an emphasis on understanding artworks in their environmental context, Jack Burnham put it much more broadly by suggesting that anything that processes art data has to be a part of the artwork. "So by that definition, the audience is part of the artwork" (Burnham, 1969 in Edmonds, 2007, p.xxiii).

Gere (2008, p.84) cites John Cage's *4'33"* (1952) as "possibly the most influential avant-garde work of the post-war era" that "more or less invented interactivity, or at least made it available as an artistic strategy." Gere also describes Fluxus as a movement based on activating process as art, which was concerned with interactive communication more than any other art movement (p.89). Functioning as a theoretical ground, Umberto Eco's *The Open Work* contributed to the interpretation of the part played by the spectator in a participative work, where the artist decides to leave arrangements of some constituents of a work to the public or chance (Eco and Robey, 1989, p.4).

The increasing involvement of computers set up a tension between the idea of participation, and that of interactivity, where the term *movement* no longer signified the movement of a participant in space—as in a Happening for example, where a participant would have to alter the bodily position in space in order to perceive differently. Interactive art enabled by computers substitutes the movement of a participant, with a change in perspective of a projected scene, perhaps using a joystick as an interface, as in Jeffrey Shaw's *Points of View* (1983), where there is a

profound shift in the way a participant is relating to environmental and social context.

Michael Rush distinguishes between the neo-avant-garde works of Fluxus and Happenings and the interactive digital art being made at the end of the twentieth-century by saying, “the new interactive art is not controlled by the artist in the same way” (1999, p.201). He means that the instructions of interactive digital art are much looser—participants are encouraged to create their own narratives and associations with the interactive works, exemplified early on by Lynn Hershman-Leeson’s first interactive installation *Lorna* (1984), and other artists such as Ken Feingold, Perry Hoberman and Jeffrey Shaw.

Navigating a work, or responding to strict instructions as prescribed user actions “in which deliberate actions result in predictable outcomes is a very different aesthetic experience to negotiating one in which inadvertent actions and, so, unpredictable events, form a story by chance rather than through decision” (Peacock, 2005, para.21).

The conceptual rigour of strict instructions for participants found in Kaprow’s *Eighteen Happenings in 6 parts* (1959) has been relaxed by artists and replaced by a wealth of possibility only limited by the amount of time a participant chooses to engage with the work.

To return to the interface of Duchamp’s seminal interactive artwork—an explicit instruction to operate a switch results in a pre-determined act. Once

triggered, all there is left to do is to stand back and enjoy the event. The artist Roy Ascott (2003, cited in Goodman, 2018, p.37) considers the flicking of an 'on' switch as a linear and trivial form of interactivity, "a closed linear system with finite data". However, it is considered interactive nonetheless in that it is a work realised through active participation of the viewer. In Ascott's definition, a non-trivial form of interactivity "has the open-ended capacity to accommodate new variables" (2003, p.378).

Paul (2003, p.11) describes the historical and neo-avant-garde's "emphasis on formal instruction, and focus on concept, event and audience participation, as opposed to unified material objects". Ascott shares this concern when he comments that, "[a]rt is no longer seen as a linear affair, dealing in harmony, completion, resolution, closure—a composed and ordered finality. Instead it is open-ended, even fugitive, fleeting, tentative (...)" (1991, para.7).

2.4.2 More or Less Interactive

Roy Ascott is one of several leading artists, including Steve Bell, Stroud Cornock and Ernest Edmonds, whose theories of interactive art and taxonomies as "kinds of interactivity" have been productively summarised by Graham (1997, pp.38–48) in diagrammatic form along a sliding scale between "less interactive" or "more interactive". As previously mentioned, Ascott's classification, informed by the participatory characteristics of the avant-garde, disrupts linear communication of art

and audience, with a sliding scale between “Deterministic” and “Behavioural”.²¹ In the diagram, Cornock and Edmonds create differentiating subdivisions between interactions that depart from sole dependence on the means of physical interaction to include statistical factors, “defined in the organisational dependence of the artefact on some environmental variable(s)” (Graham, 1997, p.40). Steve Bell’s analysis highlights the nature of the interface through an itemisation of a range of I/O (input/output) methods between people and machines. Although he also brings attention to the fact that I/O is only one way to classify “kinds of interaction”, he also mentions the “mental positioning” of a participant as a way of classifying interactivity—“Is the participant inside the environment or outside looking in?” (Bell, 1991, p.53).

2.4.3 Cornock’s Classification of Art Systems

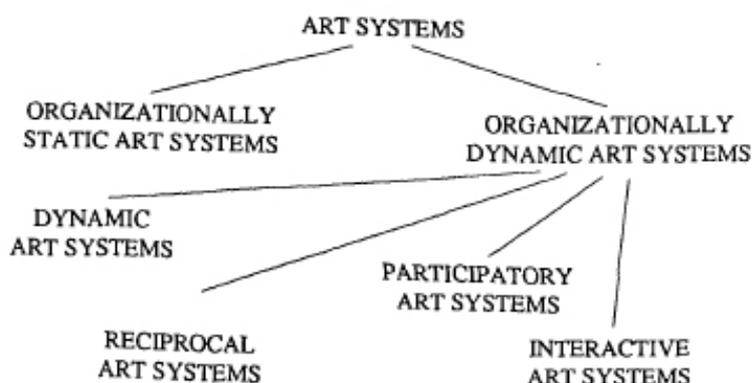


Fig.9. A classification of art systems. Cornock (1977 in Bell, 1991, p.5)

²¹ See: Figure 4: A diagrammatic interpretation of some previous taxonomies, in (Graham, 1997, p.39).

Initial reference will be made to Stroud Cornock's "classification of art systems according to the statics and dynamics of organisation", reproduced here as Figure 9. The two sub-categories of "ART SYSTEMS": "ORGANIZATIONALLY STATIC ART SYSTEMS" and "ORGANIZATIONALLY DYNAMIC ART SYSTEMS", have already been mentioned as part of Graham's (1997, p.39) diagrammatic interpretation of several previous taxonomies, on a sliding scale from "less interactive" to "more interactive". It is the "ORGANIZATIONALLY DYNAMIC ART SYSTEMS" sub-category—found on the "more interactive" end of the scale—that is of interest here.

Cornock defined the four sub-categories of "ORGANIZATIONALLY DYNAMIC ART SYSTEMS" in the following way:

1. **Dynamic systems:** the artefact in a work responds to environmental variables.
2. **Reciprocal systems:** the system has a range of states, and a human user moves the system from one state to another. This may be voluntary or involuntary.
3. **Participatory systems:** the artist defines a time, a place, a set of ideas or constraints, which constitute a matrix in which a work of art (signified by an event (...) rather than the physical presence of an artefact) can take place.

4. **Interactive art systems:** there is a mutual exchange between human and machine, which is of an order approaching that of a conversation between two human beings. To achieve this, Cornock wrote, "it should exhibit the properties of a learning system" (1977 in Bell, 1991, pp.5–6).

2.4.4 Behaving Art

Art is no longer a recording, a recollection, or a representation of something doing something: It is something doing something (Penny, 2017, p.319)

When Roy Ascott conceived of the binary classification between the "Deterministic" and "Behavioural" for artworks in 1967, he was renouncing the idea that the essence of art could be crystallised in material objects, and made the argument that art was instead "characteristic of the behavioural processes by which such objects are generated" (2003, p.24). His idea of "Behaviourist Art" drew on ideas from cybernetics and behavioural psychology, where the artworks themselves were transformed within a certain range of possibilities by the interaction of the viewer with them (p.59). He held this view whether the art was computer-based or not. Simon Penny, who considers interactivity itself as being an invention of the art world (2017, p.349), has taken the behavioural idea to cultural practices that involve "behaving artefacts"—practices that he calls "computationally articulated cultural artefacts (CACA)—in which artefact and experiencer are dynamically engaged in ongoing feedback loops" (p.319).

2.4.5 Kluszczyński's Strategies for Interactive Art

As a curator, Ryszard Kluszczyński has developed a different framework to Cornock's to classify interactivity in art (2010). The emphasis of his research is less on whether or not a particular work can be defined as interactive or how interactive it is, and pre-emptively Penny's idea of "computationally articulated cultural artefacts". In anticipation of Johnson and Verdicchio's call for AI systems to be considered "assemblages or socio-technical ensembles" (Section 2.2.6), he focuses on what he conceptualises as dynamic nets considered as interactive practices that bind together technologies and activated social and cultural components. He proposes a basic principle of interactive art based on the strategic organisation of the net's dynamics.

His research considers ways of organising fields of activity for participants in a typology of eight different strategies for interactive art (Figure 10): Instrument; Game; Archives; Labyrinth; Rhizome; System; Network; Spectacle. In his analysis, each strategy shares several common elements characterising interactivity in art. These elements are: interface; interactions; data (database); data organization (hypertext, cybertext); software/hardware system; relations among participants; performance/spectacle.

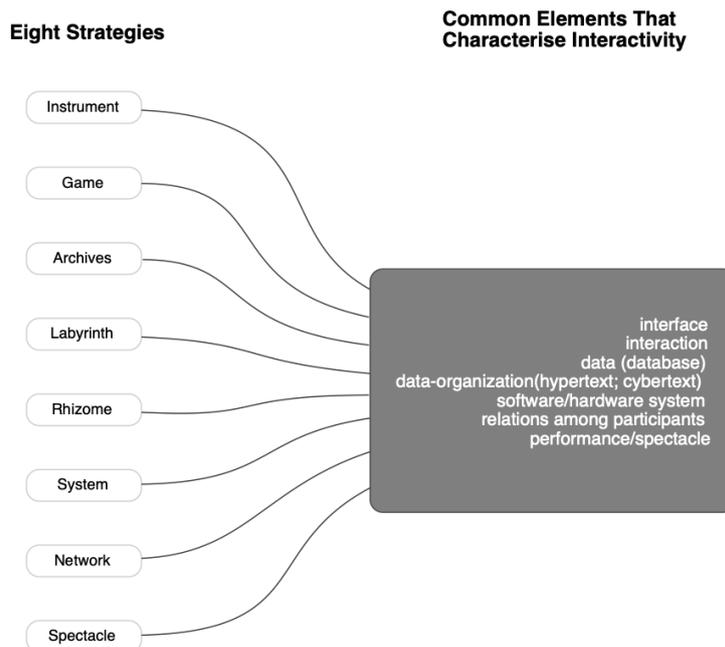


Fig.10. A diagrammatic representation of Ryszard Kluszczyński's Strategies for interactive art.

For each of the eight strategies, one of the aforementioned common elements takes precedence over the others, playing the leading role in organising the elements within the interactive experience to provide “strategies with their specific character” (2010, p.1).

The frameworks of Kluszczyński and Cornock will be referred to in Section 2.4.7 as a guide to begin parsing the interactivity of an AI/ML-enabled interactive artwork.

2.4.6 An Interface for AI/ML Art

In his thesis on Participatory Art and Computers, Bell (1991, p.26) commented that human-machine I/O devices are continually developing. In the “Human Interface”,

Richard Bolt provides an overview of human-computer interfaces in the 1980s (1984, p.84). Bolt's overview was followed by Stephen Wilson's inclusion of a table of I/O devices commonly used in computer technology in his book "Using Computers to Create Art" (1985, p.86). At that time, it was understood that interface technology would continue to develop but that the direction of its development would be unpredictable, and there would be little value in attempting to forecast developments beyond a few years in the future.

It transpires that for AI/ML-enabled art practice, a central interface is computer vision (CV), which bears little resemblance to the development of the peripheral in I/O being documented in the 1980–90s. Computer vision and machine vision are sometimes used interchangeably as they can overlap in their industrial applications—extracting information from images on an automated basis—but they are associated with different disciplines. *Machine vision* is a systems engineering discipline used for automatic inspection and process control and signal processing, where the engineer might have to think in terms of photodiodes to convert light into electric current. On the other hand, computer scientists and AI researchers take the *computer vision* approach to understanding, emulating and automating tasks the human visual system excels at and applying it to gain understanding from digital images and video. Rather than photodiodes, a computer scientist might be concerned with OpenCV (Open Source Computer Vision Library) to access ML algorithms to detect and recognise faces, identify objects, classify human actions in

videos, track camera movements among many other applications. Figure 11 indicates the close relationship between computer vision, artificial intelligence and machine learning, which is a nexus between AI/ML-enabled art and interactivity.

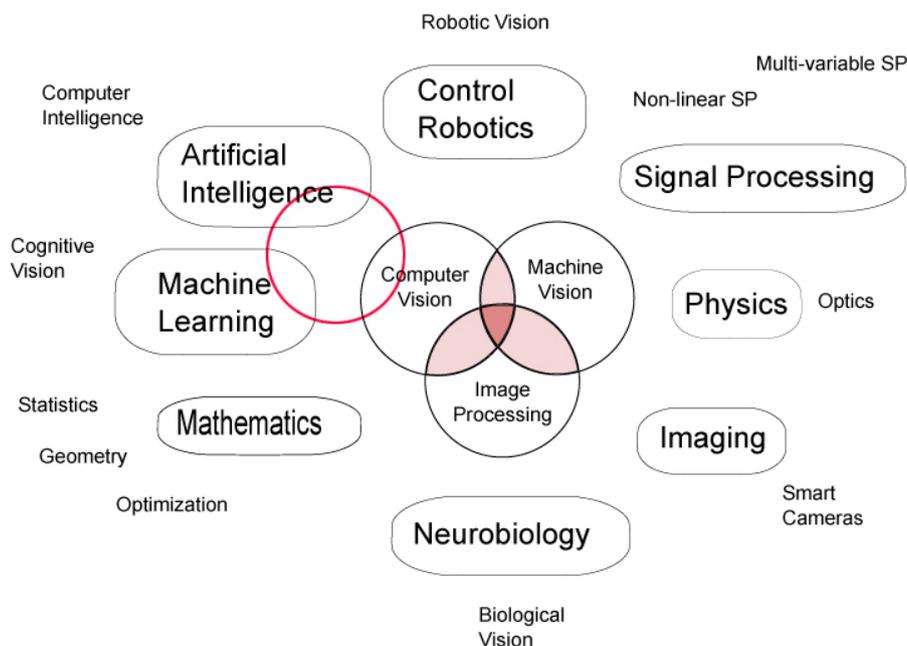


Fig.11. The nexus of AI/ML-enabled art and interactivity. Adapted from: Glossary of machine vision. Available at: https://en.wikipedia.org/wiki/Glossary_of_machine_vision (Accessed: 6 June 2021). Image: Public Domain.

In order to address the second research question concerning interactivity in the context of AI/ML-enabled art, it is essential to consider computer vision as a component of the interface through which interactivity is constituted (as discussed in section 2.4). Computer vision is understood by Azar et al. (2021) as an alienated form of social interaction that is becoming the “new normal”, where there is growing uncertainty concerning what is being rendered visible and invisible to human perception. “When the visual field is increasingly nonhuman, how is the

world made knowable to us when much of its operations lay outside our visual register and consequently outside the scope of human action?" (2021, p.1). It will be seen in section 2.5 that this is a core concern for a particular grouping of critical artists engaging with AI/ML-enabled art that is reliant on computer vision interfaces.

2.4.7 An Example of an AI/ML Interactive Artwork

As suggested in section 2.4, a difficulty encountered in discussing interactivity is a lack of consensus—similar to artificial intelligence—around the definition of the term. Goodman (2018, p.30) describes how some authors use the term derogatively to denote simplistic to-and-fro exchanges, while others use the term to suggest a much broader domain of participatory experiences broadly termed relational. Alan Peacock suggests that a lack of consensus over the meaning of the term "interactive" reflects a broader cultural condition of uncertainty amid rapid change (2005, para.2). Goodman describes how writers and artists have now moved away from using the term interactivity as a way of escaping narrow definitions. One of the main criticisms involved in this change concerns the question of "free choice" supposedly based in the decision-making process of interactivity—it is regarded as an illusion of empowerment. In these situations, participants in interactive art become "passive users" put to work in assembling an artist's vision.²² Based on the

²² See: Shanbaum, P. (2017, p.17) *The Interface is Obsolete: A Critical Investigation of the Digital Interface in Interactive New Media Installations*, where she critiques the interface as being intimately entangled with mainstream commercial technologies and the narratives of empowerment perpetuated by the technology industry.

illusion of free choice, Laetitia Wilson holds the view that “[t]he term *interactive* is an over-simplification of the dynamics of the user-interface relation that situates the user in a utopian discourse of active agency in dialogue with technology” (2003, p.1).

In relation to contemporary debates concerning interactivity in art—particularly that which is enabled by computer technologies and more recently AI/ML technologies—it is understood, via historical precedence (Section 2.4), that to be considered interactive implies an acceptance of the participation of the spectator in the making of the work somehow. With emerging technology, this assumption, based on established conceptions of participation, has become problematic. As a result, the artist and spectator's status with an interactive artwork, notions of participation and conceptual definitions have become complex and perplexing (Kluszczyński, 2010; Pinto, 2011) and need to be explored further.

As a way of exploring this perplexity, an AI/ML-enabled artwork that is regarded as being interactive is briefly discussed in relation to the concepts of display in section 2.4 and to both Cornock and Kluszczyński's frameworks of interactivity in sections 2.4.3 and 2.4.5.

In considering an AI/ML-enabled artwork within a broad conceptual framework of image synthesis, Anderson (2021, p.361) discusses Memo Akten's series of interactive artworks *Learning To See* (Figure 12). As a contributor to the inaugural DeepDream exhibition, *DeepDream: the art of neural networks* (2016)

(section 2.5.1), Akten is considered a leading AI-artist. Trained as a civil engineer, he is a former artist in residence with Google Artists and Machine Intelligence, a program “that brings artists and engineers together to realise projects using Machine Intelligence.”²³ However, Anderson misleadingly suggests that there is no history between Akten, corporate-sponsored residencies and formally trained engineers.

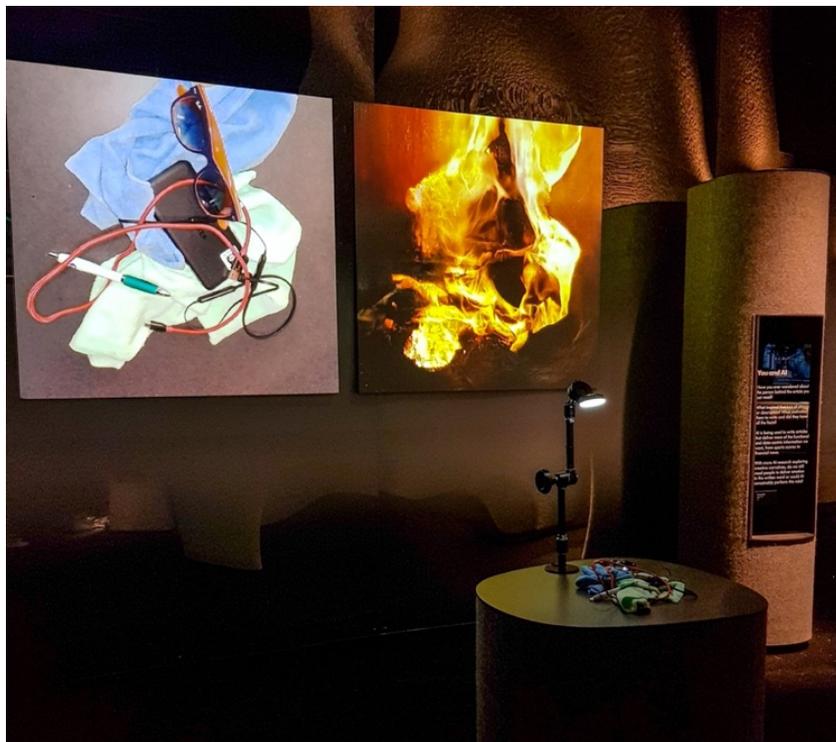


Fig.12. Memo Akten (2019) *Learning to See*, installation as part of *AI: More than Human*, the Barbican, London. Available at: <https://www.memo.tv/> (Accessed: 22 June 2021).

Learning to See transforms everyday objects into realistic-looking images generated from images used in the system’s training dataset, “[a] tangle of wires

²³ From the Artists and Machine Intelligence website. Available at: <https://ami.withgoogle.com/> (Accessed: 23 June 2021).

becomes an undulating bouquet of flowers, a hand and wrinkled dishtowel become a seascape with crashing waves, and so on” (Anderson, 2021, p.361). The public is invited to move objects around on a tabletop with a live camera mounted above pointing downwards towards the cluster of objects. This arrangement enables the live processing of effects based on the similarity to images within the system’s image training set, whereby, as an example, a diaphanous piece of fabric generates an image of a seascape. In his essay, Anderson goes on to question whether the entertaining image synthesis of work like *Learning to See* serves as a “domesticating function for machine learning algorithms, making them appear benign with consequences that are primarily aesthetic rather than political” (p.362).

2.4.8 Learning to See thought about in relation to Cornock

Learning to See is considered in relation to Cornock’s four sub-categories of “Organizationally Dynamic Art Systems”:

1. Dynamic systems (defined as):

The artefact in a work responds to environmental variables.

Lopes’s notion of “display” distributed across *Learning to See* can be considered equivalent to the “artefact” in Cornock’s dynamic system. The “environmental variable” in the above definition is equivalent to participant action—described by Lopes as “prescribed user action”.

2. Reciprocal systems (*defined as*):

The system has a range of states and a human user moves the system from one state to another. The moving of states by user can be voluntary or involuntary.

Cornock's reciprocal system can also be appreciated through Pinto, who describes how the "creator/artist, applies the rules of the constitution of the work through a precise code, creating a complex field of potential situations that could be actualized" (2011, p.13). In *Learning to See* the idea of a hierarchical, predetermined range of states as a conditional "either or" logic, designed by the artist to respond to user input has become outmoded.

In the AI/ML-enabled installation, the arrangement of objects on the table is translated via the computer vision (CV) system into numerical representations, which are presented to a trained model. The model is constituted from hundreds of thousands of statistical representations of images abstracted from a training dataset. These statistical representations can be imagined as relational clusters within a high-dimensional latent space. The "complex field of potential situations" alluded to by Pinto above is beyond the artist's control. The vectors of relations arrived at within the model, which drives the image synthesis, are internally determined by the system and are often even beyond the comprehension of the algorithm's programmer.

3. Participatory systems (*defined as*):

The artist defines a time, a place, a set of ideas or constraints, which constitute a matrix in which a work of art—signified by an event (...) rather than the physical presence of an artefact—can take place.

In Cornock's participatory system, a group of participants' reactions to an event take precedence, whereas *Learning to See* is unequivocally object-based. A participant manipulates real objects to synthesise images derived from representations of hundreds of thousands of other objects within the system. The artist has set various "constraints" regarding the kind of datasets used to train the model,²⁴ the selection of physical objects on the table, the configuration of display and prescribed user action. However, the time and place have been decided institutionally.

4. Interactive art systems (*defined as*):

A mutual exchange between human and machine which is of an order approaching that of a conversation between two human beings. To achieve this, Cornock wrote, "it should exhibit the properties of a learning system" (1977 in Bell, 1991, pp.5–6).

Cornock's speculated interactive art system, which wasn't technically feasible when he conceived it, applies to *Learning to See* in a minimal way. *Learning to See* isn't actively 'learning', although it has 'learned' by being fed a massive training dataset.

²⁴ For an engineer's perspective see: Akten, M. (2021), pp. 133–139.

On one level, the interactivity of *Learning to See* is an exchange between two discrete elements—neither of which are well understood: the ‘vagaries of mind’ of the participant under the influence of prescribed user actions; and an ‘inscrutable’ ML system.

While Cornock’s conversation metaphor points to a shared field of mutually constructive relationships, Goodman calls for a rethink on how to make and experience interactive art, citing a “complex play of forces” that are beginning to constitute objects, events and subjects (2018, p.45). He draws on Erin Manning’s idea that the “conversational model of the interactive paradigm” is no longer adequate to activate new potentials (cited in Goodman, 2018, p.45) and suggests a way forward in thinking about interactivity is to find alternatives to the idea of the discrete participant and artwork, and to think of them somehow as processes in themselves that have potential to interact.

2.4.9 Learning to See thought about in relation to Kluszczyński

Learning to See can be thought about in relation to Ryszard W. Kluszczyński’s framework of eight strategies, which consider organising fields of activity for the participant (section 2.4.5.) Parallels have been drawn between *Learning to See* and two of Kluszczyński’s strategies—Strategy of Instrument and Strategy of System.

Strategy of Instrument (*defined as*):

Works of art that offer their users the experience of a ready-made form without suggesting navigation through any form of data organisation set before its exploration. The interactive experience is organised around an interface, and it is precisely the interface that plays the primary role in the Strategy of Instrument. However, contrary to the typical forms of interface applications, which give the user the sense of communication with someone or something, or provide the sense of steering an information system, in the Strategy of Instrument, the interface plays the role of a device that generates visual or audiovisual events.²⁵

From Kluszczynski's definition above, it can be understood that in the organisation of the common elements (section 2.4.5), which characterise interactivity, "interface" takes precedence within the hierarchy of elements. As an example of Strategy of Instrument, Kluszczynski cites the polish artist Wojciech Bruszewski's *Sternmusic* (1979), which, similar to *Learning to See*, employs participant action to translate images mediated by a camera. In *Sternmusic*, participants leafed through Stern Magazine—which became a kind of score—as the camera-system transformed the image of the participant's action into music. Kluszczynski considers such participant activity as "tactical actions undertaken by the receivers" taking on the form of performances "in which these sculptures-interfaces are used solely as props in a totally functional, one might say—instrumental way" (2010, para.6).

²⁵ Slightly paraphrased from (Kluszczynski, 2010, "Strategy of Instrument," para.1)

A participant in *Learning to See* perceives the random collection of objects on a tabletop to embody the interface as a kind of functional sculpture-interface-prop, and it is by acting on this, they can alter the display. The Strategy of Instrument, as it relates to *Learning to See*, explicitly foregrounds the participant's perception of the interface in the collection of objects, which can potentially change the diptych video display. The prescribed user action is to *play with the interface*, to move it around in order to witness what occurs within the frames, without any clear sense of "communicating with someone or something", or navigating through "any form of data organisation." The synthesised images appear to have been 'conjured'.²⁶

Strategy of System (*defined as*):

Works of art that started to appear from the beginning of the twenty-first century with the noticeable fact that despite their dynamic processing and digital properties, they do not create a possibility of tangible interaction for their users. They are characterised by an idea of eventfulness that does not find many ways out to where the viewers are but instead takes place in their inner, technological, digital world (2010, para.1).

Kluszczyński posits the existence of an "inner interactivity's occurrence" due to "the digital computer system's autonomy" as the basis for his interactive Strategy of

²⁶ Based on the author using and observing the installation being used at the Barbican exhibition, *AI: More than Human*, 2019.

System. Thus, the Strategy of System involves an inner dialogue within a technological order, determined through software and hardware functions.

The characteristic of *Learning to See* that is unique in terms of the historical development of interactive art relates to the dynamic processing within the ML model. *Learning to See* subordinates this unique characteristic to an instrumental functioning of the interface—or at least the perception of an interface. The dynamic processing within AI/ML-enabled art is unprecedented in the way materials are combined and manipulated—where *materials* can be representations of objects, texts, human action or other things—within the model. The operations upon this material are pivotal to the interactive nature of an AI/ML-enabled art system. However, in *Learning to See*, the complexity and implications of these operations remain ‘undeclared’ within an “inner, technological, digital world.”

Kluszczyński anticipated that interactivity in art would become increasingly entangled with various social, political, ecological contexts implied by specific interactive strategies. He suggested (writing in 2010) that long gone are the times of fascination just with the phenomenon of digital interactivity itself. An understanding of *Learning to See* in the context of Strategy of System with its hidden, unacknowledged technological order, exposes the fact that the interactivity of *Learning to See*, in Kluszczyński’s words, is “explored in an abstract way, only for itself.”²⁷

²⁷Slightly paraphrased. (Kluszczyński, 2010, "Palimpsests and Transfigurations," para.2).

2.5 Artistic Uses of AI/ML

An initial survey of current artistic uses of AI/ML technique produced a binary perception between what is referred to as the Google affiliated, DeepDream cohort and a looser grouping of independent artists who demonstrate a more critical approach. The latter grouping provided a point of departure for the practice-based research.

2.5.1 The DeepDream Cohort

AI/ML-enabled art first came to the public's attention via *DeepDream: the art of neural networks* (2016) at the San Francisco gallery and arts foundation, Gray Area. This exhibition was curated by Joshua To, a User Experience (UX) designer employed by Google, with many of the participants having an engineering background and affiliation with the Google company.²⁸ The exhibition was organised in response to a posting made on Google's research blog the previous year: "Inceptionism: Going Deeper into Neural Networks" (Mordvintsev, Olah and Tyka, 2015). In this post the authors describe how they turned their algorithm "upside-down" as a way of visualising how a neural network—trained to 'recognise' or classify specific images—comes to represent a particular class of image after

²⁸ Participating artists and biogs available at: <https://grayarea.org/event/deepdream-the-art-of-neural-networks/> (Accessed: 19 August 2021).

having been fed millions of examples (see Figure 13).²⁹ Mordvintsev et al. describe their process as a feedback loop that “over-interprets” images so that highly detailed images seemingly appear out of nowhere. The network they used was trained on images of animals, which then tended to interpret random shapes as animals or bizarre animal hybrids, revealing the “flattening power of this process” (Mersch, 2020, p.16). Mersch goes on to say that “[o]ne can of course celebrate these ‘works’ as a new generation of AI-assisted digital art. Or one can call them what they are: psychedelic kitsch” (p.19).³⁰



Fig.13. A DeepDream image by A. Mordvintsev in Mersch (2020). Fig.5: Inceptionism, p.18.

²⁹ The term “Inceptionism” used in the blog post was in reference to a computer science paper (Szegedy et al., 2014), that proposed a deep neural network that aimed to establish a new state of the art in image classification.

³⁰ For in-depth critique of DeepDream see: Zylinska, J. (2020), pp. 75–85.

In an opening address and accompanying online essay to the exhibition at Gray Area, Blaise Agüera y Arcas, a Google machine-intelligence developer, likened the artistic use of neuronal networks to photography or the employment of optical instruments by Renaissance artists. "Like the invention of applied pigments, the printing press, photography, and computers, we believe machine intelligence is an innovation that will profoundly affect art" (Agüera y Arcas, 2017, p.1). The cultural vision of Arcas was at odds with the pedestrian-sounding mission statement of the curator, for whom the primary objective of the exhibition was to mitigate a problem of information design: how to communicate the complex ideas behind neural networks to the public in a comprehensible format (Campbell-Dollaghan, 2016). The different algorithmic techniques employed by each artist: DeepDream; Fractal DeepDream; Class Visualisation; Style Transfer, were explained in highly reductive terms for non-specialists and were represented as icons used as part of wall signage that connected contributors with dates and techniques. According to Grey Area, the exhibition and accompanying Google symposium was significant in its attempt to disseminate and inculcate a solid understanding of neural networks and DeepDream with the public. As a science communication and public relations exercise, the emphasis of this inaugural exhibition was on the workings of the technology itself; the operations of the technology were the apex focus of the exhibition. This perspective is aptly summed up by Mersch when he says, concerning the instrumentalism of DeepDream in general:

The designs they let loose refer to nothing more than the parameters of their own technical conditions; they contain neither social engagement nor historical impact, nor do they intervene in their environment: they are what molds the machines (2020, p.29).

In the Google research blog (2015) the authors consider whether neural networks could become a tool for artists, “a new way to remix visual concepts”. From the outset, there was the suggestion that AI-related technology is a conceivable remix technique, but it was not until 2021 that the field of remix studies acknowledged the potential of AI/ML as a remix engine in its literature (Navas, Gallagher and burrough, 2021, part 3). However, it is significant that this brief period of DeepDream brought the AI and art space to the attention of a broader spectrum of artists.

2.5.2 Hype Cycle From The Cultural Perspective

AI-art entered the public consciousness when Gray Area Foundation for the Arts and Research presented the inaugural DeepDream exhibition in 2016. In the same year, Luba Elliott, a curator, producer and researcher specialising in AI in the creative industries, instigated the Creative AI London meetups to develop and facilitate a burgeoning community around AI-art. In May 2017, she followed up the Creative AI London meetups with the first issue of *The Creative AI Newsletter*. There have been ten issues of the newsletter that documents an evolving landscape

of tools and interest in the field. In addition, Elliot curates the online presentation space www.aiartonline.com, which she positions as “a snapshot of AI-related work that has been made by the technical community—i.e. artists are chosen for their technical rather than conceptual prowess” for which art institutions have criticised her.³¹ She identifies a major schism in the field between work made by technical artists where mastery of the tools is paramount, and the rest, whose focus is conceptual and critical.

Figure 14 charts the frequency of particular categories throughout ten issues of *The Creative AI Newsletter*. The ‘creative/artist’ category includes visual artists, bands, authors, designers, and multi-disciplinary collaboration.

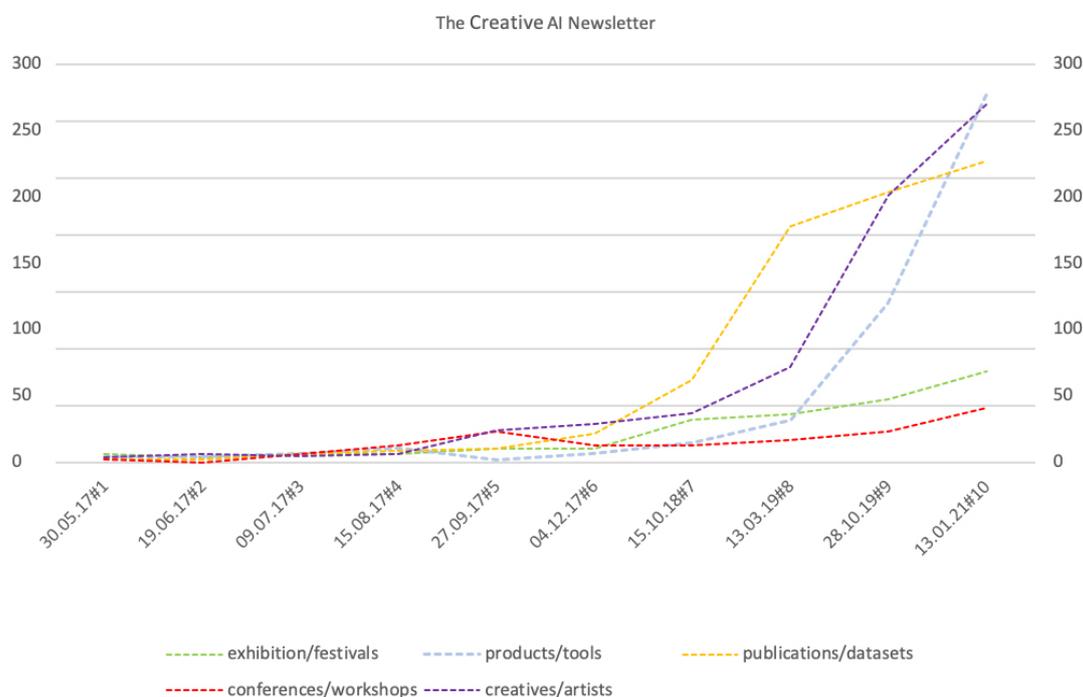


Fig. 14. The frequency of particular categories throughout ten issues of *The Creative AI Newsletter*.

³¹ Luba Elliot interviewed by Eva Jäger (Serpentine Galleries, 2020, para.16).

Coinciding with the explosion of interest in cultural AI as indicated by the frequency of terms in Luba Elliot’s newsletter and Daniel Leufer’s identification of “peak AI hype” in 2019–2020 (Section 2.3.4), the Google ngram below (Figure 15) shows the increase in book searches combining search terms ‘AI’ and ‘art’.



Fig.15. Book searches combining search words 'AI' and 'art'. Source: <https://books.google.com/ngrams/>

2.5.3 A More Critical Approach to AI/ML Art

As activity in the AI-art-space increased, the contextual review started to focus on more diverse practices that demonstrated relational approaches to AI/ML-enabled art production, where the conceptual and social was considered as much as the technical. A more critical approach can reveal structures by being mindful of the socio-historical context of AI and the processes of mystification surrounding it. A more critical approach might adopt journalistic methods or best practice descriptive language to address socio-technical blindness.

Manuela Naveau is a professor for Critical Data at the University of Arts and Industrial Design, Linz and leads a course on Artistic Journalism, which she has explained is based on the premise that arts and journalism share similar methodology involving communication, mediation, translation, investigation and emotional processes.³² She stresses the crossover by saying, "artists and journalists are up to date with what the world actually looks like" and proposes a possible counter-culture via critical data in art. As a participant in the CRUMB Discussion List, Naveau agreed that there is a dearth of language with which to discuss AI/ML-enabled art (Appendix C.2). She indicates that this is a minor echo of a more significant problem at the political level—concerning criticism levelled at the European Union's White Paper on Artificial Intelligence (Section 2.2.2).

A looser grouping of more critical artists—perceived through the combined lens of *The AI Art Manifesto* and the *AI Myths* project—forms two broad categories of practice, both of which in different ways bring what has been obscured to the foreground:

1. Practice employing journalistic approaches (as defined by Naveau) to address the ethical issues of socio-technical blindness facing the AI research community in how AI research and its products can be responsibly conceptualised and presented to the public.
2. Practice employing the idea of assemblage to harness AI/ML techniques combined with conceptual approaches following Johnson and Verdicchio's

³² Manuela Naveau discusses concepts of critical data and artistic journalism as part of *Artistic Journalism 3/3: Deep Issues* (Ars Electronica, 2020, sec.46:30).

call for AI systems to be considered “assemblages or socio-technical ensembles” (Section 2.2.6).

The selected artists from the contextual review are introduced here, grouped under the two categories indicated above.

2.5.4 Journalistic Approaches

As previously stated by Naveau (Section 2.5.3), “artists and journalists are up to date with what the world actually looks like”; there is a potential sharing of awareness of the socio-historical contexts of AI, and the processes of mystification surrounding it. Where this sharing of awareness is perceived in artistic practice, the approach is identified as being *journalistic*—a form of direct presentation of facts or descriptions without an attempt at interpretation.

Kate Crawford & Vladan Jolar: Anatomy of an AI System (2018)

The problem of socio-technical blindness is addressed by Kate Crawford in collaboration with Vladan Jolar through their *Anatomy of an AI System*, which was exhibited in *Artificially Intelligent* as part of the V&A Digital Design Weekend (2018). This work is a fine-grained breakdown as an anatomical study of the Amazon Echo as an AI system that involves a precise mapping of its use of human labour, data and planetary resources. Crawford and Jolar draw on the concept of digital labour as developed by Christian Fuchs (2016) among others. The idea of digital labour—

initially linked with different forms of non-material labour—underpins the production of complex systems such as AI and the many devices that embody it. The *Anatomy of an AI System* (Figure 16) shows that the scope of this digital labour is overwhelming:

From indentured labour in mines for extracting the minerals that form the physical basis of information technologies; to the work of strictly controlled and sometimes dangerous hardware manufacturing and assembly processes in Chinese factories; to exploited outsourced cognitive workers in developing countries labelling AI training data sets; to the informal physical workers cleaning up toxic waste dumps (Papadimitriou, Prescott and Rogers, 2018, p.113).

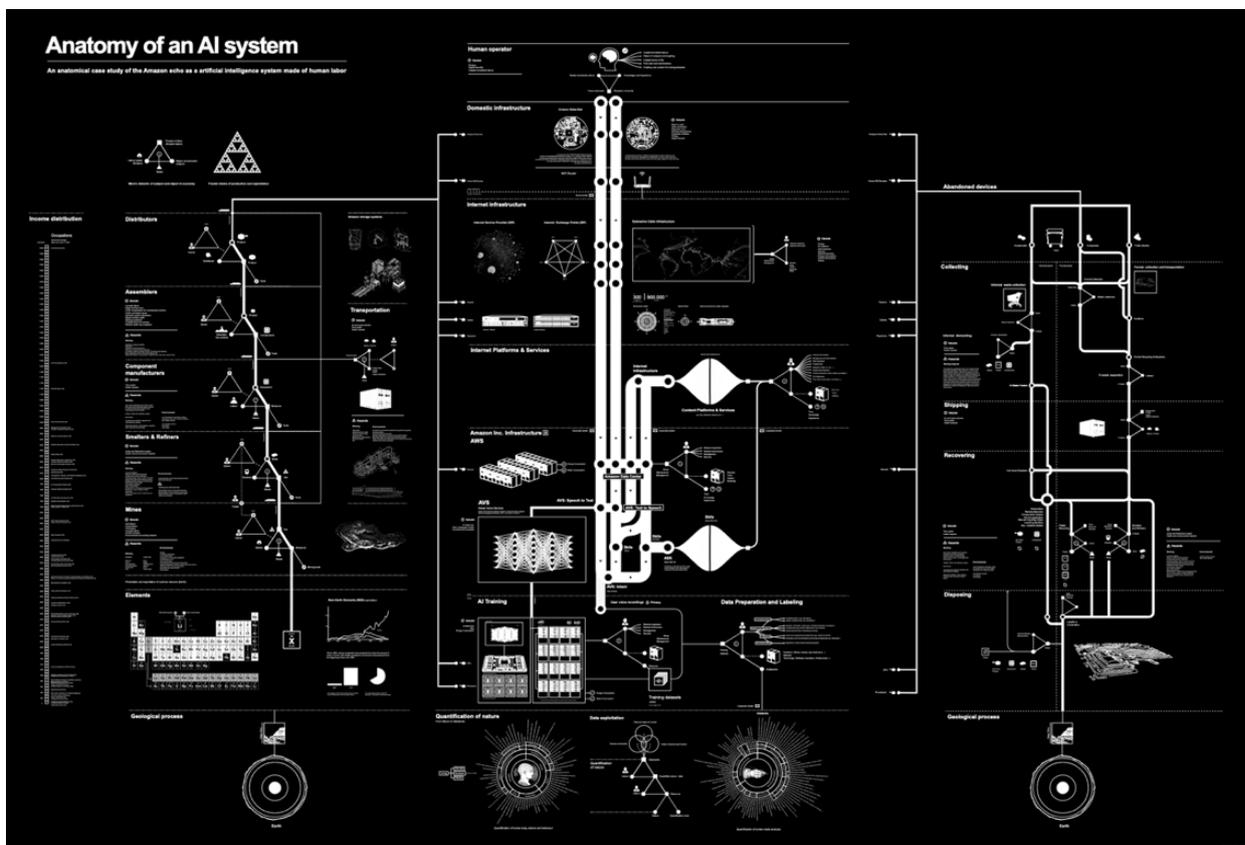


Fig.16. Kate Crawford and Vladan Jolar, *Anatomy of an AI System*. (Crawford and Jolar, 2018).

Crawford and Joler confront the problem of socio-technical blindness, where users of an Amazon Echo device might be unaware of the vast network that subtends and drives its interactive capacities and the grim physical reality of people connected to the production of the AI system. Their project aligns with *The AI Art Manifesto* of Fuchs et al. by exposing the lack of credit given to “human labor and culture where it is used in AI datasets and frameworks”. When it comes to mapping the role of cognitive workers labelling AI training data sets, Crawford and Joler help to re-conceptualise the re-embodiment of “the products of AI” re-centring them around intelligent human attribution, rather than limiting a “notion of intelligence to a virtual abstract” (2018).

Kate Crawford and Trevor Paglen: Excavating AI (2019)

Excavating AI addresses the problem of human attribution in the building of AI systems, posing questions about how text labels are assigned to images in datasets and the consequences of using these labelled images in the training of neural networks (Crawford and Paglen, 2019). They conduct an “archaeology of datasets” to reveal assumptions that inform how AI systems “work—and fail” and how human workers pair descriptive words to images in the act of labelling. They explore the relationship between ImageNet, the canonical image training set for computer-vision research, and WordNet, a database of word classifications developed at Princeton University in the 1980s that attempts to organise the entire English

language. This relationship is fundamentally structural: ImageNet's structure is based entirely on the nested cognitive synonyms (synsets) that constitute WordNet. This pairing of image and word assumes a fixed and quantifiable correspondence between images and concepts, between images, referents and labels, which (through erroneous inferences) can produce bizarre or derogatory coupling of pictures and labels:

A child wearing sunglasses is classified as a "failure, loser, non-starter, unsuccessful person." You're looking at the "person" category in a dataset called ImageNet, one of the most widely used training sets for machine learning (Crawford and Paglen, 2019).

They address the fact that the automatic interpretation of images is essentially social and political rather than solely technical and demonstrate how this has become a critical issue as AI systems become intrinsic to the architecture of social institutions.

Excavating AI is primarily focused on object and face recognition, which is perhaps the most widely known application of AI technology, with face recognition in particular steeped in scandal around the biased assumptions made as part of its construction. However, there is less awareness around the development of human-action-recognition (HAR), and very little (if any) artistic research focused on it. Paglen and Crawford introduce HAR, which has directly informed this practice-based

research (Section 3.1.2) in exploring the “erroneous inference” that can attend algorithmic controlled correspondence between images and concepts.

As part of their exhibition *Training Humans* at the Fondazione Prada in Milan, Paglen and Crawford produced the website, *ImageNet Roulette* and made it available to the public for a limited amount of time. The site’s algorithm was trained on photos of people contained in ImageNet. Created in 2007 by researchers at Stanford and Princeton Universities, ImageNet includes more than fourteen million photographs, mostly of objects but also of people, that have been classified and labelled by large numbers of workers on Amazon’s crowdsourcing labour site, Mechanical Turk.³³ Once uploaded to *ImageNet Roulette*, image recognition software identified faces in photos and labelled them with one of the 2,833 subcategories of people that exist within ImageNet’s taxonomy. As an example of “erroneous inference”, Figure 17 shows the result from a photo uploaded to *ImageNet Roulette* by the author. The photo depicts the AI-art collective, Obvious, who are shown posing with an image from their generative adversarial network (GAN) portrait series. *ImageNet Roulette* assigns them all with the labels: ‘psycholinguist’; ‘rape suspect’; ‘breaststroker’; ‘nonsmoker’.

³³ Nicolas Malevé has researched ImageNet as part of *Data/Set/Match*, The Photographers’ Gallery digital programme seeking new ways to present, visualise and interrogate contemporary image datasets (Malevé, 2019).



ImageNet Roulette

ImageNet Roulette is a provocation designed to help us see into the ways that humans are classified in machine learning systems. It uses a neural network trained on the "Person" categories from the [ImageNet](#) dataset which has over 2,500 labels used to classify images of people.

It is currently on show as part of the [Training Humans](#) exhibition by Trevor Paglen and Kate Crawford at the Fondazione Prada museum in Milan.

ImageNet Roulette isn't designed to handle heavy traffic so if it's not working for you please be a little patient.

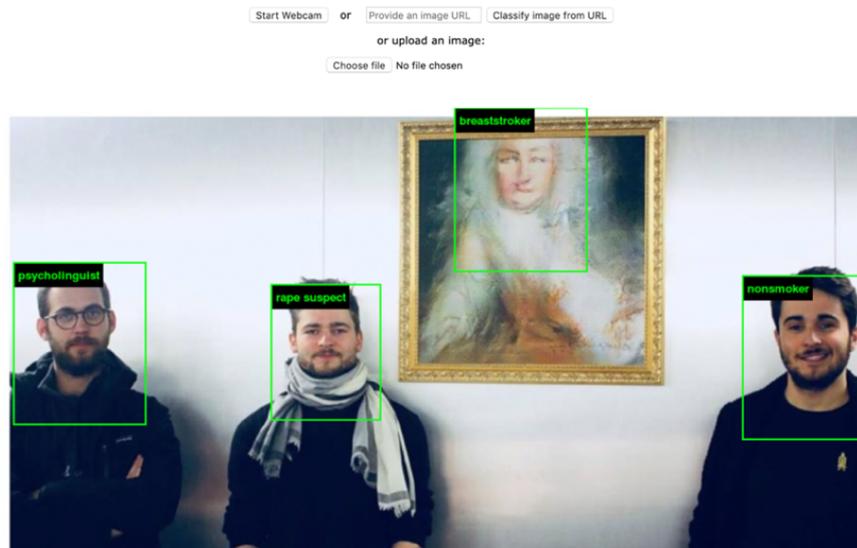


Fig. 17. Portrait of Obvious processed by *ImageNet Roulette* (2019). Original image sourced from Obvious' website: <https://obvious-art.com/> (Accessed: 4 October 2021).

The Asian American journalist Julia Carrie Wong, referring to her own classification by *ImageNet Roulette* as "gook" makes the point that, this is exactly the outcome that Crawford and Paglen were aiming for. *ImageNet Roulette* is not based on a magical intelligence that shows us who we are; it's based on a severely flawed dataset labelled by fallible and underpaid humans that shows us its limitations (2019).

Crawford and Paglen's sustained critique of socio-technical blindness has had tangible effects on the AI research community: Yang et al. (2021) are now

obfuscating faces in the ImageNet dataset; Prabhu and Birhane (2020) are addressing the “stagnant concept vocabulary of WordNet”; the Neural Information Processing Systems Conference (NeurIPS2021) have announced a new track to develop improved dataset development and ambition to increase publication on data and benchmarks (Vanschoren and Yeung, 2021).

Max Dovey: HITS (2016)

Max Dovey utilises game show tropes as a way of addressing socio-technical blindness. *H.I.T.* (2016) stands for Human Intelligence Tasks and refers to the human labour involved in developing image recognition algorithms (Figure 18). To investigate the position of human labour in the production of algorithms, artists Max Dovey and Manetta Berends have adapted an automatic image-tagging application to create a participatory game show with cash prizes. In the game show, multiple teams compete to identify the human labour involved in developing an image-recognition algorithm.

It is a participatory performance where audience members compete to produce their own image recognition algorithm. It is styled on the annual ImageNet challenge, where groups of researchers compete to develop the most accurate image recognition algorithm. *H.I.T.* adapts this competition to reveal and perform the manual labour involved in training an algorithm on a public image dataset. Two teams play against each other in front of an audience where each round is a task taken from the production of an image recognition algorithm. Within the tasks, the cognitive labour is embodied by

the participants as the often obscured process of producing a working algorithm is performed (2016).



Fig. 18. Max Dovey (2016) *HITS*. Sourced from the artist's website.

2.5.5 Assemblage Approaches

The following grouping of artistic practices employs AI/ML techniques combined with conceptual approaches as an *assemblage*. However, in the context of this research the definition of the term *assemblage* needs clarification.

Manuel DeLanda (2016, p.1) points out that the word *assemblage*—as an English translation of the original French word *agencement*—fails to capture the

double meaning of *agencer*. *Agencer* alludes to *how* things fit together as components as well as to the results of the fitting together; summed up as “an ensemble of parts that mesh well together” (p.1). The English translation only relates to the latter of the two definitions, giving the impression that assemblage is something closer to a collage—a finished product—and fails to indicate the *process* aspect that’s present in the original French expression. DeLanda interprets the simplest³⁴ definition of Deleuze and Guattari’s original concept of assemblage as something comprising of parts that are heterogenous, lacking uniformity in both nature and origin, and that are actively linked together through the assemblage’s establishment of relationships between the parts: “the assemblage’s only unity is that of a co-functioning” (DeLanda, 2016, p.1). To appreciate the source of DeLanda’s interpretation, it helps to look to a well-known example given by Deleuze and Guattari of assemblage through historical analogy as a weapon of war, in the “man-horse-bow assemblage”:

The whole composed of a human being, a fast riding horse, and a missile-throwing weapon like the bow is the best-known example of an assemblage of heterogeneous elements, cutting as it does across entirely different realms of reality: the personal, the biological, and the technological (2001, p.404).

³⁴ In “A Thousand Plateaus” (2001), Deleuze and Guattari give multiple definitions of *assemblage*, with each definition of the concept connecting to a different aspect of their philosophy. For the sake of clarity, the research will refer to DeLanda and Hayles’ interpretation.

As a development of the concept, Katherine Hayles' interpretation of assemblage "emphasises the flow of information through a system and the choices and decisions that create, modify, and interpret the flow" (2017, p.116). This idea is applied to AI/ML-enabled art practice so that a component of the work can be conceived of as part of a process-flow diagram incorporating machine process and human involvement; where one part feeds or stimulates the other. The intention is that through imagining the assemblage in this way, the interconnecting parts of an otherwise opaque AI system might become more discernible and, therefore, more comprehensible.

xtine burrough: A Kitchen of one's Own and Epic Hand Washing (2020)

In 2020 xtine burrough was part of The Photographers' Gallery year-long program *Data/Set/Match* collaborating with Sabrina Starnaman and technical director Dale MacDonald. In a post to the Jan 2021 CRUMB discussion list, burrough described the work in the following way:

Both projects confronted the training data—a set of videos—from the Epic Kitchens 2018 data set. For both projects, we created a parallel set of data (quotes) to transform what we imagined the researchers to have considered "neutral" video footage of people working in their kitchens into visual narratives that forward stories of women in the domestic and professional kitchen spaces. The resulting display (the "Kitchen" piece for the media wall and "hand washing" for the browser—a piece we made, rather quickly, in response to being confined in our homes starting in March last year) remixes

those videos from Epic Kitchens into stories about women and the #MeToo movement (Kitchens) and stories about humans and hand washing during plagues and epidemics (Hand Washing) (Appendix C.4).

As part of the CRUMB discussion list, burrough and other invited respondents were asked to consider how the introduction of ML as a tool in art has increased the complexity of human attribution. The invitation was also informed by the controversy concerning the sale of AI-art by Obvious at Christie's, and Joel Simon's GANbreeder incident as described by Bailey (2018), which invoked questions of authorship, copyright, appropriation, collaboration and remix, which are terms from the lexicon of remix studies. With respect to this invocation of remix terms, could AI/ML-enabled art be examined in the context of remix studies? In response to this, burrough asserted that both projects, *A Kitchen of one's Own* and *Epic Hand Washing* employed strategies of remix as a way of interrogating AI/ML by examining a data training set, "[w]hile I do think of these projects as remixes, I don't think of them, strategically, as efforts in 'cut, copy, and paste'" (Appendix C.4).

It had previously been suggested to the list, that the 'cut, copy and paste' metaphor would be outmoded should AI/ML be considered a remix technique. To address this, burrough started to break her projects down into component parts and began to articulate the relationships between the parts (Figure 19). This made it

easier to conceptualise the production as an assemblage and imagine the process-flow that constitutes the work.

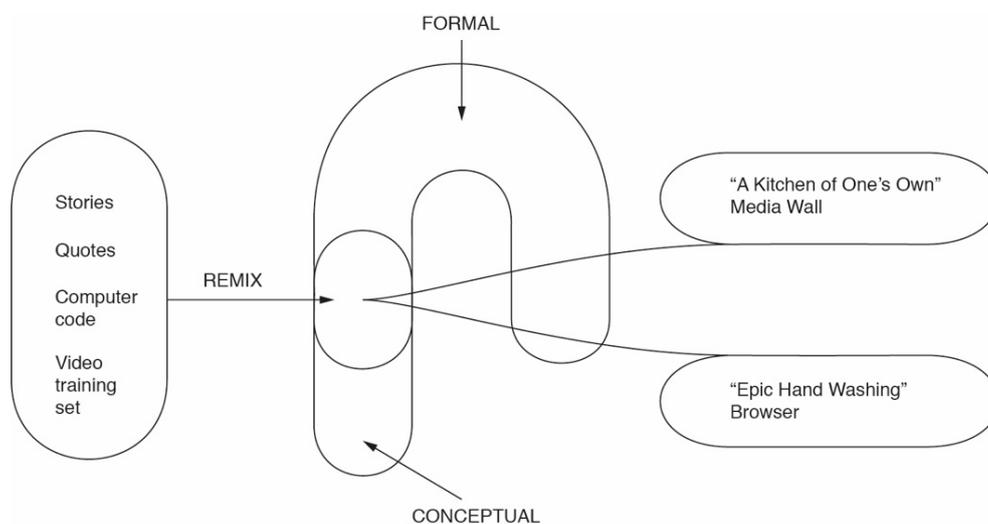


Fig. 19. Visualising xtine burrough's process from *Data/Set/Match* (2020). Diagram by Bruce Gilchrist from a description by xtine burrough (2021).

An initial distinction was made between the formal and conceptual dimensions of the work. Formally, these are works in juxtaposition and computation, and conceptually they are narrative interpretations and translations. burrough explains that the formal dimension includes the modes of display (data projection on the Media Wall of the Photographer's Gallery and rendering in a web browser), both of which have their own sets of rules and constraints. The blending of formal and conceptual dimensions produces complexity, where the blending is also understood as a remix constituted "from multiple players—the stories (the quotes in our datasets), and the machines (rules for the AI/ML, keywords tagged to training data information, and the videos in the training set)" (Appendix C.4).

Robbie Barrat: GPT-2 Landscapes (2019)

The documentation of the process for *GPT-2 Landscapes* (Figure 20) provided by Barrat, shows that he used a text, “The Garden of Eden has: 1. A large apple tree in the centre. 2.” as a prompt for a GPT-2 language model to generate a set of instructions. Once established, he then acted on those instructions to generate a computer-generated landscape using 3d modelling software.



Fig.20. Robbie Barrat (2019) *GPT-2 Landscapes*. Available at: <https://twitter.com/videodrome/status/1199095612031078400/photo/1> (Accessed 23 August 2021).

In terms of thinking about the production of *GPT-2 Landscapes* as an assemblage, there are several discernible processes at work:

1. The provision of the source text used to prompt the GPT-2: “The Garden of Eden has: 1. A large apple tree in the centre. 2.” (It is not known where this text came from).
2. Feeding this text prompt to a GPT-2 model to generate a list of four short sentence instructions (Figure 21). The prompt can be understood as having been auto-completed in the output by GPT-2:

Prompt	Language model	Output
The Garden of Eden has: 1. A large apple tree in the center. 2.	—>GPT-2—>	The empty grey area in the centre of the ground.
		3. ????? deep in the ground.
		4. Flowers on all four sides of the apple tree.
		5. A small rock near the centre.

Fig.21. GPT-2 Landscapes. Step 2.

3. The outputs of GPT-2 from step 2 above are curated by deciding (using the artist’s discretion) which outputs are nonsense and discarding them. The remains are cleaned up by fixing punctuation.
4. Once curated and cleaned up, the entire output from step 3 above was fed back to GPT-2 as a string of text to generate three further instructions (Figure 22):

Prompt	Language model	Output
1. A large apple tree in the center. 2. The empty grey area in the centre of the ground. 3. ????? deep in the ground. 4. Flowers on all four sides of the apple tree. 5. A small rock near the centre.	—>GPT-2—>	6. Animals.
		7. Rows of wheat and barley growing on the sides.
		8. Fish swimming upstream.

Fig.22. GPT-2 Landscapes. Step 4.

Barrat refers to the various GPT-2 outputs as rules. However, they could also be understood as a set of instructions in the manner of a Fluxus Event Score. A Fluxus Event Score is an instruction that invites the application of imagination and interpretation to translate concepts into other concepts or concepts into tangible artefacts, “event scores may force the performer to complete a sketchy or

incomplete instruction” (Anderson, 2016, p.1). The final instruction in the making of

GPT-2 Landscapes:

5. Use 3d Landscape 2.0 Deluxe for Windows software as a tool to translate instructions numbered 1-8 into a computer generated image.

Barrat provides no information regarding the text corpus that has been used to train the GPT-2 model. Therefore the model was either trained by OpenAI using random web text, or Barrat selected a specific training corpus suitable for his project.

Robbie Barrat: Untitled (2019)

Barrat describes *Directions for the World's Most Interesting Drawing* (Figure 23) as “heavily inspired by Sol LeWitt-I use GPT-2 to generate a set of rules describing a drawing; then based on my interpretation of those rules; I make a Processing sketch.”³⁵

³⁵ From Robbie Barrat’s Twitter feed: <https://twitter.com/videodrome/status/1177012430230183937> (Accessed: 12 April 2021).

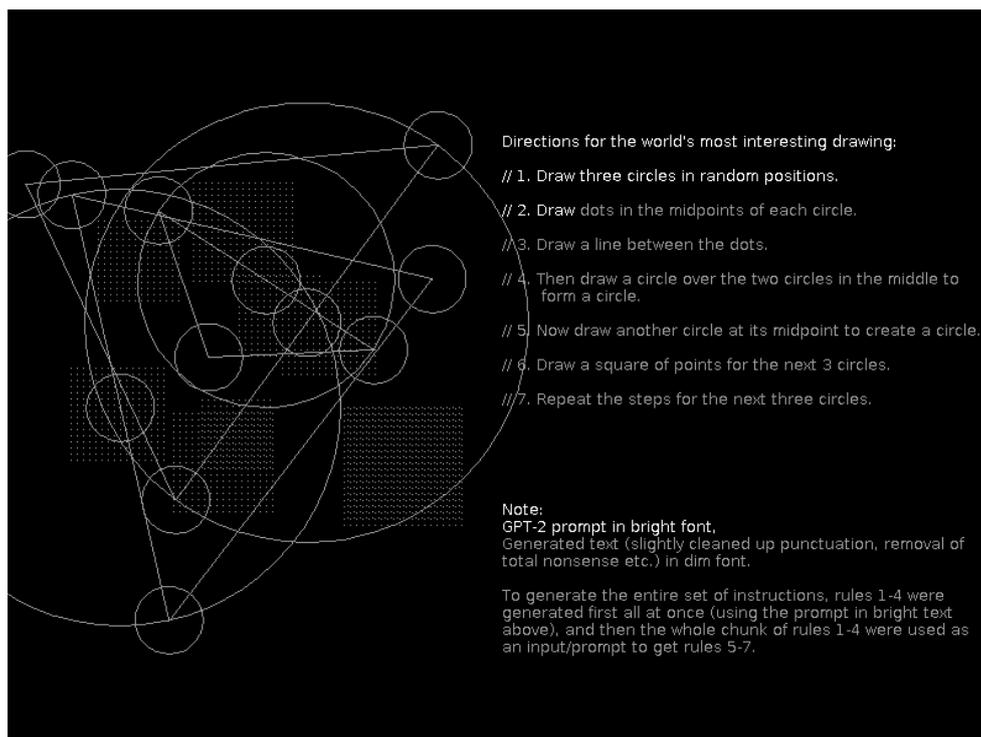


Fig.23. Robbie Barrat (2019) *Directions for the World's Most Interesting Drawing*. Available at: <https://twitter.com/vidodrome/status/1177012430230183937/photo/1> (Accessed 23 August 2021).

Sharing the principle of *GPT-2 Landscapes*, Barrat generates instructions and then acts on those instructions in the manner of a Fluxus Event Score; there are rules to generate the rules to make the art. He first interprets, and if necessary, “completes a sketchy or incomplete instruction” before translating the instructions into another form. The principle of *Directions for the World’s Most Interesting Drawing* is the same as *GPT-2 Landscapes*, but differs in the final part of its process, which utilises the software tool Processing³⁶ to act on the instructions.

³⁶ Processing is a graphical library and integrated development environment (IDE) built for the electronic arts, new media art, and visual design communities: <https://processing.org/> (Accessed: 4 October 2021).

Albena Baeva and Natalia Fuchs: Trust Territories (2021)

Trust Territories (Figure 24) is another project that heavily references Sol LeWitt. On their project website Baeva and Fuchs mention LeWitt's often-quoted aphorism:

"The idea becomes a machine that makes the art." In the context of AI/ML-enabled artworks, LeWitt's "machine" can be understood as an assemblage. *Trust Territories* references Instruction Art from the 1960s onwards, with the definition that, "Instruction pieces are a set of instructions created by the artist for the spectator or performer to follow, or as scores for the owner to reproduce" (Baeva and Fuchs, no date). They make a distinction between the themes of control and manipulation that were explored in the Instruction Art of the 1960s, and *Trust Territories*, which they frame as "collaboration and care". The artists claim that these are new themes, which have been highlighted by the COVID-19 pandemic, bringing human relationships with machines and technology into a new focus. They cite an imperative of physical distancing forcing them as artists to embrace "diverse digital solutions" (no date), asking whether a new collaborative state between machines and humans has evolved.



Fig.24. Albena Baeva and Natalia Fuchs (2021) *Trust Territories*. An instruction generated by GPT-2 realised as an augmented reality artwork. Available at: <https://www.trustterritories.com/> (Accessed 7 August 2021).

Trust Territories employs GPT-2 trained with original artwork-instructions from the 1960s to ‘remix’ new instructions—although Baeva and Fuchs don’t use the term ‘remix’. The GPT-2 outputs are realised as paintings, frescoes and augmented reality. The augmented reality work shown in Figure 24 was produced from the following GPT-2 instructions:

Build a sculpture of a woodchuck on a log\n You’ll need at least two log sculptures, one in your yard and one outdoors. The first sculpture should be about six to eight feet long, have a pointed end, and should be painted a dusty purple. The distance between it and your tree should be at least eight feet. You’ll want to surround the sculpture with a scattering of small twigs so that it doesn’t break your object. Next, put a layer of sandpaper. (no date)

In order to comprehend how the different components of *Trust Territories* mesh together as an assemblage, Baeva and Fuchs were asked via email how they had prompted the GPT-2 language model to generate the new instruction. Was the

prompt itself a product of algorithmic process, or was it imagined? Using the term input rather than prompt, Albena Baeva responded by saying:

The input comes from human imagination. The first thing we tried was using the titles from the original artworks, then we experimented with different phrases that we came up with. For the exhibition the phrases were connected with the process of drawing and sculpture (Appendix B.2).

Keeping with the theme of Instruction Art, Jennifer Walshe has sustained an interest in text scores, utilising algorithms and Markov chains to 'breed' them from pre-existing sources such as Fluxus. Since 2010 she has been compiling a dataset of text scores (limited to English) for machine learning (ML) applications in collaboration with Ragnar Árni Ólafsson. She has released *Text Score Dataset 1.0*, which is comprised of over 3,000 text scores, and has used various natural language generators (NLGs) including GPT-2 to remix them. "Different networks produce different results, even when they are trained on the same dataset, even when primed with the same prompts. Each Machine Learning network gives the results its own 'flavour'" (Walshe, no date, p.9). As a note on copyright, she views the remixed scores as the product of a community, "of a shared avant-garde imaginary in continuous dialogue with itself" (no date, p.10).

Nye Thompson: CKRBT

Nye Thompson describes herself as a creator of artist-software-systems designed to explore a world of connected objects and nascent AI. She uses a combination of gallery installation and online channels to display and record her explorations. The work *CKRBT* (Figure 25) is the latest iteration of a series of works that have developed from what she has described as the “global phenomenon of self-surveillance” (Thompson, 2019).



Fig. 25. Nye Thompson (2019) *CKRBT*. Watermans Art Centre, London. Available at: <https://nyethompson.net/works/theseeker-ckrbt.html> (Accessed: 23 August 2021).

On entering the exhibition, one immediately senses that what is being manifested concerns communication technologies, followed by the realisation that the communication is not being directed towards the gallery visitor; rather it is an expression of a technological inscrutability. In the wider context, as machines are

being trained on visual input from the world, Thompson is curious about what sort of things are being 'recognised', what is being 'ignored', and the terminology used to describe these things. As part of this process, she collected and archived images captured by online agents (bots) from unsecured security cameras. She does this to investigate "the underpinning anxieties and privacy implications, as well as notions of agency and authorship" (2019).

Thompson's *CKRBT* can be understood as an assemblage of interacting components and processes spanning a local area network (LAN) in the gallery and Amazon Web Services (AWS), a cloud computing platform providing access to computers and software services throughout the internet.

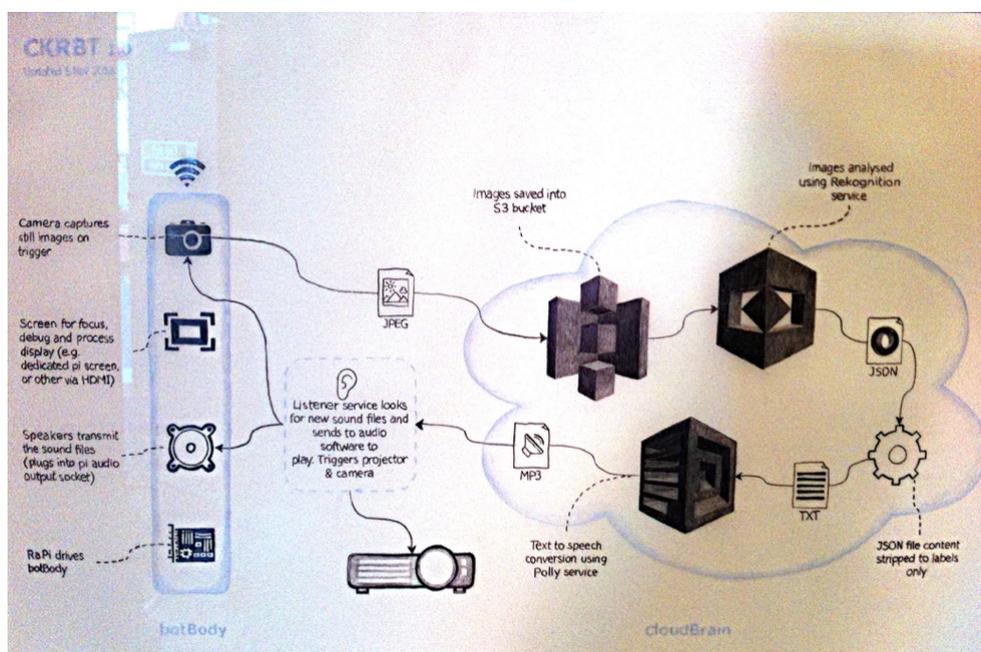


Fig. 26. Nye Thompson (2019). Drawing of *CKRBT* process, Watermans Art Centre, London.
Photo: Bruce Gilchrist.

The three main components of *CKRBT* are designated as “botBody”, “cloudBrain” and “Listener service” (Figure 26), which serves an intermediary function, receiving data from “cloudBrain” and feeding it back to the “botBody”. Data fed back to “botBody” triggers the “botBody” camera focused on a video projection on the gallery wall. The camera captures a still image from the video projection—a montage of unsecured webcam footage the artist has collected. The JPEG file is then transferred to the cloud, which begins a new cycle of live processing between gallery LAN and AWS. The cloud components of the assemblage comprise AWS S3, which provides storage infrastructure for the uploaded JPEGs, which are passed to AWS Rekognition, which provides the image analysis service, the results of which are passed on in the form of a JSON³⁷ file. The JSON file is consequently stripped down and translated into a text file format of the descriptive text labels generated by the Rekognition analysis. The text file is finally passed to AWS Polly, which translates text into lifelike speech in the MP3 format. The sound file is passed out of the “cloudBrain” component into the “Listener service” component in the gallery where it is served to the “botBody”, becoming audible via a speaker and triggering the camera to take the next still from the projected wall video. The representation of the production in this way makes it possible to comprehend the process-flow between all the components.

³⁷ Based on the JavaScript Programming Language, JSON (JavaScript Object Notation) is a data-interchange format designed to be human readable and efficient for machines to parse and generate.

CKRBT, presented at the Watermans Gallery in May 2019, is a more complex arrangement of elements based on a work entitled *The Seeker: Words That Remake The World*, first presented as part of Digital Design showcase, The V&A Museum, London. Thompson describes *The Seeker: Words That Remake The World* as constantly trawling the internet capturing images from unsecured surveillance cameras. The system then employs Amazon's proprietary image analysis software, *Rekognition Image* via an application programming interface (API) to analyse and create labels for the captured images. Amazon Rekognition is an image analysis and image recognition software built on top of deep learning technology and is one of the first cloud-based image analysis services. It enables people, text, scenes, and activities in images and videos to be identified and classified with a text label and is aggressively marketed by Amazon to police, Immigration and Customs Enforcement. Rekognition is perhaps best known for being exposed via Joy Buolamwini's research showing the software's tendency to inaccurately distinguish gender among certain ethnicities (Hardesty, 2018). Disregarding concerns around the efficacy of the technology, Amazon Technologies, Inc. has a patent to pair this software with the Ring doorbell camera.³⁸

³⁸ Available at: <https://patents.google.com/patent/USD798177S1/en> (Accessed: 21 September 2021).

2.6 (In)appropriate Metaphors

The logic of machine learning (ML) is difficult to imagine—for the layperson as well as the expert. The use of metaphor is a proven way of imaginatively ‘inhabiting’ inscrutable spaces. Grba (2021, p.255) has suggested that, to get beyond consuming hype, the general public and institutions need to somehow work towards demystifying and reconceptualising AI to match its technical and conceptual intricacies. One of the most creative ways artists can engage with AI, according to Joanna Zylinka, is to tell better stories about AI by “[m]obilising the tools of imagination, visualisation, narrative, metaphor, parable and irony”, as a way of “blowing some much-needed cool air on the heat and hype around AI” (2020, p.31).

2.6.1 Introduction

Participating in Nye Thompson’s cyber writing workshop provided the seminal intuition that her AI/ML technique was producing a remix in the form of a literary cut-up. This intuition, combined with insights from practical projects and consensus from the CRUMB discussion list theme—“Machine Learning in Art as Remix Technique”—led to a speculative proposal that AI/ML in art is better understood in the context of Remix studies. In order to imagine how an AI/ML system might function as a remix engine, the operations within the latent space of neural networks will need to be conceptualised. However, visualising high-dimensional latent space

(typically around 300–500 dimensions) is an impossible task,³⁹ as latent data is occluded: rather than being directly observed, it is inferred mathematically, another reason why the logic of ML is difficult to comprehend. Before it can be statistically analysed by ML, image or text data has to become machine-readable through its encoding as a vector, which is the most efficient way of presenting data to a neural network. As a way of explaining this to non-specialists, Akten (2016, sec.4.3 Higher dimensions) has presented a comprehensive, high-level lecture on multiple dimensions and transformations as part Gene Kogan's *Machine Learning for Artists* course.

The computational poet Allison Parrish uses the term “language-vectors” to describe the pairing of language with numerical values in latent space in such a way that the semantic meaning of the word is somehow recorded within the vector (Bell, 2019, sec.Working With Word Vectors). Vector space is being perceived as a “new cultural technique”, currently being explored in the field of Digital Humanities, which studies “vectorialisation through which our collective knowledge is invisibly rendered and processed” (Joler and Pasquinelli, 2020).

³⁹ A form of visualisation is T-Distributed Stochastic Neighbour Embedding (t-SNE), an ML algorithm for data visualisation, which is based on a dimensionality reduction technique. The algorithm maps multi-dimensional data to two or three dimensions where the neighbourhood relations of datapoints are preserved. An in-depth description of t-SNE can be found in the original article: https://lvdmaaten.github.io/publications/papers/JMLR_2008.pdf (Accessed: 6 April 2021).

2.6.2 The Mechanics of The Autoencoder

Implicit in the process of vectorialisation is the autoencoder, a type of neural network where the inputs and outputs are the same, but in the hidden layers, the dimensionality is progressively reduced to obtain a more dense representation of the data (Figure 27). Autoencoders are described as learning models that manipulate 'closeness' of data in the latent space (Tiu, 2020). There are many different types of autoencoders, with different numbers of hidden layers designed for different problems, from facial recognition to acquiring the semantic meaning of words, but essentially the architectural principle is the same, and for this research it is the principle that is key.

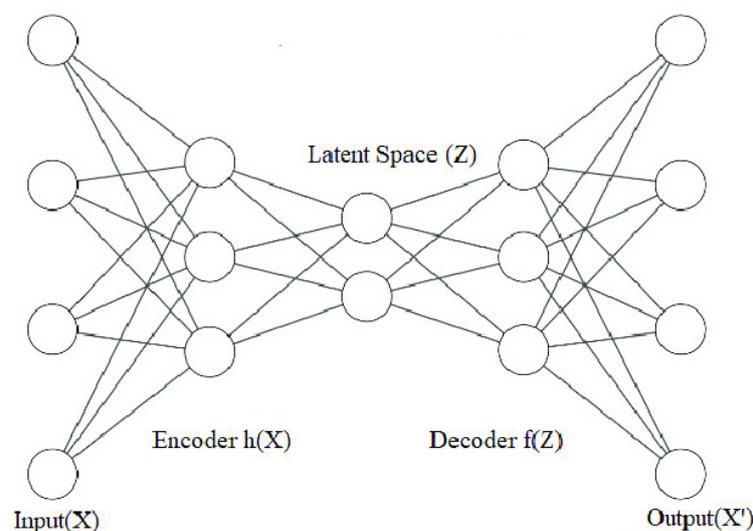


Fig.27. Wei et al. (2020) Variations in Variational Autoencoders–A Comparative Evaluation.
DOI: 10.1109/ACCESS.2020.3018151

In "A Literary Theorist's Guide to Autoencoding", Peli Grietzer (2019)

outlines a literature theory based on how AI/ML systems process literary corpus. He makes an analogy between the mechanics of an autoencoder and the way artists

make facsimiles or imitations of the world. The input channel of the autoencoder takes data such as text or images, which the encoder function turns into, in Grietzer's terms, "short summaries", in the form of vectors, which populate the latent space as a representation of compressed data where statistical analysis is carried out. An output channel attempts to reconstruct (decode) from the information in the "short summaries". The operation aims to match the decoded reconstruction as closely as possible to the data before it was encoded. During the training stage, the accuracy of the reconstruction is measured by an optimiser function that then "applies a formula that slightly revises the specifics of [the] method of summary and reconstruction to slightly improve [the] future accuracy on this input" (2019, para.2). The optimiser function reviews the results and calculates small adjustments aimed at making the next summary-and-reconstruction cycle produce more accurate reconstructions, and the entire process repeats itself. The process typically loops for up to several million rounds, and concludes when the procedure can't be improved by any more small adjustments. AI researchers refer to the process of iterated small adjustments as "gradient descent".

When the researcher turns off the optimiser function, the model is considered to be trained. Grietzer conceives of the autoencoder's latent space, or "feature function" as he calls it, as the "worldview" or "conceptual scheme"; the decoder or "projection function" as "mimesis". The concept of mimesis is employed as the encoder process is in general extremely lossy—information is discarded during the

encoding phase to reduce dimensionality. Therefore, during the decoding phase, that which was initially discarded has to be extrapolated back into existence somehow as part of the “projection function”.

There is a technique for manipulating data in high-dimensional vector space referred to as a *latent-space-walk*, which is frequently conceptualised by authors and commentators as *morphing*. To address the third research question—can AI/ML in art be considered a remix technique?—the remainder of this section focuses on why morphing is a misleading and inappropriate metaphor and proposes a productive alternative.

2.6.3 The Latent-Space-Walk

The principle of the latent-space-walk is similar for both image and text-based models. In describing his project, *A Book from the Sky*, which explores the latent space of a neural network trained on a database of Chinese characters, Gene Kogan offers the following explanation:

Rather than simply exploring the neighbourhood around individual characters, we can span the latent space between characters as well. By producing samples along a straight line from one character to the next, we get an impression of imaginary characters which are interpolated from in between real ones, perhaps corresponding to semantically intermediate concepts (2015).

In the same project, Kogan describes characters in transition as ‘gliding’ into forms and positions. The deep learning engineer Julien Despois also uses the term *interpolation*, defined in Merriam-Webster as a process of calculating an appropriate value based on values that are already known. Despois describes two images from a dataset in linear interpolation, which effectively “blends the images in a kind of ghostly way” (2017).

The latent-space-walk as a *moving image* technique was brought to the attention of the gallery-going public in London and the art press via Pierre Huyghe’s exhibition *Umwelt* at the Serpentine Gallery in 2018 (Figure 28). Terms and expressions used in press articles (The Guardian and New York Times) to describe the latent-space-walk in *Umwelt* were varied and included “shifting AI images”; “prodigious collages”; “flow of evolving dreams”.



Fig.28. Pierre Huyghe (2018) *Umwelt*, Serpentine Gallery. Available at: <https://thequietus.com/articles/25633-pierre-huyghe-umwelt-serpentine-review> (Accessed: 30 August 2021).

A term that is frequently used to describe the latent-space-walk is “morphing”: “Klingemann then combines the results obtained into videos showing multiple featureless faces seamlessly and dreamily morphing into one another”, (Zylinska, 2020, p.80). An article in The Guardian reported the same work by Klingemann, describing an aspect of the work where “human faces morphed by the machine flow by on screen” (Jones, 2019). RunwayML, a team of artists, engineers, developers and researchers who are developing a commercial platform to deliver AI/ML technology, have a ‘Latent Video’ webpage where they offer to “morph generated images into videos.”⁴⁰ In these examples, due to a lack of appropriate lexicon with which to discuss relatively new processes, the actual mechanics of the autoencoder is superseded by the mechanics of the morph.

2.6.4 The Mechanics of The Morph

Manuela Naveau has raised a topic concerning conceptual obsolescence surrounding emerging technology by asking: “Is technology what we have learned about?” (2020, sec.47:21). She refers to the occasions when outdated conceptual frameworks are forced into service, consequently restricting a user’s comprehension of new phenomenon. She uses the example of the pocket calculator as a *closed* system—something trusted for being precise and correct—the familiarity of which is

⁴⁰ RunwayML invites users to “morph generated images into videos”. Available at: <https://app.runwayml.com/modelcollection/latent-videos> (Accessed: 6 August 2021).

projected onto something relatively unknown, an *open* system for instance, that 'learns' from input data (autoencoder). The suggestion is that there is a propensity to project old ideas onto new things in the face of unfamiliarity. This habit becomes apparent when the morphing metaphor is used to provide a conceptual bridge to understanding the specific complexity of AI technology in the form of the latent-space-walk.

The basic concept behind morphing has been around for several centuries (Wolf, 1999). In the early 1500s, Albrecht Dürer discovered that he could account for a wide variation in head and facial structure by applying and manipulating lines of proportion: moving and rotating their angles relative to one another (Figure 29). Through these explorations, Dürer revealed the underlying similarities between facial structures and sketched out methods of transforming one into the other based on mathematical ratios.

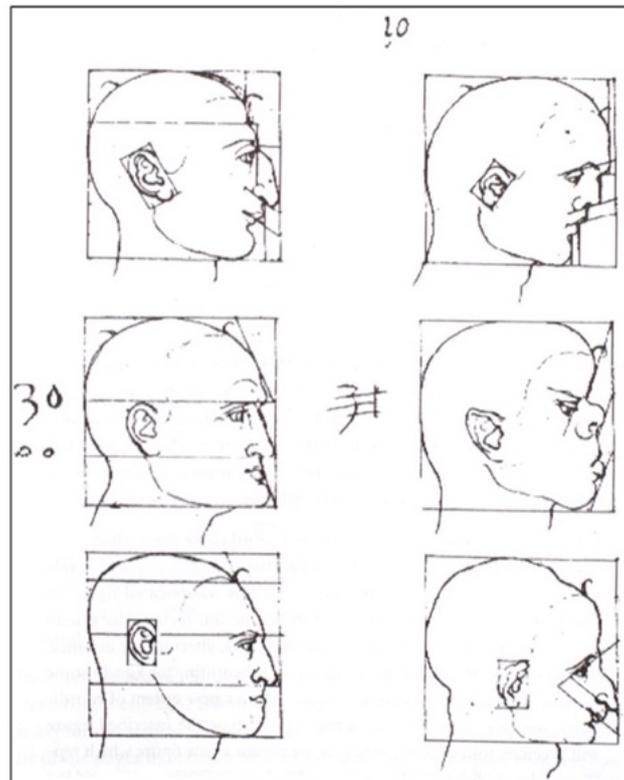


Fig.29. Albrecht Dürer, 'The Human Figure' from *The Complete Dresden Sketchbook*. Image source: *Metamorphing: Visual Transformation and the Culture of Quick-Change*, ed. Vivian Sobchack, 2000 p.85, Figure 5.1.

Thus the idea of correspondences between different forms became the core idea of morphing, which René Descartes was able to mathematically express through algebra and geometry over a hundred years later. Descartes's "Geometria" introduced the idea of a system of Cartesian coordinates, which enabled the locating of lines and points on a two-dimensional grid: "The Cartesian grid mathematised space and allowed for a precise expression of the manipulations of geometric forms within it" (Sobchack, 1999, p.84). Fast forward to the early 1980s and morphing begins to be explored using computers to bring coordinate-based morphing into the third dimension. These techniques became commonplace

following the establishment of digital imaging in the early 1990s when pictures became grids of pixels open to mathematical deformation and warping.

Although offering a similar surface appearance of effect, the latent-space-walk departs from the morph in its mechanics at a basic structural level. Whether a digital image with an underlying structure of gridded pixels, or a book with its structure of words, syntax, paragraphs and pages, the process of feeding data to an autoencoder necessitates marshalling media into lists of numbers. The morph, on the other hand, depends on the continuity and legibility of the Cartesian coordinate system, enabling an object to reshape and transform itself into another object in full view of the audience through an 'elastic grid of pixels'. In direct contrast, in preparation for a latent-space-walk, a grid system is unwrapped, and through its unwrapping, the latent-space-walk's transformations in time become inscrutable. Furthermore, unlike the morph where the 2d or 3d grid functions as a framework for elucidation, the rationale of the latent-space-walk becomes unknowable as the algorithm itself has determined so much of the process automatically, in ways that are not human-readable.

2.6.5 Re-Mixing Metaphors

The complexity and speed, indeed the profound otherness, of these algorithms requires a significant speculative leap—or act of fictioning—to allow us to form any kind of image of them (Reeves-Everson, 2017, p.43)

Metaphor is regarded as a strategy by which language divests itself of its function of direct description and is variously theorised. In a recent hypothesis (Surovtsev and Syrov, 2015) declare that the primary effect of metaphor is simply to “capture imagination” as a way of creating new meaning. They discuss the potential of metaphor in the processes of cultural production, where “it must be assumed that through metaphor the common feature is created rather than explicated.” Finding a way of “capturing imagination” becomes critical when conceptualising an inscrutable space such as an autoencoder.

The term remix has come to be used as shorthand for human creativity, as an “explanatory metaphor that illuminates the connectedness of knowledge and expression” (Borschke, 2016, p.90). Contemporary remix and remix culture are associated with digital practices and artefacts, and as such, are associated with cut-copy-paste technologies. According to Adema (2018), writing about the history of the Cut-Up, the different types of media, technology, and materials that people have been able to access and use have played a central role in the development of cut-copy-paste practices. In this regard, the latent-space of AI/ML—considered as a remix engine—is a continuation of the story of cut-copy-paste practices predicated on access to vast datasets. How then can the cut-copy-paste metaphor still relate to the mechanics of the autoencoder?

The cut-copy-paste metaphor was created initially from a user-study by Larry Tesler (2012) during the development of the word processing program, Gypsy in

1975 at a Xerox Palo Alto Research Centre. Users in the study wanted the machine to mimic the creation and editing tasks they performed on paper. Technological development involving copying and replicating media by companies such as Xerox has meant a departure from physically cutting apart and splicing to create original forms of media, towards less physically destructive methods of manipulation. The cut-copy-paste commands were further popularised by Apple and led to wider development of remix practice. Adema's essay "Cut-Up" (2018) demonstrates how this has directly influenced various technology-art experiments with combinatorial poetry, text generating initiatives and machine writing. However, when attempting to imagine operations within latent space through the descriptions given by Grietzer, Kogan and Despois, their use of terms such as "glide", "blend" and "interpolate" seem fluid and elemental compared with the rigid mechanical procedures of cut-copy-paste, as illustrated in Larry Tesler's "The Intuitive Typewriter" (Figure 30).

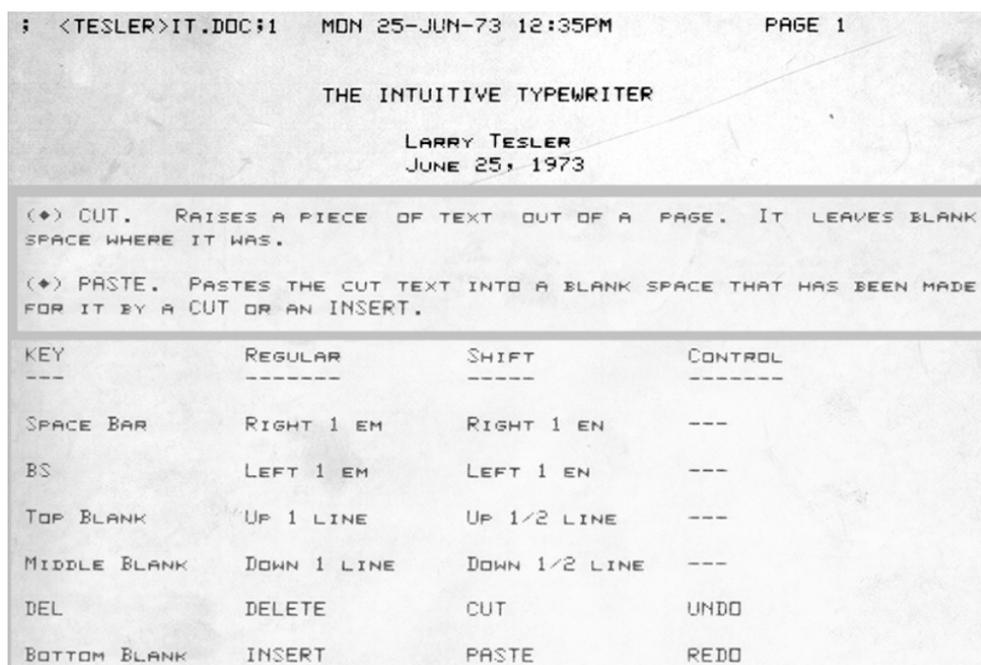


Fig.30. A lecture slide by Larry Tesler introducing the cut and paste concept from his presentation, 'Modeless Interaction Techniques for text Editing' for *Interaction Techniques*, CMU HCII (2014). Available at: <https://www.cs.cmu.edu/~bam/uicourse/2014inter/lecture07.Tesler.pdf> (Accessed: 11 May 2021).

With the rudimentary high-level overview of the autoencoder in mind (Section 2.6.2), and considering ways that artists are increasingly engaging with AI/ML tools to make art, the following question was posed to the CRUMB discussion list:

With the emergence of and increasing access to new tools and techniques that can repurpose and manipulate material in unprecedented ways in the making of 'new' work, the terms associated with remix resonate strongly. However, there is an implicit understanding that the cut-copy-paste metaphor has become redundant. So how are these types of operations to be thought about in high dimensional vector space? (Appendix C.1).

xline burrough shares a similar view, when considering her own practice with AI/ML in relation to remix, she says:

While I do think of these projects as remixes, I don't think of them, strategically, as efforts in "cut, copy, and paste" (which sounds very physical). I tend to think of artworks in their formal and conceptual dimensions (Appendix C.4).

When the artist Katja Novitskova discusses her work, she talks about making distinctions between the virtual and the physical through the gradient or spectrum rather than oppositions (or cutting), where the virtual and the physical "kind of melts into each other", and where there is a "spectrum of analogue codes becoming digital" (Kay, 2013). Similarly, at The Photographers' Gallery *Data/Set/Match* exhibition (2019), Zac Blas evoked the gradient when he talked about "dialling reality up and down" with reference to adjusting the 'weights' of an image generation model, "before it cohered into recognisable patterns."⁴¹ Likewise, when processing two different datasets of text with a Markov chain generator, the 'influence' of each can be adjusted by 'dialling up or down' through numerical input at the command line interface (CLI).

In these examples, allusion is being made to metaphorical governance via potentiometer or slider. As an AI researcher—in the process of administering a latent space—imagines the increasingly fine-grained, iterative improvements of an autoencoder's optimiser function as a "gradient descent", artists use similar

⁴¹ Gilchrist, B. (2019). In: informal notes taken at The Photographers' Gallery digital programme *Data/Set/Match*. 30, November.

metaphorical language to blend together the physical with the virtual, analogue with the digital, abstract with the real.

In addition, Julia Kaginskiy introduced ideas of optical metaphors via the CRUMB discussion list that distort and warp “as if seen through a funhouse mirror” (Appendix C.7). As part of the same discussion, Julia Kaginskiy and Libby Heaney (Appendix C.8) both made reference to “diffraction” (Figure 31) as a counterpoint to reflection metaphors—which mirror sameness—for AI/ML and natural language processing (NLP). This draws on theory by Donna Haraway, which Karen Barad has expanded: “diffraction is marked by patterns of difference” (Barad, 2007, p.71), making the point that diffraction maps the effects of where differences emerge. For Kaganskiy, this is:

reminiscent of the way ML models spatially map information according to categorical similarity/difference—perhaps we can say that AI-art does not so much ‘remix’ material as ‘diffract’ it, or filter it through ‘diffraction patterns’ produced through the process of categorization (Appendix C.7).

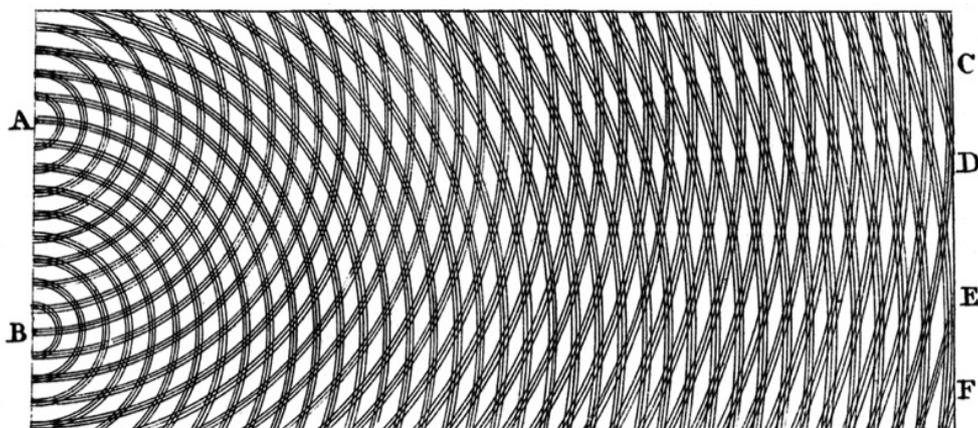


Fig.31. Thomas Young's sketch of two-slit diffraction presented to the Royal Society in 1803.
Image source: Public domain.

The metaphorical use of diffraction patterns resonates with the idea of words inhabiting semantic clusters or neighbourhoods, both bound and separated by the similarity and difference codified in vectors. According to Libby Heaney, an artist with a background in quantum computing, unconventional artistic use of ML algorithms can “diffract canonical histories and stories into strange new forms”, challenging dominant narratives by enhancing hidden patterns in algorithms (Appendix C.8).

This kind of optical metaphor for AI/ML is also found in the work of Matteo Pasquinelli and Vladan Joler, where they explore the rise of statistical models as instruments of knowledge magnification that enables a human perception of patterns and correlation between things over massive amounts of data. They make an analogy between this form of knowledge magnification and science and technology’s history of optical instruments in the fields of astronomy and medicine, perceiving AI/ML as a “Nooscope” (from the Greek *skopein* ‘to examine, look’ and *noos* ‘knowledge’).

They go on to suggest that “[t]o understand machine learning and register its impact on society is to study the degree by which social data are diffracted and distorted by these lenses” (2020, para.4). However, the metaphor employed in *Nooscope* can also be interpreted as *refraction* when they say: “the information flow of machine learning is like a light beam that is projected by the training data,

compressed by the algorithm (...) towards the world by the lens of the statistical model" (2020, para.6).

Unlike diffraction, the physics of refraction describes how refracted light is subject to bending because of speed change due to encountering difference in the refractive index of materials—passing from air to glass for instance (Figure 32). As described previously (Section 2.6.2), the decoding phase of the autoencoder reconstructs the compressed data through a form of mimesis. The missing data (from the lossy encoding process) is synthesised from the "short summaries" to match the input as closely as possible. In this way *refractive index* becomes a metaphor for the *computational economy* of an autoencoder's encoding-decoding functions.

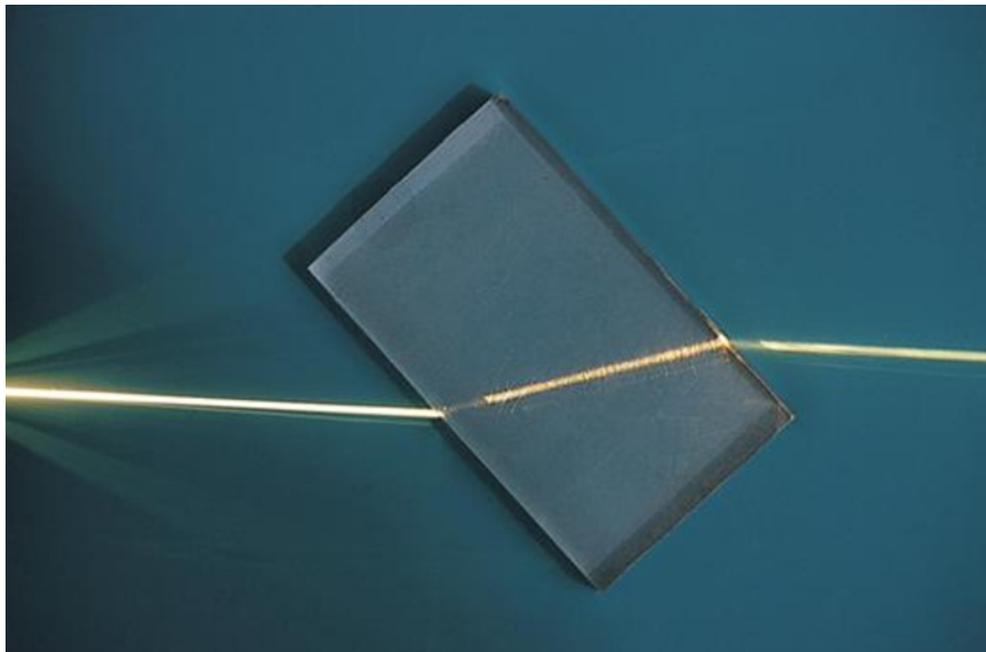


Fig.32. Refraction of a light ray through a glass slab.

Image source: https://commons.wikimedia.org/wiki/File:Refraction_photo.png Public domain.

2.7 Anxiety of Influence: Appropriation and Copyright

This section considers the concept of appropriation in art and the implications of copyright in relation to an AI/ML training dataset.

Appropriation has long existed as a strategy within art-making (Navas et al., 2018, p.15). Isabelle Graw makes the definitive statement, “[a]ppropriation is a precondition for artistic work” (2004, p.45), and locates the historical roots of appropriation art in the Renaissance period, where “appropriation became organised in the crucial institution of the teacher-pupil relationship” (p.45). In the classical academic study of art, when a teacher instructs the artist to copy the work of another, it is considered a preparatory study, which will be replaced by original work in the artist’s own hand. By appropriating an image by copying it, the intention is to *internalise* the knowledge contained in the image.

It was not until the postmodernist questioning of the importance of authorship and originality that this system of values was challenged, in what Frederic Jameson refers to as quotation culture, “[the] creating subject gives way to the frank confiscation, quotation, excerptation accumulation and repetition of already existing images” (Foster, 2002, p.53). In her essay “Dedication Replacing Appropriation” Graw describes the moment where “the model of the strong subject that creates something new using its own resources” was superseded by “[a] model of appropriating, parasitic behaviour” (2004, p.45). Influenced by Walter Benjamin’s essay “The Work of Art in the Age of Mechanical Reproduction” (1934),

appropriation art evolved among certain American artists during the 1970–80s: Sherrie Levine, Louise Lawler, Cindy Sherman, and Richard Prince, among others explored "processes of quotation, excerptation, framing, and staging" (Crimp, 1979, p.87). They appropriated original media in the tradition of Dada and Pop while in dialogue with critics who were developing a concept of appropriation as critical and subversive. Graw cites a definition of appropriation art, still under the critical subversive emphasis, as "re-coding" or a "shift in meaning", which means that "a shift in meaning takes place purely due to the fact that an original image has been appropriated" (2004, p.59). By the end of the 1980s, it became necessary to distinguish between 'good' and 'bad' appropriation as so many artists had become involved. This criticality led to differentiation between appropriations of style and material, whereby material appropriations were accepted and those of style rejected. It is interesting to consider the history of appropriation art in relation to AI/ML-enabled art systems as the parameters of the material-style distinction have undergone a form of reversal. For example, an appropriated Foucault corpus fed to a neural network to build an ML language model is reconstituted from vectorialisation through 'mimesis'. It is familiar in its altered state purely through a distilled sense of Foucault's style, with much of the original material discarded during the lossy process of encoding.

The complex tensions alluded to here between appropriation, citation, and originality can be found in Harold Bloom's *The Influence of Anxiety: A Theory of*

Poetry (1975), which describes the influence of deceased precursor poets' legacies on the practice of living poets. The living poets fear they are at risk of producing derivative work that sits too close to the precursor work on which they've trained themselves. An analogy can be made between the training dataset of an AI/ML system and the precursor poets described by Bloom—the *anxiety* experienced by the living poet is equivalent to the *uncertainty* around the copyright status of things rendered by the AI/ML remix engine. The outputs of an AI/ML-art system are often based on the work of others, often without their consent.

The question of whether AI-generated output should be protected by copyright is not straightforward: it brings together technical, legal, and philosophical questions regarding creativity, authorship and originality. As far as the Creative Commons organisation is concerned, "AI needs to be properly explored and understood before copyright or any intellectual property issues can be seriously considered" (Vézina and Moran, 2020, para.12). There also remains significant legal uncertainty about whether copyright applies to AI/ML training. For this research project, seventeen volumes of Michel Foucault were used to train a GPT-2 model. None of these works is in the public domain and will not be for another 33 years. According to Creative Commons, in considering whether or not copyright applies to the situation of this research:

(...) it may not always be clear whether a CC license applies. In other words, there is no consensus on whether the use of copyright works as inputs to train an AI system is an exercise of an exclusive right (e.g., reproduction,

adaptation, etc.). The situation is likely to vary across jurisdictions, as countries progressively regulate the copyright-AI nexus. In the US, the use of works to train AI is likely considered fair use. In the EU, Article 3 of the Directive on Copyright in the Digital Single Market (DSM) provides an exception for non-commercial text-and-data mining (TDM, a form of AI) by research and cultural heritage institutions, while Article 4 offers an exception regime for commercial TDM, from which rightsholders may opt-out (Vézina and Hinchliff Pearson, 2021, para.3).

The outputs from this research are non-commercial, and if considered as a form of data-mining will be subject to legislation as part of the Digital Single Market (DSM) and non-commercial text-and-data mining (TDM). Since Brexit, the UK remains subject to these regulations (Carville, 2020).

2.8 Significant Findings From Contextual Review

In chapter 3 a number of practical projects will be described in detail and reflected on. The first project, *A is for Asteroid*, is informed by an encounter with an artist's work as part of the contextual review, which produced a speculation that the use of AI tools in art making could be considered as a remix technique. This speculation led to a review of the historical transformation of the list into the dictionary form (3.2.2) as a way of considering the importance of indexicality. The observation that visualisations of neural networks in the form of DeepDream are linked to notions of associative thinking and human automaticity (Khan, 2018) has been combined with a

dictionary information structure in *A is for Asteroid* to manipulate a key Surrealist text.

Further contextual review revealed the work of the poet and programmer Allison Parrish and the Belgian i-literature workgroup, Algolit, which introduced language generation algorithms that were explored in the project *Office_Composing_Machine_* (3.3).

The discovery of a Cambridge University PhD paper researching human-action-recognition algorithms (HAR) (3.1.2) and critique of the AI research field by artists Crawford & Paglen, Crawford & Joler, Max Dovey, and AI researchers Johnson & Verdicchio informed a number of practical projects (*Synset_Gloss*; *No_m_oN*; *Idling-in-the-Unreal*), which focused on the creative use of HAR. The discovery of HAR has also been central to the development of the assemblage approach (2.5.5).

A review of the work of artists Robbie Barrat, xtine burrough, Nye Thompson and Albena Baeva & Natalia Fuchs has informed the perspective of an assemblage approach (2.5.5), which, through the three practical projects mentioned above, meshes different processes together in the production of artworks.

The discovery of Peli Grietzer's *Theory of Vibe* (2017) during the contextual review was pivotal to apprehending a high-level appreciation of a neural network's latent space. From this understanding the research has been able to consider the

operation of a language generation algorithm as a remix engine and the site of algorithmic remix as described by Anderson (4.4.2).

A way of considering the dynamics of AI-enabled interactivity in the final project (3.7) was promoted through a review of a number of theories of interactivity, including Alan Peacock's "Domain of Engagement", Joan Solar-Adillon's "perceived interaction" and "emergent communication", and Ernest Edmonds' "influence" concept of interactivity in order to foreground a link between surveillance and interactivity (4.3).

3 PRACTICAL PROJECTS

3.1 Introduction to Practical Projects

Two significant factors from the contextual review influenced thinking and making of the practical projects—an encounter with an artwork that gave rise to the speculation that AI/ML in art can be considered as a form of remix technique (3.1.1), and the discovery of human-action-recognition (HAR) algorithms, and the video datasets used to train them (3.1.2). Having learned that there was very little (if any) artistic work focused on human-action-recognition, this became the direction of the research.

3.1.1 An Encounter with an AI/ML Artwork

A survey of contemporary artistic uses of AI technology was carried out as part of the contextual review. The review resulted in a binary perception between artists active in the AI-art space—those referred to as the Google affiliated DeepDream cohort, and a looser grouping of independent artists who demonstrate a more critical approach. The latter grouping provided a point of departure for the practical work, specifically Nye Thompson and Crawford and Paglen. It was a participatory encounter with Nye Thompson's project, *The Seeker: Words That Remake The World* (2018), as part of the exhibition *Artificially Intelligent* at the V&A curated by Irini Papadimitriou, that proved to be a primary catalyst for practical projects. The

encounter with Nye Thompson's artwork initiated a response to the third research question described in section 1.2—Can AI/ML in art be considered as a remix technique? The manner of this response has previously been outlined in section 2.8.

Nye Thompson's project was developed around access to unsecured webcam streams. Her process involved presenting webcam footage to Amazon Rekognition, an image analysis and image recognition software built on top of deep learning technology and one of the first cloud-based image analysis services. Using Amazon Rekognition, people, text, scenes, and activities in images and videos can be identified and classified with a text label. Thompson has described her response to using the software in an interview for Studio International:

(...) there was one image that was just a picture of a small dog sitting on a pavement, with some flowers, some grey walls and so on. I ran it through a commercial image-recognition system and (...) it came back with descriptions such as "battleship", "aeroplane", "warplane"—all of these really super-militaristic terms. Obviously, this technology isn't perfect and clearly it gets things wrong, but it really reminded me that all the really big, cutting-edge development in machines learning to look at the world and analyse it, is all coming from the military. It's coming from homeland security, and it's all built around threat detection. So, although I was using a commercial service, it made me think of this bleeding of a paranoid machine gaze into the general public domain (McNay, 2019).

As a satellite project to *The Seeker: Words That Remake The World*, visitors were invited to participate in a cyber-writing experiment, working with a designated still-image from the webcam stream.



Fig.33. Nye Thompson (2018) *The Seeker*. Postcard from *New Dreamers* cyber-writing workshop showing webcam still-image. Digital Design Weekend, V&A Museum, September 2018.

The still-image (Figure 33) was associated with a list of text labels printed on the reverse of the postcard. The labels were generated from the Rekognition image analysis of the webcam still image:

Human People Person Birch Flora Plant Tree Backyard Outdoors Yard
Oak Sycamore Alley Alleyway Building City Road Street Town Urban
Path Trail

According to the workshop brief, participants were instructed to “collaborate with AI to create a unique cyborg narrative.” Personally, on looking at the postcard still-image (Figure 33), there was a spontaneous evocation of an image from personal memory. Context and objects were mapped to produce a blend between the webcam still-image and the memory image. A short descriptive sentence formed around the memory image, which was typed word-for-word into the white spaces between the Amazon Rekognition labels to produce a nonsense text (Figure 34).

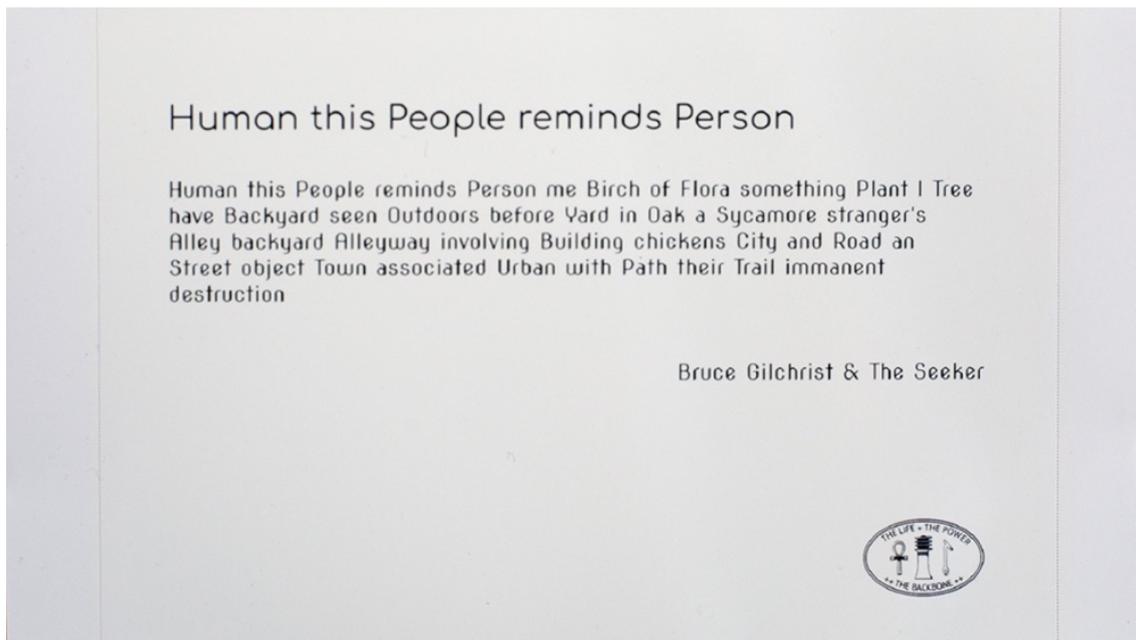


Fig.34. Nye Thompson (2018) Postcard from *New Dreamers* cyber-writing workshop showing nonsense text. Digital Design Weekend, V&A Museum, September 2018.

The Rekognition text labels—as a product of AI/ML analysis—represent the operations of an artificial memory attempting to function as a register of something

real. Human memory elicited a sentence as a register of something remembered—another source text—which was spliced and merged with the Rekognition labels as a cut-up: a combinatorial act that conflated artificial and biological memory. The nonsense text became a metaphor for the ‘messiness’ of forgetting and half-remembering, where language is perceived as something shifting and malleable.

3.1.2 Pantomime Violence

An introduction to the work of Crawford & Paglen has been influential in that it has helped to respond to the first research question described in section 1.2—How can AI/ML be combined with a poetic strategy to enable the making of an artwork? This has been achieved by contributing to the development of the assemblage approach (2.5.5) in the form of a human-action-recognition (HAR) algorithm as one of the components.

HAR aims to automatically examine and recognise the nature of action from unknown video sequences. Due to the growing demand for automatic interpretation of human behaviour, HAR has caught the attention of both academia and industry. Analysing and understanding a person’s behaviour is fundamentally required for various applications such as video indexing, biometrics, surveillance and security. This research field acknowledges that ambiguities in recognising actions come from the difficulty of defining the motion of body parts and many other challenges related to real-world problems. “Many public datasets are

unrealistic and recorded in controlled environments such as fixed and uniform backgrounds with static cameras” (Jegham et al., 2020, p.10). “There has been little research work in the real-world conditions of human-action-recognition systems” (p.1).

The approach to conducting artistic research on HAR began with discovering a Cambridge University PhD paper outlining “a real-time drone surveillance system to identify violent individuals in public areas” (Singh, Patil and Omkar, 2018). It is trained on datasets of “violent behaviour” with the proposal to be deployed in drone-based surveillance systems to detect and isolate violent behaviour in crowds (Figure 35).

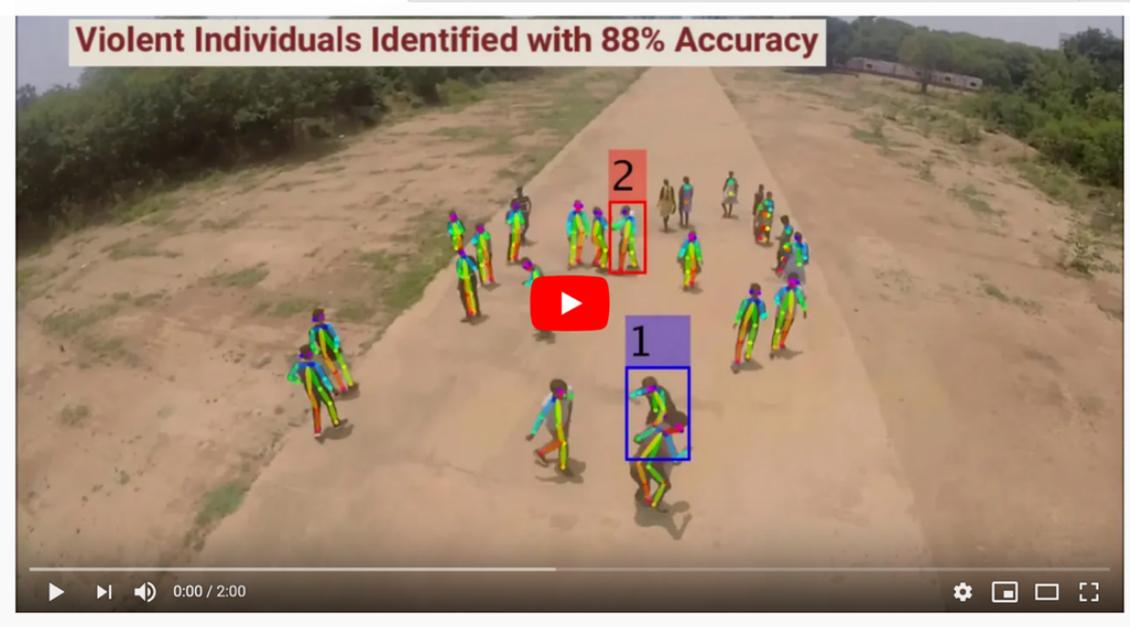


Fig.35. *Eye in the Sky: Real-time Drone Surveillance System (DSS) for Violent Individuals Identification.*
Available at: <https://www.youtube.com/watch?v=zYypJPJipYc> (Accessed: 6 August 2021).

The Cambridge research created the Aerial Violent Individual (AVI) dataset, consisting of 2,000 videos of people engaged in violent activities. However, due to

the relative scarcity of appropriate material on the internet, the video footage has not been obtained from the wild. Instead, the 'violent behaviour' has been performed by 25 male volunteer subjects between the ages of 18–25 years (Figure 36).

The 'violent individuals' mimic violent acts in the AVI dataset, which remains unpublished. Scrutiny of the YouTube video makes it clear that the volunteers are not particularly skilled in the art of physical performance—they are too hesitant, stand too far apart, make sluggish, exaggerated gestures with no physical contact. There is a world of difference between explosive real-life violence and the kind of mimetics involved in the training dataset. The researchers claim the technology can spot stabbings, shootings, and brawls, however civil libertarians are warning that software like it is error-prone and could lead to mass surveillance (Melendez, 2018).



Fig.36. The violent activities from the AVI dataset: (clockwise from top) (i) Strangling, (ii) Punching, (iii) Kicking, (iv) Shooting and (v) Stabbing. Image source: 'Eye in the Sky: Real-time Drone Surveillance System (DSS) for Violent Individuals Identification using ScatterNet Hybrid Deep Learning Network', Figure 1, (Singh et al 2018).

3.2 Project #1: A is for Asteroid

3.2.1 Summary

A cursory survey of the history of the dictionary form shows how indexical function has become associated with the list, transforming the list into an information model. The evolution of the list into early forms of dictionary in the seventeenth century was coincident with notions of the book as something that was still materially negotiable. This introduced the idea of working with an information model in the form of a Python dictionary to remix a text.

3.2.2 Introduction: From Lists to Dictionaries

While still under the influence of Nye Thompson's cyber-writing experiment—a ferment of ideas of aleatoric and recombinant culture—an invitation was received to produce an artwork for live radio broadcast on Resonance 104.4 FM, in collaboration with the improv-music-ensemble, Asteroid, in November 2018. Further thinking around the cut-up form led to devising a method to remix a text using a simple computational method. *The Magnetic Fields*, a collaboration between André Breton and Philippe Soupault in 1919 and considered the most vital of the automatic texts of Surrealism was used as a source text. For this project, the first chapter of *The Magnetic Fields*—'The Unsilvered Glass'—was used in

combination with a JSON file of Sci-Fi movie titles⁴² to create a dictionary written in the Python programming language.

The literary cut-up has early-modern roots, much before Kathy Acker, William Burroughs and Brion Gysin and the historical avant-garde experiments of André Breton and Tristan Tzara. The literary cut-up can be traced back to the practice of compiling scrapbooks, or “commonplace books” used for information management, pedagogical tool, memory aid and aspirational device. Whitney Trettien identifies what she calls remix practices in the seventeenth century by studying the cut-and-paste “biblical harmonies” (a way of reordering and harmonising the story of Christ's life) made by the Anglican women of Little Gidding during the 1630s (Trettien, 2012). Early modern books were material forms that invited their physical remaking: books were purchased unbound, prompting readers to rearrange and personalise them. As Adam Smyth has argued, the book was still “materially negotiable” (2013, p.9).

Commonplacing in the early modern period was an approach to reading and writing that involved the transformation and redeployment of value through the remixing of texts. Conversely, at the level of the word, this expression of media flux coincided with attempts to stabilise the English language, initially through the device of a list, a fundamental way of classifying and ordering information.

⁴² The Sci-Fi movie titles dataset was sourced from the data-science resource Kaggle. Available at: <https://www.kaggle.com/> (Accessed: 4 October 2021).

The inaugural form of the English dictionary was Richard Mulcaster’s *Elementarie* first published in 1582 (Figure 37), and comprises a list of 8000 words. The *Elementarie* attempted to standardise language by setting down some spelling rules such as using an “e” to distinguish between words like “mad” and “made”. However, none of the words are accompanied by definitions, and so the list cannot be classified as a dictionary, but instead marks the beginning of an attempt at organising the English language.

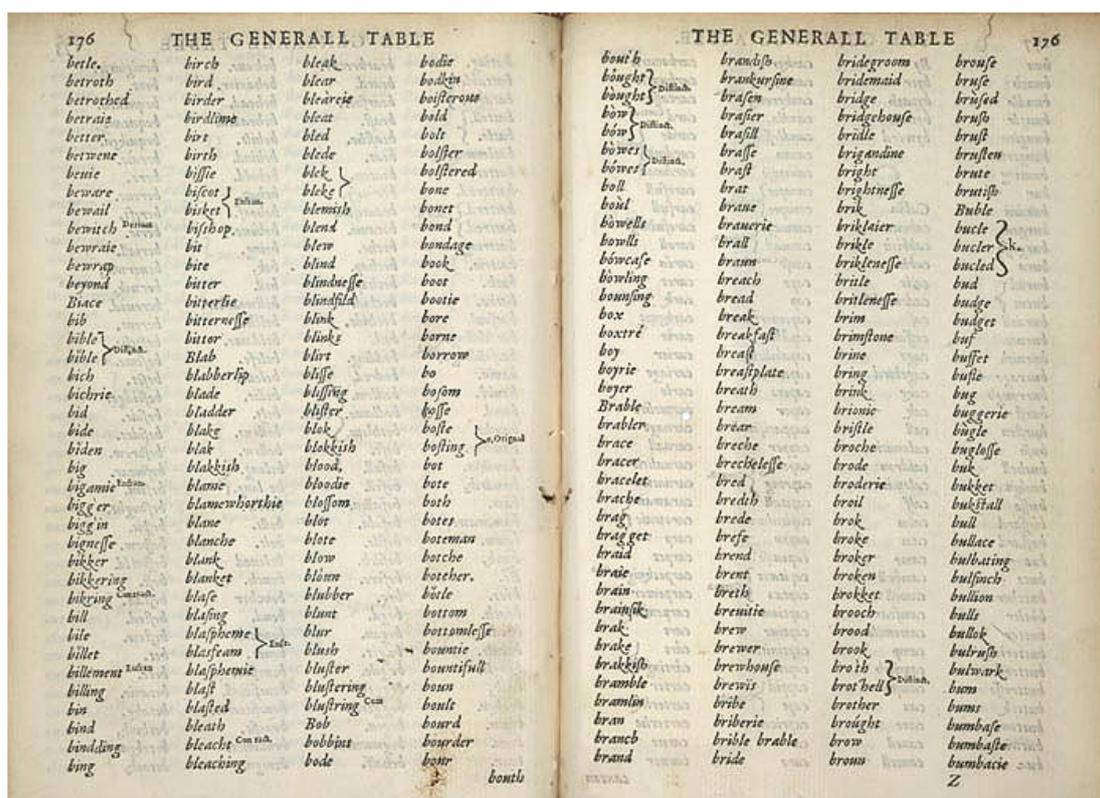


Fig.37. Mulcaster's *Elementarie* (1582). An early attempt to make English language and culture more respected and accessible. Available at: <https://www.bl.uk/collection-items/mulcasters-elementarie> (Accessed: 23 August 2021).

The *Elementarie* was superseded by Thomas Blount's *Glossographia* (1656), which introduced word definitions and explorations of etymology. Nathan Bailey's

Dictionarium Britannicum (1730) was larger and more comprehensive than the *Glossographia*, including names of people and places, etymology drawing on Greek, Hebrew and Latin and advice on pronunciation. Bailey's dictionary-making conventions paved the way for Samuel Johnson's *Dictionary of the English Language* (1755), which included over 114,000 quotations, the first work of lexicography to use citations in this way, and set a benchmark for future dictionaries.

Early dictionaries' development shows how the index function became associated with the list, transforming the list into an information model with transformative potential. From Mulcaster's *Elementarie*, which simply listed words in current use and set down rules to standardise spelling, to Johnson's *Dictionary of the English Language* whereby looking up a word creates access to various inter-relationships among data.

The history of the dictionary form suggested the idea of working with an information model in the form of a Python dictionary as a way of remixing "The Magnetic Fields". A Python dictionary consists of a collection of key-value pairs. Each key-value pair maps the key to its associated value. The following represents the dictionary data structure written in Python:

```
d = {  
    'key': 'value',  
    'key': 'value',  
    'key': 'value',  
    'key': 'value',  
    'key': 'value',
```

```

.
.
.
'key': 'value'
}

```

Replacing the *key* with a word from 'The Unsilvered Glass' chapter of *Magnetic Fields*, and replacing *value* with data from the JSON file of Sci-Fi movie titles, the key-value mappings become:

```

d = {
'do': 'and you thought your parents were weird',
'kind': 'rock monster',
'square': 'the survivors',
'burning': 'velocity trap',
'rather': 'plague',
.
.
.
'weakness': 'trancers 5: sudden death'
}

```

The dictionary data structure is similar to that of a list in that it is a collection of objects, but dictionaries differ from lists primarily in how elements are accessed. Whereas list elements in Python are accessed by their position in the list via number indexing—each element in the list is assigned a number—dictionary elements are accessed via keys. In other words, the value 'velocity trap' from the example above

is accessed by looking up the key 'burning'. This is still indexical, but rather than accessing through numbers as in a list, *values* are accessed through *key* words.

3.2.3 Project Method

Another chapter from *The Magnetic Fields*—'Eclipses'—was fed through the Python dictionary to produce output. The Python script looked up each word from 'Eclipses' in the dictionary keys, and if a match was found the corresponding dictionary value was returned. However, if no matching key was found—because that particular word in the 'Eclipses' chapter was not present in the 'The Unsilvered Glass' chapter—the unpaired word from 'Eclipses' was returned and became part of the final output. (See Appendix A.1 to see a code snippet).

The final text output was given to the Asteroid improv-music-ensemble in advance of the live radio broadcast, which they used to design strategies for their improvised performance. Voice synthesis allowed the text to 'speak', and this was layered over the music improvisation during the live broadcast.

3.2.4 Reflections On Project Method

Drawing from the field of Translation Studies, the output from the Python dictionary has been considered in terms of equivalence to both source language (SL) and target language (TL). Roman Jakobson has described three methods of interpreting language signs: intralingual, interlingual and intersemiotic, and it is the first method

that is relevant here: “Intralingual translation or rewording is an interpretation of verbal signs by means of other signs of the same language” (1959, p.233). The translation operation of the Python dictionary is understood as *rewording*, where words from the ‘Eclipses’ chapter considered as source language (SL) are reworded by the indexical operation of the Python dictionary, considered as the target language (TL). Although this procedure appears to have the constitutive SL and TL of Translation Studies producing the effect of one text translating into another text, the product of the Python dictionary cannot be considered translation or interpretation in any meaningful way. Translation Studies defines *translation* as “the replacement of a text in the source language by a semantically and pragmatically equivalent text in the target language” (House, 1977, p.29). Both translation and interpretation involve working with the context of language; words are seen as a “linguistic reality placed within semiotic facts and cultural dimension” (Sharma, 2018, p.212). Considering that the exchange between SL and TL involves evaluating semiotic and other contexts to enable translation and interpretation, anything beyond the simple rewording operation in the Python dictionary cannot be regarded as analogous to translation as it is appreciated in Translation studies.

Referencing C.S. Peirce’s diagram of Intersemiotic Translation,⁴³ the rewording operation of the Python dictionary is depicted as a diagram of triadic relations (Figure 38). The diagram shows the correlations between a word from the

⁴³ C.S.Peirce’s diagram of Intersemiotic Translation sourced from Queiroz and Aguiar (2015) Fig 7.3.

'Eclipses' chapter functioning as source text, channelled to the output via the Python dictionary as the target text.

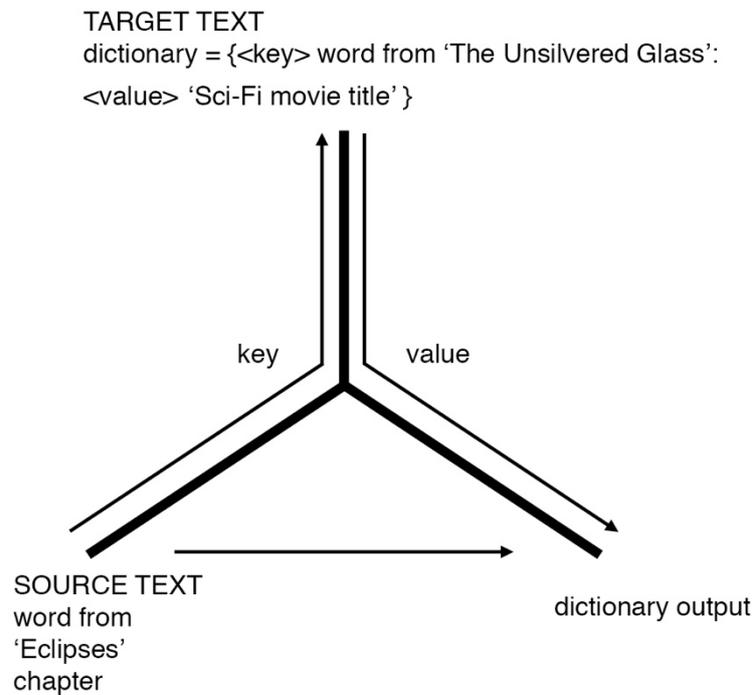


Fig.38. Triadic diagram of *A is for Asteroid*.

3.3 Project #2: office_composing_machine_

3.3.1 Summary

In response to Project #1 that produced text stripped of former semantic context, a new technique was sought to produce more coherent texts. A Markov chain generator in combination with a Twitterbot and an Instagram account was used to remix text corpora and images.⁴⁴ Anticipating pandemic induced work-from-home

⁴⁴ Twitterbots and Markov chain generators are part of an established generative language practice by artists and poets and theorised in a thesis by Matthew Plummer-Fernandez (2019).

regimes, the intention was to explore the automated juxtaposition of photographs of empty offices with machine generated text—both of which signal the absence of human workers.

3.3.2 Introduction

Contextual review introduced the work of Allison Parrish, a computer programmer and poet who teaches at NYU's Interactive Telecommunications Program. She researches art-making with language and how it is used and arranged in the context of computation and the Internet. She is a prominent member of Algolit, a Belgian workgroup that research i-literature, free code and texts. Algolit is based on the principles of Ouvroir de Littérature Potentielle or Workshop for Potential Literature (Oulipo) formed in 1960 by the novelist and poet Raymond Queneau, to investigate "artificial restriction in literature." Brotchie (1997, pp.ix-x) explains that as an Oulipian term, *restriction* means a constraining method, or system or rule that is capable of precise definition.

Both Algolit and Parrish have applied the principle of potential literature made from constraint to look at the use of statistical machine learning models and archival materials for literary writing. The "constraining method" is supplied through the use of a Markov chain generator—an algorithm that generates language from a corpus text by employing randomly determined (stochastic) methods to scan a corpus text for the probability of next word occurrences. This operation produces

transition probability tables, which can be computed without semantic or grammatical natural language understanding.

3.3.3 Project Method

A is for Asteroid created a continuous string of text, with each word in the string removed from its former context in a senseless juxtaposition. The *office_composing_machine_* project aimed to produce a more coherent text while exploring the cut-up concept as part of a poetic strategy. Markov chain generators have the potential to mix multiple sources in creating text models, from which texts can be automatically generated with parameters that can be ‘dialled up and down’ to modulate the influence between sources.

The Twitterbot was used to automatically post scheduled texts created by the Markov chain generator via the Developer API made available by Twitter and was broadly understood as an *artbot*, “small, experimental, absurd, subversive, and characterful—and yet interoperable with larger systems” (Plummer-Fernandez, 2019, p. 50). Two text datasets were used to train the Markov chain generator sourced from Kaggle.com—an online community of data scientists and machine learning practitioners who find and publish datasets. Reddit posts self-labelled “sarcastic” by users, and posts from Stack Overflow—a question and answer website for professional and enthusiast programmers—were used. The text datasets

were used in accordance with Kaggle's Terms and Conditions that asks that its services are used for personal, non-commercial use.

An Instagram account combined with an automated Python script was used to find and download images with the hashtags #office, #composing and #machine. The project eventually focused on photos taken by Instagram users of empty offices and office equipment with the appropriation being understood as *fair use*, generally interpreted as copying of copyrighted material for a limited and 'transformative' purpose. Since 1990, standards have been introduced that have become the norm concerning decision-making around fair use, where the core guiding concept is *transformative purpose*—"whether the new author was using copyright-protected material for a different purpose than the one for which it was originally placed on the market or designed" (Aufderheide, 2018, p.87). Under UK copyright law, fair usage is commonly referred to as fair dealing, or free use and fair practice. As an exception to British copyright law, fair dealing is a legitimate defence if the use is for the purposes of research or private study (The British Library, no date, para.10).

Someway into the process however, it became apparent a mistake had been made using the "Sarcasm on Reddit" dataset, which contains 1.3 million comments extracted from Reddit containing the \s (sarcasm) tag. Redditors often use this tag to indicate that their comment is *in jest* and not meant to be taken seriously, and is generally considered a reliable indicator of sarcastic comment content.

3.3.4 Reflections On Project Method

It soon became apparent that the Markov chain generator output reproduced the bias found on Reddit by generating abusive and discriminatory (racial and sexual) speech. Due to the size of the dataset, this prejudiced content was hidden from view, a mistake that is typical of the ideology of data extraction, which treats data as an inert substance free of context and politics, an attitude which can cause a host of problems downstream.

Interestingly, Eleuther, a new open source project being built to match OpenAI's latest GPT-3 language model, has stated it is avoiding sources like Reddit that are more likely to include dubious material. Eleuther claims it is going to great lengths "to curate a dataset that is both well filtered and diverse" (Knight, 2021). Due to the toxic aspect of the Reddit dataset the *office_composing_machine_* project was abandoned, but not before learning how to successfully utilise Markov chain generator scripts, a technique that is put to use in project #3.

3.4 Project #3: Synset_Gloss

3.4.1 Summary

The Cambridge University PhD paper (Section 3.1.2) led to further discovery of the mimetic performances of machine learning (ML) researchers in a University of Texas at Dallas (UTD) lab, video-recording themselves performing actions to train a human-action-recognition (HAR) system. The UTD training videos were fed to an

established HAR system trained on the Kinetics 400 dataset extracted from YouTube. The resultant classifications from the HAR analysis were often inconsistent with the intentions of the researchers in the UTD lab. As a way of capturing the discrepancy between the intent of the mimetics and the HAR classification, Python programming was used to develop a method to generate enough language from the elicited classification labels so that a Markov chain generator could be employed to produce coherent sentences. The Markov chain generator was then brought into association with a more sophisticated 'learner', which was prompted by the generated sentences to produce substantial blocks of text. The final text outputs were then re-associated with action on a video timeline.

3.4.2 Introduction: A Multimodal Human Action Dataset

The unpublished dataset of Singh et al referred to in Section 3.1.2 instigated the search for something similar: a video dataset made with mimetic actions. The search led to the University of Texas at Dallas (UTD), where a dataset has been created as part of research on HAR and made available online for other researchers in the field.⁴⁵ There is an emphasis on the multimodal method used to capture the movement data via a Kinect sensor and a wearable inertial sensor. The emphasis is due to the economy of the low cost of production and relatively low computational

⁴⁵ The University Texas at Dallas (UTD) Multimodal Human Action Dataset contains 27 actions performed by 8 subjects (4 females and 4 males). Each subject repeated each action 4 times. Available at: <https://personal.utdallas.edu/~kehtar/UTD-MHAD.html> (Accessed:14 April 2021).

power of real-time data manipulation. However, there is no discussion regarding the efficacy of the performed actions in terms of ‘teaching’ a machine to ‘recognise’ human actions in the wild. There is no consideration of how accurately the UTD dataset reflects the researchers’ intentions and what vulnerabilities the system might expose when parsing human actions outside the lab. This lack of consideration constitutes a potential *AI Blindspot*, defined as “oversight in a team’s workflow that can generate harmful unintended consequences”, and which “can occur at any point before, during, or after the development of a model” (AI Blindspot, 2019).

To explore how a machine trained using examples from the wild would respond to the UTD video dataset with its mimetic actions (Figure 41), I obtained the ResNet model—a HAR neural network—from Adrian Rosebrock, PhD. The model was trained on the Kinetics 400 video dataset, which contains 400 human action classes with up to 1150 video clips for each action, extracted from YouTube. The HAR was stimulated with the UTD video dataset (Figure 39), with the HAR often misclassifying. It became evident that the HAR tended to parse the constituent parts of actions then classify each part over the whole—a “bowling” action would be interpreted as “front raises”, “side kick”, “jumpstyle dancing”, “juggling soccer ball”, “squat”, and “lunge”. The clip was never classified as “bowling” because videos of people bowling are not present in the Kinetics 400 training dataset. Also, the software does not have the capacity to assimilate the micro-movements into a

gestalt of meaningful human action. The documentation of this process has been assembled and made available as a video (Video 1).

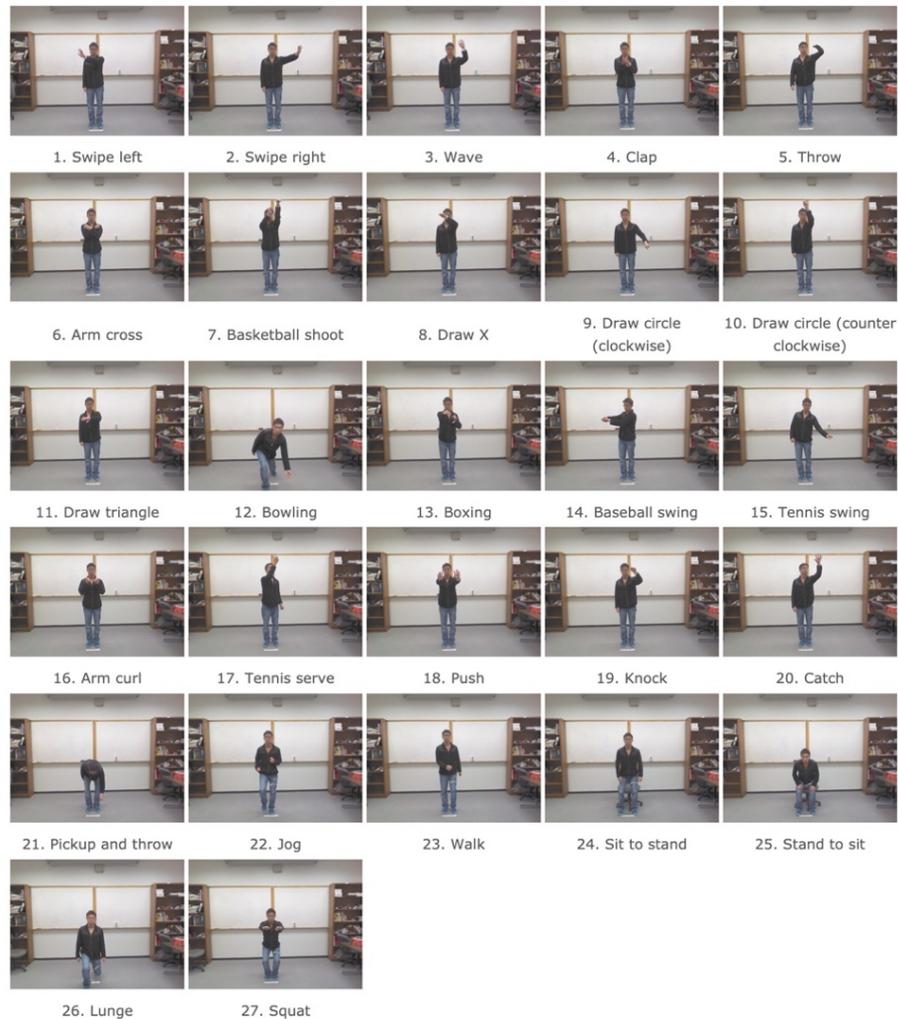
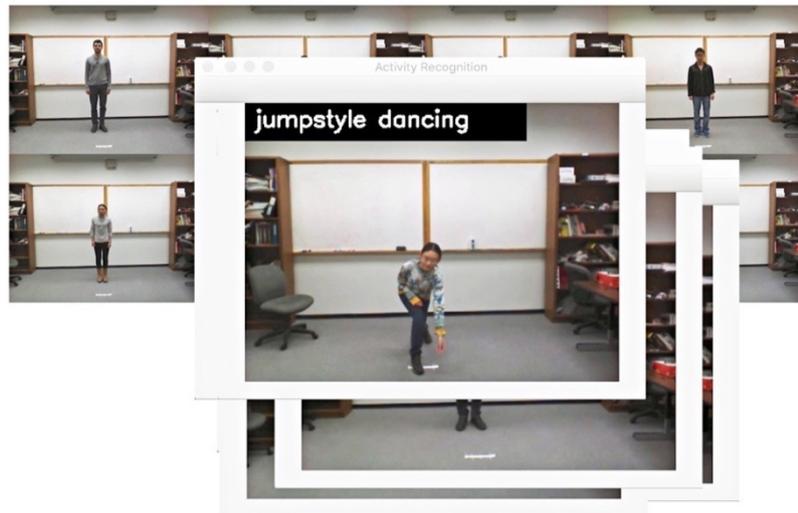


Fig.39. Video stills from the UTD dataset depicting the 27 designated actions. Available at: <https://personal.utdallas.edu/~kehtar/UTD-MHAD.html> (Accessed: 14 April 2021).



Video 1. Bruce Gilchrist (2020) *Bowling*. Development video for *Synset_Gloss*. Available at: <https://bit.ly/3GAFbEo> (Accessed 19 March 2022).

3.4.3 Project Method

The OED defines *mimicry* as "the action, practice, or art of mimicking or closely imitating the manner, gesture, speech, or mode of actions and persons, or the superficial characteristics of a thing."⁴⁶ In the classical definition, mimesis shows rather than tells through an enacted representation (Davis, 1999, p.4). It is the potential relationship between showing and telling, the process by which showing becomes telling, that is explored in this project.

The *showing* is considered as the mimetic actions portrayed in the UTD video clips, and the *telling* is considered to be the results of the analysis by the ResNet HAR model in the form of text labels (Figure 40).

⁴⁶ "mimicry, n." *OED Online*, Oxford University Press, June 2021, www.oed.com/view/Entry/118659. Accessed 6 August 2021.



Video 2. Bruce Gilchrist (2020) *Searching*. Development video for *Synset_Gloss*. Available at: <https://bit.ly/3qxLbs4> (Accessed 19 March 2022).

The documentation of this process has been assembled and made available as a video (Video 2). The labels produced in this way were further processed by a Markov chain generator, the output of which was used to stimulate a trained natural language generation model (GPT-2), which had been trained on seventeen volumes of Michel Foucault.

Consideration of the contemporary manifestation of power in the form of social media data, data analytics, and perpetual algorithmic evaluation evokes Foucault. The HAR analysis of human action in footage is an attempt to predict human behaviour, and as AI becomes increasingly integrated with CCTV, it will constitute a new form of surveillance power.⁴⁷ This form of power expressed through data is perhaps the most significant kind of power that has arisen since

⁴⁷ For an overview of the real-world challenges of vision-based HAR systems, see: *Forensic Science International* (Jegham et al., 2020).

Foucault's death in 1984. In *The History of Sexuality Volume 1*, Foucault discusses "biopower" for the first time in print. This form of power was designed to subject the population to "precise controls and comprehensive regulations" and became an "indispensable element in the development of capitalism" (1998, pp.137–141).

Foucault is not known for having engaged the idea of biopolitics with modern media. However, his description of the "phenomena of population" being adjusted to "economic processes" (p.141) is an apt description of Platform Capitalism and the economic imperatives implied within the containment measures of contagion (coronavirus) administered through track and trace apps and vaccine passports.

Foucault's emphasis on the relationship between power and the body, and considering the critique that AI/ML, in general, fails to account for existing power dynamics, it seemed appropriate to build a training corpus from his oeuvre.

The project method was developed through the use of several PIFs, the process of which provided insight into image misclassification (see Appendix 1: Three Examples of Image Misclassification). The final PIF used was *Coughs and Sneezes* (1945) directed by Richard Massingham, which provided the means to stimulate the HAR to produce text.

The labels initially produced by the HAR analysis were also used to direct a selection of representative YouTube and Vimeo video clips. These clips were superimposed with the simple rule that every other frame would be from the original PIF to produce a flicker effect. This process was carried out by manually

searching for video clips online that had been tagged using the exact label text produced by the HAR analysis. The *Synset_Gloss* (Video 3) workflow is summarised in Figure 42.

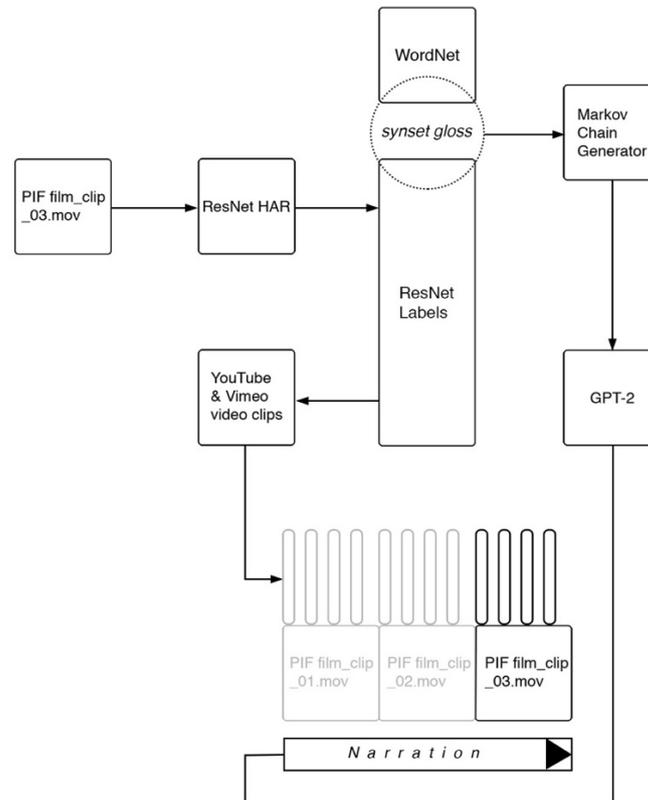
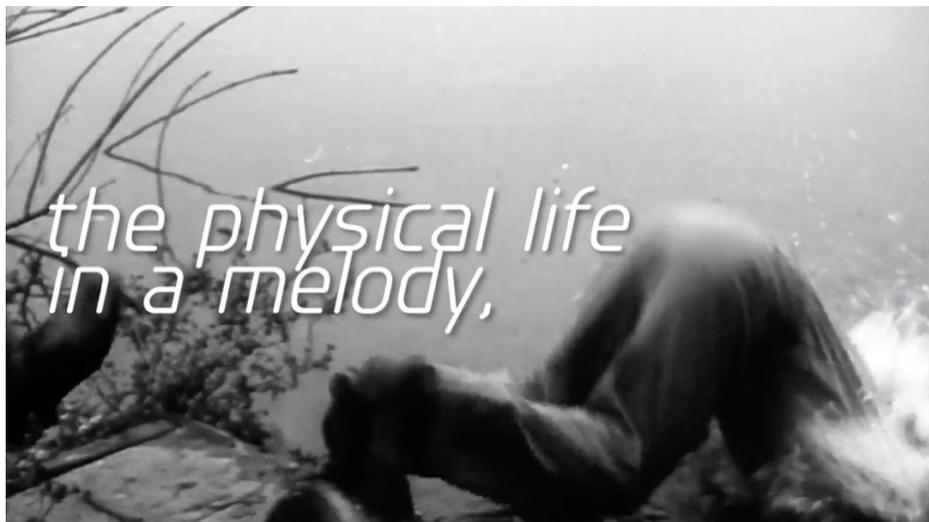


Fig.42. *Synset_Gloss* Workflow.



Video 3. Bruce Gilchrist (2020) *Synset_Gloss*. Available at: <https://bit.ly/3rjx5cM> (Accessed 19 March 2022).

3.4.4 Reflections on Project Method

In the neural network, the neurological exercise involved in natural seeing and interpreting is broken down into discrete, jittery steps (...) in order to give rise to an interpretation (Khan, 2018, p.69)

Synset_Gloss confronts training data by utilising the often erroneous inferences of the HAR algorithm. Frequent misclassification exposes a problem of human-action-recognition and machine learning in general—how can what has been ‘learned’ be mapped onto novelty? A person looking at the public information film will perceive flowing images co-existing with an unfolding narrative. Things never seen before are assimilated and understood. However, when analysed by the HAR model and classified with a label, different textuality emerges (Section 1.1). As Carvalhais et al. have explained (Section 1.5), as a result of being trained via supervised machine learning, the model detects information patterns represented within a predefined data collection. In the context of the HAR model, this can be understood as a kind of search function that only detects actions inherent in a dataset. The HAR model has not been programmed to declare that the images within the film footage do not register with the limited ‘worldview’ of its training dataset—there is neither null nor void. Therefore, through analogical reasoning, it adheres to the principle of the ‘nearest neighbour’, and finds the closest match from the labelled examples of the training dataset (Section 3.4.2).

3.5 Project #3: No_m_oN

3.5.1 Summary

This project employs motion capture (mocap) files from a Carnegie Mellon University (CMU) database. A seven-minute animation was made within the constraints of the mocap library, working exclusively with files that used the descriptive terms "conversation" and "quarrel" in their file names. The animation skeletons of the digital human puppets were re-targeted with the mocap files in a series of animated gestures that begins in "conversation" and ends in "quarrel". Once constructed, the animation was subjected to the same method of text generation that emerged through the making of *Synset_Gloss*. The technique has been used to produce poetic registers between states of cooperation and aggression by inviting the question: when does one category become the other, and how is this transformation rationalised by the machine?

3.5.2 Introduction

A proposal for a public-facing performance was developed, *Real People* (2019) (Figure 43), described as an act of participatory data-gathering. *Real People* was imagined as an exercise, where error—slowly introduced into a system—would amplify iteratively to create a gradual cascade of movement through generations of description and enactment. Performers' movements would be recorded and

collected as a database of mocap files. The intention was to use the database to creatively interact with the HAR somehow.

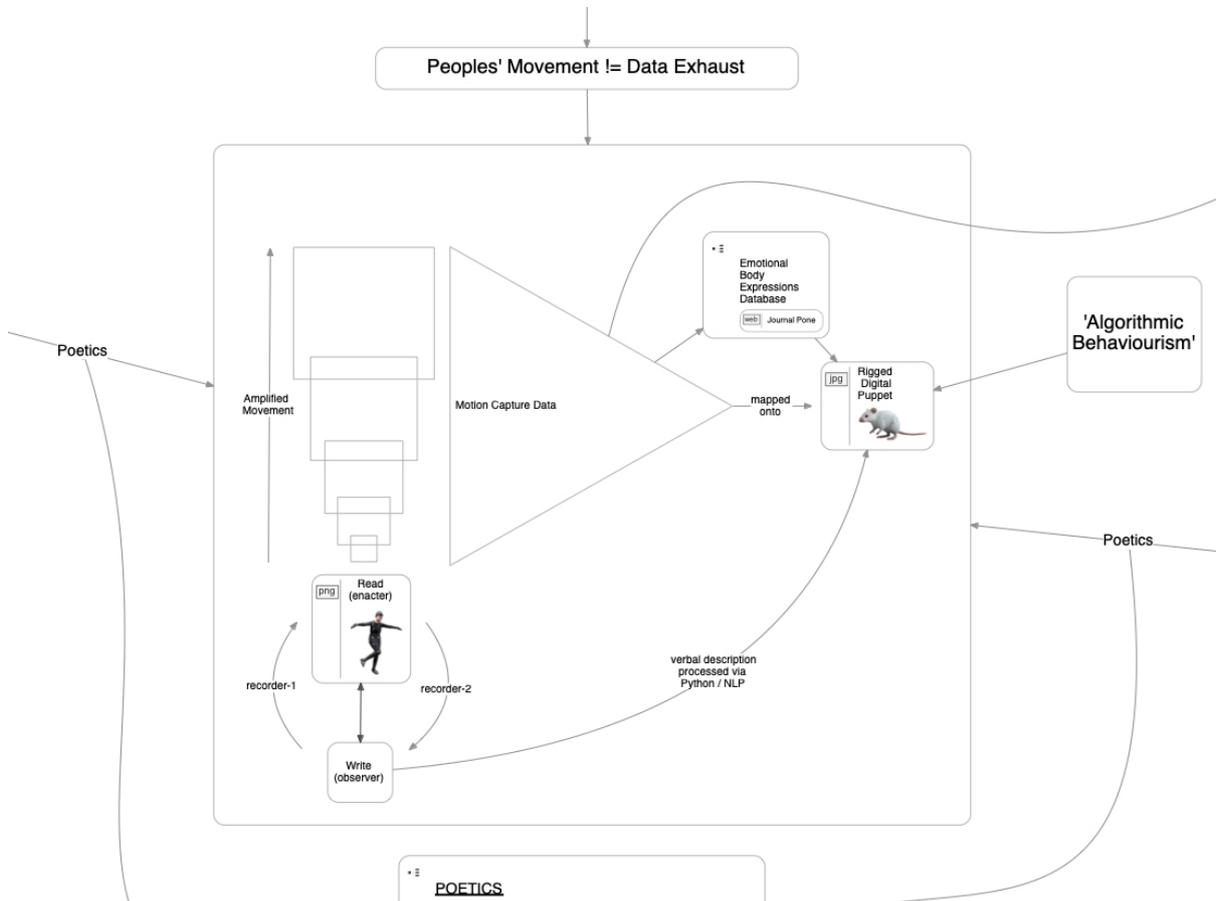


Fig.43. *Real People* (2019). An extract from a schematic for an unrealised proposal.

Real People was in part inspired by the Moravec Paradox, sometimes simplified by the phrase: “[r]obots find the difficult things easy and the easy things difficult” (Losey, 2017, para.1). This expression alludes to how computers are good at high-level logic problems, which require relatively little computation, but poor at emulating basic human sensorimotor skills like moving and looking, which require relatively large amounts of computation. The Moravec Paradox relates to how the unconscious role of the body’s sensorimotor abilities—while shaping our awareness

and imagination—also hints at a much deeper, complex knowledge system within the body, which has yet to be understood and lies beyond the computational paradigm.

In early 2020, social restrictions were imposed in the UK in response to the coronavirus pandemic. *Real People* became untenable; therefore, mocap data available online was used to continue with the practice-based research. Although mocap seems like a recent technology, the artist Alan Warburton reminds us that it has a long history. The first motion registration system to fix tracking markers to a person's body was introduced by Disney at New York's World Fair in 1964.

According to Warburton:

The material history of mocap data is cloudy: we don't know who created these motions, when they were made and for what purpose. Did they improvise? Who cleaned up the data? Who paid their salaries, or were they even paid at all? (2016).

The mocap files sourced from the CMU database are subject to the kinds of uncertainty alluded to by Warburton, which suggested that the data, once targeted to a digital human puppet, should be approached as a form of anonymous 'found footage'. The mocap files designated "quarrel" and "conversation" represent behavioural categories within a complex biological product—humans. Increasing surveillance and mediation by computer vision machines (augmented by AI/ML) necessitates the breaking down and categorising of human behavioural complexity

depicted in footage. The most pertinent question is: at what point does one category become the other when viewed and rationalised by the machine?

3.5.3 Project Method

Once the puppets' animation-rigs were re-targeted, and scenes designed and lit, the animations were finally rendered in 3D software and assembled in a video editor. The same procedure as the *Synset_Gloss* project was followed, except that the video of mocap animations replaced the PIF. The video was assembled from several sequences, with each sequence driven by a different mocap file from the "conversation" and "quarrel" categories. The text output from the HAR analysis was curated for the 'best fit' in terms of how it related to the action on screen. Once the text was finalised it was vocalised synthetically as an audio file and rendered as part of the final animation (Video 4).



Video 4. Bruce Gilchrist (2020) *No_m_oN*. Available at: <https://bit.ly/3KiZZTd> (Accessed 19 March 2022).

3.5.4 Reflections On Project Method

Through the principle of the *Synset_Gloss* method being applied to the *No_m_oN* project (Figure 44), it can be seen that the core components common to both projects are:

- 1) ResNet HAR generates text labels from analysis of human action in video.
- 2) A Python script associates the ResNet HAR labels with WordNet to produce the synset gloss—an ‘amplification’ of language to produce a small corpus of text.⁴⁸
- 3) A Markov chain generator produces sentences from a small corpus of text.
- 4) A GPT-2 language model generates several semantically coherent chunks of text that forms the narration to the video track.

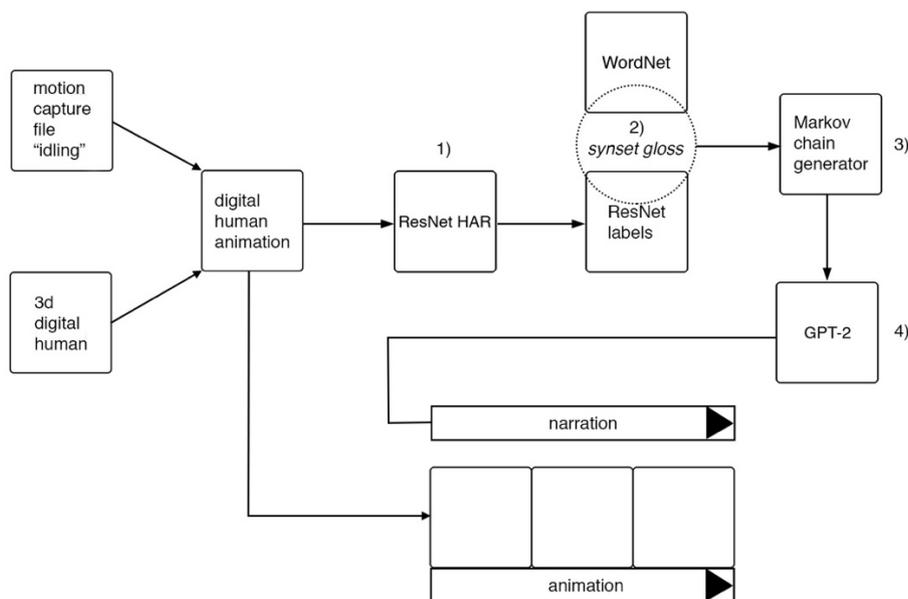


Fig.44. *No_m_oN* workflow.

⁴⁸ In WordNet, synonyms are grouped into unordered sets called synsets. Synsets contain brief definitions called gloss, and it is a combination of synset and gloss that is processed by a Python script to produce the small word corpus to feed the Markov chain generator. See: <https://wordnet.princeton.edu/> for more detailed information concerning WordNet structure (Accessed: 27 September 2021).

The difference between *Synset_Gloss* and *No_m_oN* is the nature of that which is fed to the ResNet HAR algorithm, and how the outputs are ultimately assembled. The core components remain the same. However, the ResNet HAR algorithm processes different material: public information films (PIF) in the case of *Synset_Gloss*; digital human animations in the case of *No_m_oN*. The form of the final output of *No_m_oN* is similar to that of *Synset_Gloss* in that a video timeline is superimposed with a narration soundtrack.

Both projects fed material to the main component of the assemblage (1–4 above) in the form of video footage. In the case of *Synset_Gloss*, the footage already existed in a historical archive of public information films. *No_m_oN* differed in that the footage used to stimulate the HAR algorithm was constructed from an archive of mocap employed to animate a digital human puppet. The latter was therefore more involved through the use of virtual cinematography and stagecraft.

Like real-world filmmaking, the 3D software used to produce the animations requires decisions regarding focal length of the camera lens, f-stop and depth of field, focus, camera blur, camera position, field of view. Stagecraft considers all aspects of lighting and atmosphere and the modelling of the environment where the action takes place. This combination of factors gave rise to the idea of a virtual camera—as a *parameter* that influences the stimulation of the HAR algorithm to generate text—as something to be explored in the next project.

3.6 Project #4: Idling-in-the-Unreal

3.6.1 Summary

Like its precursor *No_m_oN*, *Idling-in-the-Unreal* is made from the constraints of a motion capture (mocap) library. The mocap files are used as a source material to generate text from a series of animated digital humans. A series of eighteen looping animations were made using different digital human characters. Each character was animated using a mocap file from the “idling” category. Mocap files are the recorded physical actions of actors and objects used in filmmaking and video games. The “idling” category of animations are typically programmed into video games so that action will play without input from the player or as a default action that auto-plays when the character initially loads into the scene in anticipation of change. Sometimes an idling action in a video game signals that a player is AFK—away from keyboard. Using the “idling” category as a stimulus for a HAR algorithm, the project explored the possibility of different fields of view (FOV) eliciting variance in the text produced by the assemblage. Practical work demonstrated how the same character—animated with the same “idling” mocap file—produced different text output depending on the position and FOV of a virtual camera.

3.6.2 Introduction

In *No_m_oN* the virtual camera’s FOV was manipulated primarily for aesthetic reasons—framing the action in a particular way to evoke the dynamics of a

relationship between two characters. In the context of the assemblage, this kind of decision making produces effects similar to the indexical operation of the Python dictionary (Section 3.2.2). A particular FOV with its bounded contents could be considered to act like a *key*, potentially eliciting a *value* from the language model. In *Idling-in-the-Unreal*, the FOV of the virtual camera governs the story-making.

3.6.3 Project Method

Three different FOV were chosen for the same digital human animated with the same “idling” file. Each FOV is associated in a table with:

- 1) The text labels produced by the HAR.
- 2) A selection of three outputs from the Markov chain generator, all of which are fed to the GPT-2 language model.
- 3) One selected output from the GPT-2—for the sake of brevity, the character count was limited to 256 characters.

The processes numbered 1), 2), and 3) above have been tabulated in Appendix A.5. Figure 45 shows the three camera positions in relation to the digital human, and indicates process-flow.

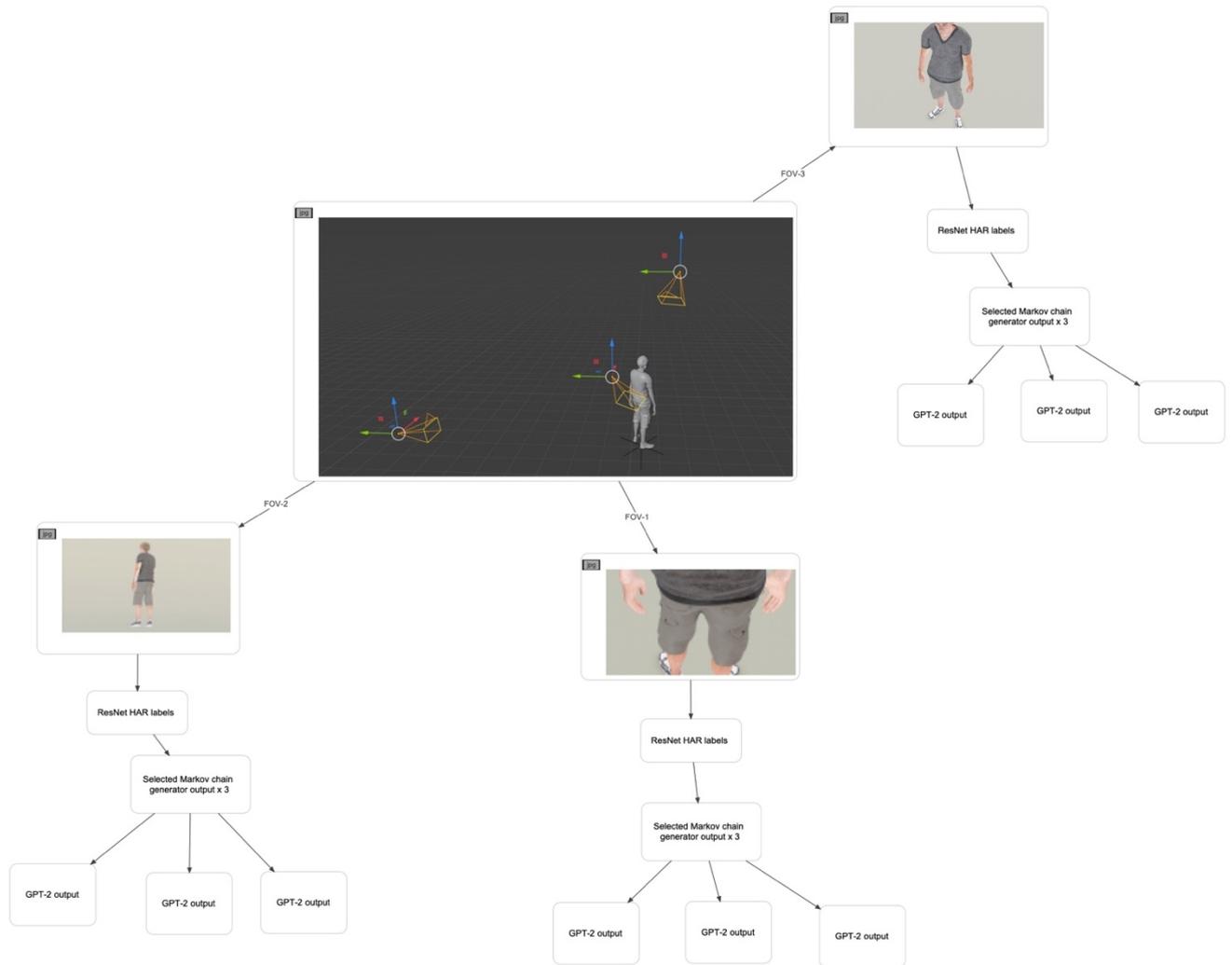
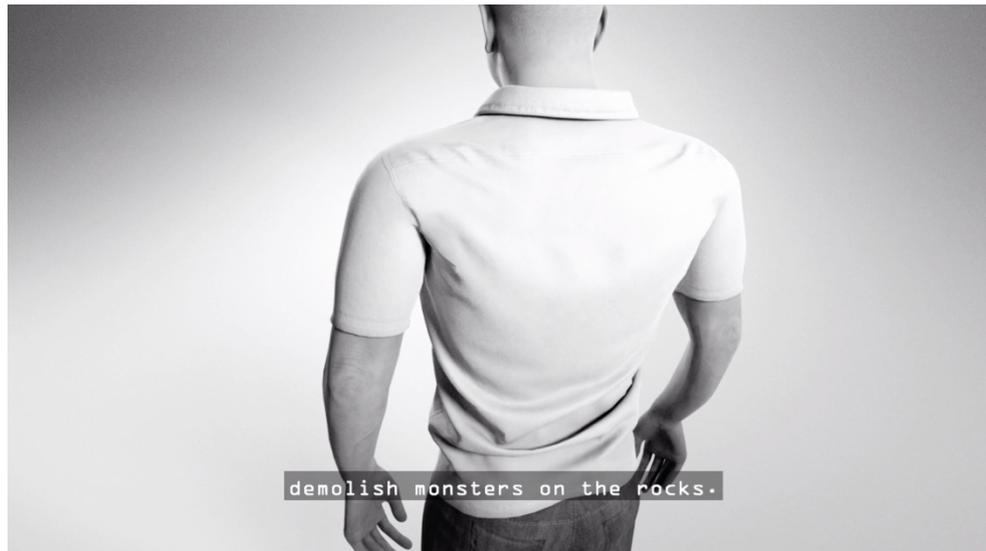


Fig.45. Three fields of view (FOV), with each FOV generating original text via the assemblage.

Eighteen rendered animation loops with accompanying text were made and later developed into an animation produced for the group exhibition *Can we ever know the meaning of these objects?*, Gallery 46, London E1, July 2021 (Video 5).



Video 5. Bruce Gilchrist (2021) *Idling-in-the-Unreal*. Available at: <https://bit.ly/33rjVCD> (Accessed 19 March 2022).

3.6.4 Reflections On Project Method

It has been demonstrated that a changing FOV within the scene will generate different textual output. This invites an alternative reading of camera FOV as a story-maker in a literary sense, drawing from the latent space—or “conceptual scheme” as it is referred to by Grietzer (Section 2.6.2)—of the language model. xtine burrough has suggested that to conceive of remix in the context of AI/ML techniques, the formal and conceptual elements have to be differentiated and then blended, with the blend space as the locus for remix (Section 2.5.5). The use of a virtual camera in *Idling-in-the-Unreal*, with its ability to compose different shots, can be understood as part of the formal component. The augmented effects of the camera via the assemblage can be considered part of the conceptual component. Understood in this way, the positioning of the camera in the virtual environment,

directed at the animated digital human, becomes an operative part of the remix engine.

3.7 Project #5: Smart-Hans

3.7.1 Summary

In November–December 2020, I was invited to participate in *Deepfakes-Synthetic Media and Synthesis*, an online residency organised by Thoughtworks Arts and Baltan Laboratories. The residency was considered a critical approach towards AI/ML mechanisms found in smart and social technology. A speculative story concerning computer and non-human animal intelligence was explored as part of a multi-disciplinary team. The project resulted in a proof of concept interactive installation presented in an exhibition space at Baltan Laboratories, Eindhoven. The project draws from the story of Clever Hans, a horse owned and trained by mathematics teacher Wilhelm von Osten (Figure 46) which was wrongfully assumed to have an ability to perform mathematical calculations and understand German language, evidenced through its response to questions. The project's initial aim was to playfully ask: what is the difference between a *smart horse* understanding written language and performing calculations, and the seemingly intelligent behaviour of a machine? The residency was approached as an opportunity to create a system with which to address the second research question: how can current developments in

AI, including machine learning (ML) contribute towards a new model of interactivity in art?

3.7.2 Introduction

At the beginning of the twentieth century, Wilhelm von Osten exhibited Clever Hans throughout Germany, causing a public sensation as the first and most famous 'speaking' and 'thinking' animal. Clever Hans solved calculations by tapping numbers or letters with his hoof in order to answer questions. The horse could count the number of persons in the audience, perform arithmetic operations, read the clock, recognise and identify playing cards, and knew the calendar of the whole year. In response to a question, he would tap with his hoof to indicate a number or the right option among many given.

Except for a few sceptics, the majority of biologists, psychologists, and medical doctors, experts of all kinds, and laymen were rather convinced by this example that animals are able to think in a human way and to express human ideas in non-verbal human language (Samhita and Gross, 2013).



Fig.46. Clever Hans and Wilhelm von Osten (1838–1909). *The “Clever Hans Phenomenon” revisited*, 2013, Fig.1. Available at: https://www.researchgate.net/publication/260376462_The_Clever_Hans_Phenomenon_revisited (Accessed: 24 August 2021). Photo: Public Domain.

In order to test von Osten’s scientific claims, The Hans Commission was formed by the German board of education in 1904 from a panel of thirteen professional people. The commission concluded that there was “no trickery whatever in the performances of the horse.”⁴⁹ Von Osten claimed that he had taught the horse over four years in much the same way that he would have taught a child at school using the same kind of apparatus (Pfungst, 2010, chap.VI).

Contemporary scientific studies (Hauser et al., 2000; Rugani et al., 2015) have since shown that animals do possess an approximate-number-system (ANS), which includes the recognition and comparison of number quantities. However, a closer

⁴⁹ “‘Clever Hans’ Again. Expert Commission Decides That the Horse Actually Reasons’, *New York Times*, 1904. Available at: <https://timesmachine.nytimes.com/timesmachine/1904/10/02/120289067.pdf> (Accessed: 26 May 2021).

examination of Clever Hans' performances by the psychologist Oskar Pfungst in 1907, contrary to the claims made by the Hans Commission, demonstrated that the horse was not performing computational tasks, but was responding to involuntary visual cues that the human questioner was expressing as part of their body language (Pfungst, 2010). Pfungst had uncovered an anomaly within the previous research methodology, which has come to be known as the Clever Hans effect. The story that leads to the Clever Hans effect is analogous to the Eliza effect (King, 1995), which describes the situation where a computer system is accredited with doing something it has not done, a false belief concerning the capabilities of a system. As well as discrediting von Osten's claims, Pfungst's findings have contributed to research into the "observer-expectancy effect", also known as "expectancy bias", which studies the ways a researcher's subconscious bias can cause them to influence participants within an experiment. Under Pfungst's examination it was shown that changes in the questioner's posture and facial expression sent signals acting as subtle cues that influenced Clever Hans' performance. Once he had become aware that the horse's innate communication system—based on physical signals transmitted between animals—was the basis for Clever Hans' performances, Pfungst was able to conduct laboratory experiments with human subjects, where he played the part of the horse. The questioner was asked to "think of a particular number", and through a reading of subtle cues in

their body language, Pfungst was able to tap out the number with his right hand (Pfungst, 2010, p.103).

Pfungst's emulation of the horse's behaviour is essentially the premise for the *Smart-Hans* project—to simulate the performances of Clever Hans with computer vision and AI/ML, with the aim going forward to train the computer system to read combinations of face and posture signals towards the prediction of a number *held in the mind* of the human subject (installation participant).

A basic understanding of interactivity in art emphasises mutual or reciprocal activity between participant and artwork involving the actions or input of a user. With this basic definition in mind, the question is whether such a potentially open system as proposed in *Smart-Hans* can be considered interactive art and to take a view as to where the participant might be positioned within such an idea of interactivity.

3.7.3 Project method

A reading of Oskar Pfungst's text revealed that through his investigation of Clever Hans' performances, he had discovered several changes in human posture that were significant to the horse's social communication system, including for example:

- Bowing head and torso down towards the horse's foot—cue to start tapping.
- A slight upward jerk of the head when the horse reached the number—cue to stop tapping.
- A full return to normal position, when the horse does not continue to tap—cue not to start again.

The movement descriptions above will be referred to as *Pfungst movements* from now on. There are a number of different technologies that can be used to detect and respond to specific patterns of posture changes and facial expression. For example, PoseNet is a machine learning (ML) model that allows for real-time human pose estimation. Key points are returned as x, y position coordinates associated with body parts for each frame of a moving pose and can be computationally mapped to other processes. Figure 47 illustrates the seventeen key points on the body.

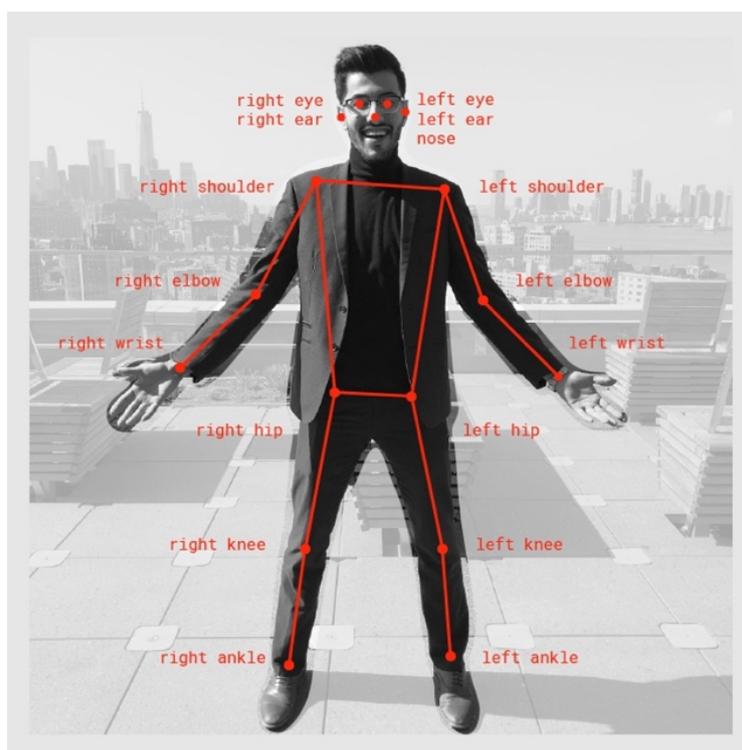


Fig.47. Seventeen pose key points detected by PoseNet. Available at: <https://medium.com/tensorflow/real-time-human-pose-estimation-in-the-browser-with-tensorflow-js-7dd0bc881cd5> (Accessed: 31 July 2021).

EmoPy is a Python toolkit developed by Thoughtworks Arts with deep neural net classes that predict human emotional expression classifications given images of people's faces and could be used in conjunction with PoseNet. The developers of

EmoPy created and tested the system using only publicly available datasets;⁵⁰ therefore the behaviour of the system is highly dependent on the available data.

Rebecca Fiebrink's Wekinator 2.0 employs ML and is typically used to build musical instruments, gestural game controllers and computer vision to create interactive systems. Instead of writing programming code, the Wekinator can be trained via physical demonstration of human actions in front of a camera. This method resonates with the ML researchers in Section 3.4.2, mimicking human actions to a camera to create a training dataset. It also has the advantage over EmoPy in that there is no reliance on an external dataset with the potential biases and assumptions that it might contain; for these reasons, plus the relatively quick physical demonstration aspect, the Wekinator 2.0 system was chosen to build the *Smart-Hans* prototype.

The physical-computing set-up for *Smart-Hans* consisted of Wekinator 2.0 using Open Sound Control (OSC) protocol, Arduino microcontroller, proximity sensor and webcam. The Pfungst movements were performed repeatedly to train the Wekinator system and enable it to classify movement in an installation participant. The classifications were channelled to a Processing sketch and mapped to digital animations of a horse performing foot-tapping and a series of idling actions. The system was triggered by a participant standing near a proximity sensor

⁵⁰ More information on EmoPy is available at: <https://github.com/thoughtworksarts/EmoPy> (Accessed: 27 September 2021).

attached to a pole placed in front of a screen displaying the horse animations (Figures 48–49).

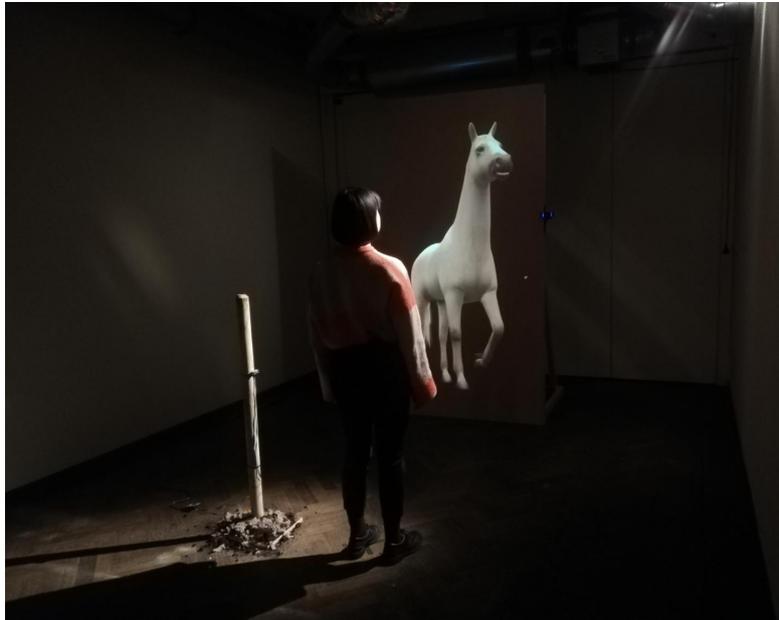


Fig.48. *Smart-Hans* Installation at Baltan Laboratories, Eindhoven (2020).
Photo courtesy of Baltan Laboratories.

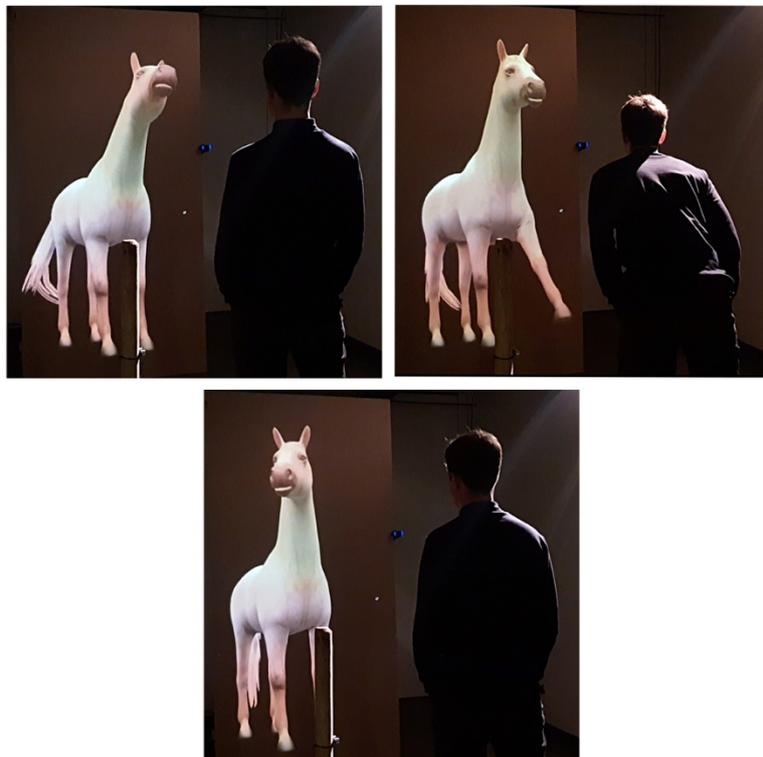


Fig.49. *Smart-Hans* Installation at Baltan Laboratories, Eindhoven (2020).
Photo courtesy of Baltan Laboratories.

3.7.4 Reflections on Project Method

To date, due to COVID-19 restrictions, the *Smart-Hans* installation has not been tested with the general public. Figure 50 depicts Martina Huynh, one of the *Smart-Hans* collaborators, stimulating the installation. The manifestation of the installation at Baltan Laboratories exhibited the kind of behaviours that were expected of it—once classified, the Pfungst movements elicited appropriate changes in the animations being played. For example, the participant leaning forward would cause a looping animation of the horse tapping its hoof to be played; an upward movement of the participant's head would stop the tapping loop and trigger an animation of a horse idling action; a return to an upright standing position would bring the cycle to a close, and another idling animation would play.

The prototype is awaiting further development, and many questions need to be addressed for future iterations, including how to develop the 'mind reading' aspect: having held a number in their mind, a participant will need to be able to feedback into the system to confirm whether or not *Smart-Hans* predicted the correct imagined number. Theoretically, this feedback will enable the system to 'learn', correlating patterns of posture change with correct predictions, eventually leading to a bespoke logic.

It has already been indicated that the subject matter of *Smart-Hans* is conceptually rich: it ripples through a set of disciplines outside the domain of art, including animal and human psychology and computer science. Computer science

has adopted the lesson of the Clever Hans effect in order to assess whether learned models are reliably delivering for the problem the ML model was conceived for:⁵¹

[O]ur work intends to add a voice of caution to the ongoing excitement about machine intelligence and pledges to evaluate and judge some of these recent successes in a more nuanced manner (Lapuschkin et al., 2019, p.1).

Concerning the intent of this project to explore unconscious forms of audience interaction, Martina Huynh was the only *Smart-Hans* team member in the Netherlands with access to Baltan Laboratories and was responsible for physically assembling the installation as well as managing its testing. Therefore, she had intimate knowledge of the installation's behaviours as well as its conceptual underpinnings. Through her, the other four members of the remote team have had to imagine a scenario where a member of the public, with no prior operational or conceptual knowledge, encounters the *Smart-Hans* installation. If we consider that the success of the future work will rely on participants displaying spontaneous, subconscious behaviour, how can they understand the artworks' behaviour when the effects of their actions might not be immediately discernible? How much conceptual and operational knowledge will they need as participants, and how should that be delivered to them?

⁵¹ Researchers provide examples where a learning machine exploits spurious correlations in data to exhibit what humans would refer to as 'cheating'. In the paper by Lapuschkin et al. (2019, p.4) they refer to the phenomenon known as 'overfitting', which they identify "as a clear case of Clever Hans behaviour".

4 CONCLUSIONS

4.1 Introduction to Conclusions

This research arises from practice and is based on a need to appreciate AI-related technology's poetic potential in art. The research idea formed during an AI hype cycle, a consequence of which meant that in order to apprehend a working definition of AI, a path had to be found through a mire of extravagant claims and obfuscation. A working definition was provided by Maya Indira Ganesh (2020), who suggests that AI is, in fact, "a suite of technologies" that includes machine learning (ML) and natural language processing (NLP), among others that exist in an "awkward and unique space as technology, metaphor and socio-technical imaginary" (Section 2.3.4). As well as dispelling myths around the subject, Ganesh's definition provided the realisation that there is a choice of different tools. This working definition combined with learning from Daniel Leufer's *AI Myths* project (2020) and *The AI Art Manifesto* (Fuchs et al., 2020) further informed the contextual review to reveal a binary of artistic approaches to the use of AI/ML related technology (Section 2.5). The different perspectives include the instrumentalist approach of the Google cohort and the more critical approach of an independent grouping that employ journalistic approaches as defined by Manuela Naveau (2020)—some of which came to be understood as assemblage approaches. From

the artists identified as more critical, both Nye Thompson and Crawford and Paglen have been particularly influential for practical projects.

The discovery of a more critical grouping was pivotal to the direction the research would take: participation in Nye Thompson's cyber-writing experiment provided the intuition of AI/ML in art being a mode of remix technique in the form of a literary cut-up method (Section 3.1.1). Furthermore, a perception of language as something shifting and malleable resulting from a fusion of human automatism, aleatoric and recombinant culture led to an often-made connection between technological art employing neural networks and Surrealism (Khan, 2018). This connection informed the first practical project, *A is for Asteroid*, that played with a dictionary structure as an information model used to remix textual content, further highlighting the material negotiability and fluidity of the text. The initial practical projects (*A is for Asteroid*; *office_composing_machine_*) led to a combination of processes being conceived as an assemblage, which was then used to produce three other projects (*Synset_Gloss*; *No_m_oN*; *Idling-in-the-Unreal*). The practical projects address research question (1): How can AI/ML be combined with poetic strategy to enable the making of an artwork?, and (3): Can AI/ML in art be considered as a remix technique? A fifth project, *Smart-Hans*, is a work in progress, a collaboration initiated by an artist residency at Baltan Laboratories, which addresses question (2): How can current developments in AI, including ML, contribute towards a new model of interactivity within art?

4.2 Reflection on Question (1)–Poetics

How can AI/ML be combined with poetic strategy to enable the making of an artwork?

The emergence of a working definition of AI led to the adoption of a number of key tools: a human-action-recognition (HAR) algorithm, a Markov chain generator and a GPT-2 language model, which, through their combined operation, addressed the question of poetic strategy.

4.2.1 The Development of a Poetic Strategy

There is no agreed-upon definition of *strategy* that describes and limits its boundaries, (Freedman, 2013, p.xi) although it is commonly understood that adopting a strategy first entails establishing objectives, then determining which actions are appropriate to obtaining those objectives. Suitable resources are then mobilised to carry out the actions. A conventional definition begins with a description of a desired end state. However, this research required the discovery of accessible resources (tools and techniques) as a preliminary step, taking precedence over the conventional framing of a projected outcome.

Over time, and through the discovery of accessible tools and techniques, the strategy evolved through iterations of practical projects, eventually becoming established in the mixed form of an assemblage held together by poetic alliances—the product of one component fed another component to create new material.

Brian Eno and Peter Schmidt's *Oblique Strategies* (1975) was considered as a strategy employed in art, described as a card-based method for promoting creative thinking. Each card in *Oblique Strategies* contains a gnomic suggestion, aphorism or remark to break a creative block or dilemma situation. The function of a card is to serve as a *prompt*, which the user is invited to respond to somehow to initiate action and break the deadlock. The Fluxus artist George Brecht's *Water Yam* (1963) is a precursor to *Oblique Strategies*. *Water Yam* is considered one of the most influential works published by Fluxus and appeared in the form of a box (Fluxbox or Fluxkit), which housed a large number of small printed cards containing instructions known as event-scores, or fluxscores. These scores were typically open-ended and could be performed in public, private or left to the imagination to encourage broad interpretation by the performers and audience.

These two examples of artistic strategy stimulated thinking about the poetic alliance between the assemblage's components—the HAR algorithm, the Markov chain generator and the GPT-2 language model—leading to the idea of a text-based output from one being conceived as a prompt for the next. Through a process comparable to an auto-complete, the short Markov chain generated sentences (previously 'prompted' by the HAR labels) were extrapolated into longer sentences by the GPT-2 language model. Redolent of *Oblique Strategies* and the fluxscores, and thought of as a poetic strategy embodied by the assemblage, textual output from a component becomes a prompt or a catalyst to 'remix' a text

via the GPT2 language model. In this way, the remix function of the assemblage can be understood as an emergent property arising from relationships between its components. This property is analogous to the functions of GPT models, which are considered to be emergent, arising from the three components of “Open and big data + computational resources (supercomputers) + Machine Learning models” (Leivas, 2020, para.2).

In conclusion, the poetic strategy is conceptualised as an ensemble of parts that share processes to create, modify, and interpret a flow of information to produce AI/ML-enabled artworks. This understanding reveals the poetics of AI in the form of an assemblage of techniques, where poetics is understood as active making (poiesis) and a technique for manipulating language.

4.3 Reflection on Question (2)–Interactivity

How can current developments in AI, including machine learning (ML) contribute towards a new model of interactivity within art?

Katja Kwastek’s research project, *A Taxonomy of “Interactive Art”* (2007) shows how the theory of interactive art has focused on descriptive approaches using graduation of differing degrees of interactivity and scales of weak to strong interactivity. This descriptive approach can be seen in the taxonomies of Roy Ascott (1967), Cornock and Edmonds (1977), among others. However, other approaches have employed more interpretive methodology in studying aesthetic strategies and

the structural/aesthetic aspects inherent in the interactive process, such as that described by Ryszard Kluszczyński (2010) in Section 2.4.5.

Within the literature of interactive art, Soler-Adillon (2015) identifies three main approaches to defining interactivity, which depend on where the defining effort places its focus:

- a. On the structure of media, which understands interactivity as a characteristic of media.
- b. On the user, around a concept of *perceived interaction*.
- c. On the communication process that interactivity represents, focussing on the process that develops as the interactive system and the user act and react to one another.

Based on (c.) focus on the “communication process” above, Soler-Adillon goes on to define interactivity as “a series of related actions between two or more agents where (1) at least one of them is an artificial system that (2) processes its responses according to a behaviour specified by design and (3) takes into account some of the previous actions executed by them” (2015, para.3) He makes this definition based on his understanding of design and functionality. In doing so, he explicitly states that the process of dialogue that is alluded to is between the behaving system and the human interactor, that it is somehow objectified and precludes the subjective experience of the interactor.

Considering interactivity within this research, it is worth thinking about the participant’s subjective experience. If *Smart-Hans* is compared to Soler-Adillon’s

definition above, focus on the user (b.), and communication (c.), can be combined to consider the participant’s perceived interaction, with an emergent process of communication as its corollary.

Soler-Adillon’s idea of perceived interaction is expressed through Alan Peacock’s concept of a domain of “engagement” (2005, para.15). Peacock positions deliberate actions and predictable outcomes at one end of a continuum, with the opposite end marked by inadvertent actions and entropic events, where entropy is broadly understood as the degree of disorder or uncertainty in a system. Peacock’s concept has been interpreted as a simple diagram to indicate a sliding scale from one state to the other in Figure 50.

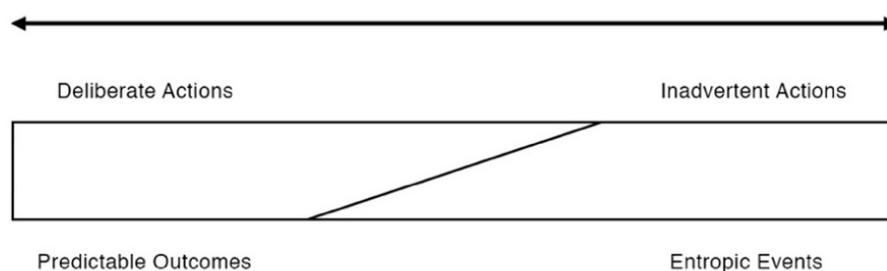


Fig.50. A diagrammatic interpretation of Alan Peacock’s domain of “engagement”.

Peacock situates a work that will respond to a passerby who is perhaps unaware that their actions have triggered a sensor at the “Inadvertent Actions” end of the scale. He cites Susan Collin’s work, *Litter* (1994), where a passerby triggers a video projection of a banana onto the pavement. Initially, the participant might be unaware that their movement has been a significant action within the interactivity of the work. However, Peacock describes how eventually they might “puzzle out” that

they can make something happen by moving a certain way. “As they do this, of course, so their actions become increasingly deliberate and the moment of discourse shifts, changes, tending towards the deliberate and so also towards the redundant” (2005, para.16).

The potential to “puzzle” something out is an apt description of a participant encountering *Smart-Hans*, where they might initially be unaware of the correspondence between their actions and the movements of the animated digital horse.

Soler-Adillon’s emergent process of communication can also be understood through Ernest Edmonds’ “influence” concept of interaction, which he has been developing since 2007, where the key idea to understand is that,

a direct response, in the moment, is only a very small subset of what interaction implies. The idea of influence is to take account of how an action may change an internal state, have no instant result, but change long-term behaviour (Jeon et al., 2019, p.5).

In relation to Edmonds’ “influence” concept of interaction, as a participant moves, *Smart-Hans* constantly analyses their body movement via the ML model. There are many exchanges in how this data is processed, but the exchange does not guarantee a discernible change in *Smart-Hans*’ behaviour. This lack of visibility brings into question the relationship between input and any later output. In the most basic example of an interactive system, an input is followed after a certain

period by a predictable output—when a physical switch is depressed, a light comes on. This situation is made more complex by introducing an *internal state*, an intermediate process between the physical switch and the lightbulb. If the internal state is an ML model, many possibilities unfold but establishing the causal chain becomes difficult or even impossible to understand. In relation to the question concerning inputs and outputs of interactive systems, Edmonds (2007, p.xxvii) reasons that input can elicit both a predictable response *and* a change in an internal state. From this, he considers different kinds of input to an interactive system and identifies some of them that:

- 1) Generate a given response after a given time.
- 2) Change the internal state (and so influence later behaviours).
- 3) Both respond and change the internal state.

This range of possibilities raises a fundamental question for him regarding what the term ‘interaction’ actually means. In some respects, he considers interaction an inappropriate word to use, and suggests that the words “influence”, “stimulus” and “interchange” are more evocative. For an AI/ML interactive system ‘learning’, he suggests “[w]e may talk about the audience’s influence on an art system where the development of its behaviour is affected by the interactions that it has experienced” (p.xxvii).

Smart-Hans can be understood as an interactive system with an ML model as the internal state. Currently, the function of *Smart-Hans*’ model is to ‘read’ the

participant's movements and respond in a pre-programmed manner if any of the Pfungst movements are classified. There is also potential for the internal state to influence later behaviours, which can be understood as 'learning'. *Smart-Hans* proposes that *all* its interaction flows through the ML model; therefore, the internal state needs to be imagined as two different programs: one for responding to physical movements more or less immediately; another for 'learning' from the movements in order to influence future behaviours.

4.3.1 Further speculation on Smart-Hans' Proposed Interactivity

It is not enough to indicate the strategies for and forms of making something "novel"—it is also necessary to discover the specific 'leaps' and 'rifts' (Risse) that make art enter into the vocabulary of its times (Mersch, 2020, p.13)

In this view we are not interactive at all, but merely a probed subject (Wilson, 2003, p.3)

A future participant in *Smart-Hans* might not initially appear to have any authority over the interaction. By participating, they will be assigned a role that they are not aware of or have consented to—training a system to 'learn' from their behaviour. In this sense, the interaction can be understood as *extractive*.

Kwastek (2007) references a precedent for extractive interactivity in *registrational interactivity*, which stores participant data to become part of the 'text'. Outside of the domain of art, in a study of a mass communication model, Sally J McMillan delineates the concept of interactivity into an intersecting four-part

typology, one of which is “Registration”, where access patterns are recorded in a central registry as in a surveillance system. “The accumulation of information at a centre often takes place without reference to, or knowledge of, the individual” (2002, p.273). McMillan gives an example of registrational interactivity as the internet “cookie,” which tracks and customises content of Internet sites visited by the user.

Smart-Hans has been thought about in relation to Cornock’s interactivity system (Section 2.4.8) and Kluszczyński’s framework of eight strategies (Section 2.4.9). As an aid to parsing the interactivity of *Smart-Hans*, the three most salient characteristics from the comparison with Cornock and Kluszczyński are mentioned below:

1. Concerning Kluszczyński’s framework of Strategy of Instrument:

On first encountering the *Smart-Hans* installation, it is anticipated that a participant will be unaware that their body language is being analysed by a responsive system. There will be no sense of “communication with someone or something” or “steering an information system”. Instead, the interface will generate an event that the participant might not be unaware of having contributed to.

2. Concerning Kluszczyński’s framework of Strategy of System:

Smart-Hans is potentially beyond conscious control, where an AI/ML-enabled system prioritises a participant’s subconscious behaviours. The operation of the ML model within *Smart-Hans* is equivalent to Kluszczyński’s conception of an “inner interactivity’s occurrence”, an “eventfulness” that occurs outside the participant’s awareness. Considered through the Strategy of System, *Smart-Hans* is located on a boundary between conscious control and

unconscious reaction. Unconscious reaction has been previously discussed with Clever Hans as the “observer-expectancy effect”, also known as “expectancy bias”, which studies how a researcher’s subconscious bias can cause them to influence participants within an experiment (Section 3.7.2).

3. In relation to Cornock’s Dynamic systems, where the artefact in a work responds to environmental variables:

The “environmental variable” in this category can be understood as “participant behaviour” in *Smart-Hans*, but it has yet to be determined how a participant will apprehend an equivalent of “prescribed user action” as a way of altering the display (Section 2.4). As discussed in Bradbury (2015, p.37), how that kind of instruction is imparted remains to be seen.

The question of communicating a “prescribed user action” to a *Smart-Hans* participant is the final thing to discuss in this section. It needs to be reiterated that *Smart-Hans* is a work in progress; its development has been set back by social distancing restrictions, rendering aspects of this discussion speculative. However, in thinking it through and with further prototyping, care will need to be taken not to privilege the demonstration of interaction over the emergence of an experience. User instruction needs to be balanced with the fact that,

the desire to clearly demonstrate to the participant that they are indeed interacting with and causing change or growth in the artwork can prevent the riskier task of enabling the performative exploration of emergent relation (Goodman, 2018, p.39).

4.3.2 The Question of Participant Instruction

When *Smart-Hans* is developed with members of the public as participants, they will approach the work without prior knowledge of the installation's behaviours or its conceptual underpinnings. In her research on the performativity of code, Victoria Bradbury emphasises that besides instruction in the form of code that are the building blocks of computer programs, there is "another layer of instructions that frame participation when a visitor approaches and engages with a new media artwork" (2015, p.37). Bradbury understands "that code running within new media artworks is important to the meaning of the work whether it is foregrounded or not" and that "[b]oth computer programs and instruction-based artworks require an explanation of their process to be read and to be followed, in order to be enacted" (p.37).

This understanding is particularly apposite to *Smart-Hans* because of its conceptual underpinnings, which relate to the problem of socio-technical blindness, where confusion around the perception of autonomy and blindness to human attribution is shown to be intimately linked (Section 2.2.5). The critiques of Crawford and Jolar (2018), Crawford and Paglen (2019) that underscore the need for sharing of awareness of the socio-historical contexts of AI (Section 2.5.4) are also pertinent, as is the general need for more critical approaches to the use of AI/ML in art (Section 2.5.3). These critiques are further emphasised by the fact that the deployment of AI/ML technology in society is often controversial. Elements of

interactivity and control have become highly contentious, being thought of as subtending “overlapping ‘social-assemblages’” that have histories of control and power embedded within them (Goodman, 2018, p.33).

Bradbury appreciates the importance of how the instructions for visitor participation are composed and how they must work in tandem within the language of the piece, “[t]he instructions must be carefully considered as they will serve as a bridge between the participant and their actions within the system of the artwork” (2015, p.40). The quality of the instruction and the way it is imparted will determine the participant’s level of engagement—that is, where they stand (both literally and metaphorically) in relation to the place or devices of interaction. In *Smart-Hans*, as it currently exists, there are two interface zones: the proximity sensor that ‘wakes up’ the system and the computer vision that has a specific field of view (FOV). The instruction will determine how the participant relates on a physical level to the interfaces, the ML model component that responds to participant actions, and how empowered they are in effecting the outcomes of their actions. In this way, the instruction should be considered as part of the interface—the boundary condition across which interactivity occurs (Section 2.4).

4.4 Reflection on Question (3)–Remix

Can AI/ML in art be considered as a remix technique?

Incorporating a human-action-recognition (HAR) algorithm into an assemblage that produces language relates to a recent history of machine-driven text transformation approaches, which has evolved from a much longer history of combinatorial poetry and permutational literature. The idea of automatically convoluting texts by using simple algorithms to induce new word combinations has been around for millennia. Florian Cramer point out that in its long history, written combinatory poetry frequently does not include the generated text itself, but only a framework of instruction (2001, para.2).

The process of remixing through machine-driven text transformation approaches shows continuity from the combinatorial experiments realised by the Ouvroir de Littérature Potentielle (Oulipo) to advanced remix possibilities of developing software, and up to contemporary attempts to establish something approaching an “automatic publisher” (Ludovico, 2021, p.302). *Combinatory poetry* is defined by Cramer as literature that “openly exposes and addresses its combinatorics by changing and permuting its text according to fixed rules” (2001, para.2), which includes historical cut-ups among many other techniques. This research has focused on assemblage as a “framework of instruction” that embodies fixed rules specifically relating to the invariant, core aspect of each component—the HAR algorithm, the Markov chain generator and GPT-2 language model. The text

being “permuted” is understood to be the data contained in the autoencoder’s latent space. By conceptualising the language model’s latent space as the equivalent of the “text being permuted”, the language model can be considered a remix engine—where the combinatorial operation of the assemblage can be geared to produce markedly different remixes. As an exercise, an identical prompt text was fed to two different GPT-2 language models, one being trained by OpenAI (the authors of GPT-2) on a random corpus of web text, the other on the writings of Michel Foucault.

As part of the *office_composing_machine_* (Section 3.3), a Markov chain generator mixed two text datasets comprised of Reddit and Stack Overflow posts. One of the first generated texts was “method is the error”, which has been used as the prompt for the two GPT-2 models. It will be seen that feeding the same prompt to two different models produces remarkably different outputs.

The language model operates in an autocorrelative manner, similar to an auto-complete function predicting the next word. The text outputs for the exercise were limited to under 500 characters and the prompt was fed to each language model three times. Outputs have not been edited apart from capitalising (see Appendix 6 for all the results).

The following output from the OpenAI model trained on random web text has a strong characteristic of ‘problem solving’:

Method is the error ----- something went wrong. Go ahead and try again.

Step 2 - Test the generator

There are three basic ways you can test the generator:

-Start with the print command with the non-conformation command. Since the generator is always end up like the final string, look to see how it works:

-Make a call.

-Since we use this function, you have to change our default value to set the generated sequence to as far as possible.

-If the generator generates a set of example numbers, you might want to add (1 to 1, 2 or 3) numbers or join those. To see how it works, check out:

-Make random array assignment.

-Remember to do the extra sorting with many digits!

For example, you might want to apply the least current number without any intervening loops.

Lastly, the generated sequence can be written into a string as long as the length of its length is longer than the possible number.

Next, let's look at the following examples:

'Highlight' : \$1:2, \$2:3, \$3:4, \$4:5, \$5:6, \$6:7

Result: \$2:4, \$3:4, \$4:5, \$5:6, \$6:7, \$7:8

Res...

Notably, the model trained on random web text seems to have foregrounded a technical characteristic that reflects the Reddit and Stack Overflow posts initially used to generate the prompt. However, the model trained on Foucault appears to have produced the opposite effect. Instead of foregrounding a characteristic that

resonates with the prompt’s origins, the model expresses something resembling its training corpus:

Method is the error that keeps a useless discourse, and makes it perpetual, perpetually alternating between reproaches and indulgences. It is the discourse that is never excited again about anything. But it is not always the original difficulty of denouncing a lie or showing that it was not foisted upon men, but a discourse that tries to avoid being said, a difficult one—or which seeks to show that one cannot speak of such things. In the naturalist-science-discourse where truth appears as a single...

The output’s semblance of the training corpus can be related to Peli Grietzer’s *A Theory of Vibe*—which conceptualises the process of training a neural network on a corpus of an author’s work—as ‘distilling’ that author’s style into an abstracted mathematical formula:

The meaning of a literary work (...) lies at least partly in an aesthetic ‘vibe’ or a ‘style’ that we can sense when we consider all the myriad objects and phenomena that make up the imaginative landscape of the work as a kind of curated set (2017, para.5).

The prompt “method is the error” has been autocompleted in the style of Foucault by one language model and in the style of random web text by the other. Another way of considering these different outputs is through the diversity of the datasets used to train the two models. With its Reddit and Stack Overflow origin, the prompt has had a semblance of its original context reconstituted by the OpenAI

model because of the diverse dataset used to train it. On the other hand, the model trained on Foucault lacks diversity in that the training dataset is constituted from words written (or in some cases spoken) exclusively by Michel Foucault. This ‘exclusivity’ facilitates the mathematical abstraction of an author’s “style” or “vibe”, which in the case of the latter model’s output appears erudite and poetic when stimulated by the prompt. The reflexivity of the Foucault model’s output is understood as an aesthetic characteristic in this exercise in that it appears to mimic the author’s writing style. However, it is sobering to realise that in the wider world, a lack of diversity in a training corpus often leads to the perpetuation of bias and injustice and constantly needs to be addressed.

Conceptualising AI/ML as a remix engine in the form of an assemblage shows that a language model’s output can be altered dramatically by simply changing the correspondence between the prompt text and the training corpus. By way of summarising the exercise (Figure 51)—when stimulated by an identical prompt, the contrasting outputs from the two language models suggest a correlation between the diversity of the training corpus and the output text. More specifically in this case, the diversity or exclusivity of the training corpus relates to the likelihood of the prompt’s origins being foregrounded.

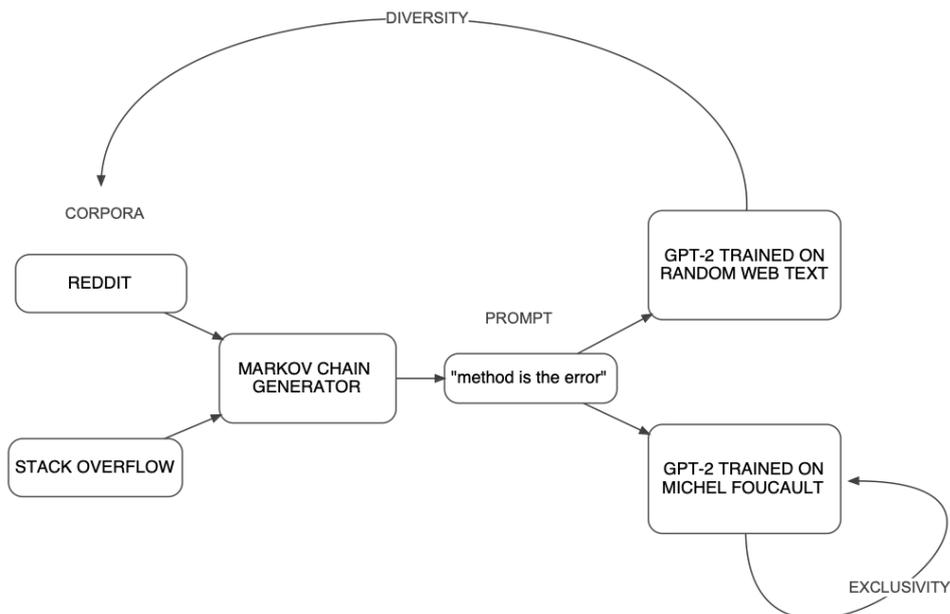


Fig.51. An identical prompt stimulating two language models to reflect the diversity of the GPT-2 training corpora.

The assemblage in this exercise could have taken many forms, with different components configured and interacting in different ways to render distinct outcomes. Rather than attempting to generalise or formulate a fixed idea, the research exercise aimed to explore text transformation approaches by introducing the combinatorial possibilities of AI/ML techniques.

4.4.1 Human Intervention

The Italian writer and artist Nanni Balestrini envisioned advanced computer processes as tools to create new, more sophisticated and automated spaces of composition. He developed a computer program that combined three poems by Michihito Hachiya, Paul Godwin, and Lao Tse to compose a new “original” poem by choosing one out of three thousand remixed versions from the same three poems.

As well as intervening to select computer output, he also corrected grammatical errors. The work entitled *Tape Mark 1* was included in the exhibition *Cybernetic Serendipity* at ICA London in 1968. Alessandro Ludovico (2021, p.304) describes Balestrini's work as opening up "a different literary space, able to dissect and reassemble pre-existing poems" where the remix was seemingly delegated to the machine. However, the artist's participation was essential to "acknowledge which of the many outcomes was eligible as a 'credible' one" (p.304). Balestrini's interventions are relevant when discussing contemporary ideas of remix using language models.

GPT-3 is the latest iteration of OpenAI's natural language generating algorithm (NLG), released in May 2020. Concerning this, the Guardian published an article proclaiming, "[a] robot wrote this entire article (...)", with the implication being that it was an autonomous process, "we asked GPT-3, OpenAI's powerful new language generator, to write an essay for us from scratch."⁵² However, if one reads the editor's note at the end, it becomes clear that the process was far from autonomous. Like Balestrini in the 1960s, the Guardian made interventions into the process by curating and editing the output. The editor's note records that GPT-3 produced eight different outputs (there are fifteen in the Google document in the

⁵² Source: <https://www.theguardian.com/commentisfree/2020/sep/08/robot-wrote-this-article-gpt-3> (Accessed: 14 May 2021).

footnote below),⁵³ where the best parts of each were chosen, where lines were cut, and paragraphs rearranged in some places.

4.4.2 Algorithmic Remix

The third research question concerns whether AI/ML in art—in the form of an assemblage comprising a HAR algorithm, Markov chain generator and GPT-2 language model—constitutes a remix as understood within remix studies. Eduardo Navas provides a clear definition of *remix* that describes samples being elaborated “from pre-existing materials and combining them into new forms according to personal taste” (2012, p.4). Navas’ idea of the remixer influencing the process by exercising “personal taste” can be seen in the examples in the previous section of Nanni Balestrini in the 1960s and in the Guardian article in 2020,⁵⁴ where, contrary to allusions of autonomous machine creativity, there is human participation in the form of curating and editing the outputs.

Steve F. Anderson has acknowledged that there is something that can be thought of as a classical age of (analog and digital) remix, predicated on discrete, remixable elements of visual and written culture. We are now in what Anderson

⁵³ All the generated outputs from GPT-3, plus the Guardian prompts are available at: https://docs.google.com/document/d/1QtbyTVRtjXIR22pHI7C_IKX_Z0hd4fcGE0qslk06lcw/edit (Accessed: 14 May 2021).

⁵⁴ As well as misleadingly suggesting the idea of creative autonomy and perpetuating the myths that plague the AI field, the Guardian article neglects to mention the continuing problems encountered with toxic content due to the GPT-3 model drawing from such massive amounts of random content from the internet, reproducing bias and producing abusive and discriminatory speech. It is well known by AI researchers that “language models pretrained on large web text corpora suffer from degenerate and biased behaviour” (Gehman et al., 2020).

refers to as “an algorithmic period of remix” (2021, p.354), whereby an ML algorithm “digests” salient characteristics from an original training set with the potential to generate something ‘new’ based on those characteristics. Algorithmic remix is consistent with the logic of remix as long as it is understood that “digestion” supersedes the “cut and copy” metaphor of classical remix; the outmoded “paste” metaphor is equivalent to the decoding and synthesis of an autoencoder operation. As Anderson describes it:

What distinguishes the algorithmic remix from its analog and digital predecessors is its irreducibility to individual components capable of conveying meaning in isolation from the computational processes by which they are generated (p.354).

In other words, the sound sample or image fragment from a “classical remix” can be identified and conceptually reunited with its source. On the other hand, a high-dimensional number vector as part of an algorithmic remix is both non-human-readable and completely meaningless beyond the context of its semantic neighbourhood.

4.5 Reflection on Method

The AI-art space and some related technologies have been examined alongside a comparison of a broad categorisation of practitioners. Based on this, an attempt to reconceptualise AI in an art context has brought combinatorial and assemblage

approaches into play, which led to the development of techniques to drive practical projects to address a number of research questions.

The qualitative researcher as bricoleur, or maker of quilts, uses the aesthetic and material tools of his or her craft, developing whatever strategies, methods, and empirical materials are at hand (Denzin and Lincoln, 1999 in Rogers, 2015, p.5).

This notion of the resourceful bricoleur is a reminder that the term “art” was initially associated with the technical ability of craft, but over time its meaning became associated with creative or imaginative skill.⁵⁵ Art is now frequently understood as an ability to adopt a creative or flexible approach, in contrast to applying more theoretical or scientific principles.

The term bricolage has been well used since the 1960s to describe the product of the bricoleur’s labour: a creative production based on a combination of disparate elements chosen because they are simply at hand. Markham describes a development of this conceptualisation of bricolage that associates the choices made “by their proximity to the thinker, the situation or the problem” (2018, p.49). In the context of this research, Markham’s notion of “proximity” as being more than just simply close to hand, is understood as the contextual review bringing “empirical materials” (Section 1.3) into the ‘orbit’ of the practical activity.

⁵⁵ “art, n.1.” OED Online, Oxford University Press, September 2021, www.oed.com/view/Entry/11125. (Accessed: 13 September 2021).

The bricolage method composed mixed techniques as an assemblage, meshing different processes together. This gathering together of different techniques expresses Maya Indra Ganesh's definition of AI as a "suite of technologies" (Section 4.1). The components of the assemblage—the HAR algorithm, the Markov chain generator and GPT-2 language model, are each associated with AI in different ways, but for the purpose of this research, have been uniquely combined.

Thinking and doing became a generative threshold that gave rise to a series of practical projects, where each project suggested new possibilities, which were acted on to create new work. The practical projects are understood as an elucidation of the contextual research—the emergent poetics of *bodies remixed as language* is a consequence of an artistic investigation into the opacity and limitations of a HAR algorithm. In this way, art practice can be thought of as a means of producing concepts that are open to scrutiny.

As part of the contextual review, an intuition emerged from an encounter with an AI-enabled artwork (Section 3.1.1). The CRUMB discussion list enabled the formulation of the intuition into a series of questions as a theme for discussion (Appendix C.1). The discussion list was considered part of the methodology and functioned as a space where ideas could be shared with invited specialists in the field as well as the wider community—this became particularly apposite in a time of pandemic induced social-distancing. From exchanges on the list, I was able to

observe whether or not a consensus formed around speculation. The invitees to the discussion list were discovered as part of the contextual review: theorists contributing to the literature, artists having exhibitions, and curators engaging with artists exploring the field.

4.6 Contribution to Knowledge

The contextual review revealed a binary approach to using AI/ML related technology in art (Section 2.5)—the instrumentalism of the Google cohort and the more critically engaged approach of an independent grouping of artists. However, the identified binary has become less distinct over time as some artists have repositioned themselves, changing how they describe their practice and adopting different techniques. Therefore, in terms of contribution, the identification of contrasting approaches is a ‘snapshot’ of the AI-art space during the peak hype cycle. Based on an understanding of AI as portrayed in science fiction and the mass media over the past few decades, there is a misconception in the public imagination that AI can exhibit near human-level intelligence with context-sensitive language understanding and reasoning. This concept of AI is very far from reality, with the current, successful ‘narrow AI’ incomparable to human intelligence. Instead, there is a statistical parroting of patterns of words and grammar that have been identified in language, which relies on the application of generic ML algorithms to increasingly larger datasets, enabled by the speed and storage capacity of modern computers.

Linguistics researchers remind their community how far they have to go in order to make an artificially intelligent agent system truly language-endowed. With the current state of the art of natural language generation (NLG) and natural language processing (NLP) from the perspective of linguistics and computer science in mind, a contribution of this research is to suggest to artists that a less mythic view of AI/ML is required, and to approach its potentiality as a remix engine for media, rather than as something that can explain “its thoughts, actions and decisions to its human collaborators in terms that are meaningful” (McShane and Nirenburg, 2021, p.xiv).

In considering question (3), which originated from an encounter with an AI/ML-enabled artwork (Section 3.1.1), there was speculation that artists employing these techniques could better comprehend them in the context of Remix Studies, with its long history of automatically convoluting texts using simple algorithmic procedures as an example (Section 4.4). Situating AI/ML-art practice in the context of remix studies is constructive for artists, as Remix Studies is well theorised, and since 2021 has started to address AI-related techniques in its literature directly (Navas, Gallagher and burrough, 2021).

The research suggests that the foundation for a basic conceptual understanding is available through the contributions of Ganesh (2020), Leufer (2020) and Fuchs et al. (2020), which will be of use to other artist-researchers. Drawing from this combined knowledge provides a countermeasure to the perpetuation of

myths surrounding AI technology, offering a grounding for best practice for artists in terms of how they at least conceptually understand, utilise and communicate what they are doing. With this foundation, a non-expert is better placed approaching AI/ML-related art from the context of remix studies rather than attempting to apprehend understanding purely from a scientific perspective, where definitions, for instance, might be determined by vested interest and “AI tribe” affiliation discussed in Sections 2.2 and 2.3.

Considering that Maya Indra Ganesh has pointed out that shared understanding of AI exists uneasily in the space of technology, metaphor and socio-technical imaginary, a contribution is made by highlighting the importance of metaphorical approaches to AI/ML in art practice, where metaphor is understood as a way to capture the imagination in an attempt to conceptualise inscrutable spaces. Appropriate metaphors are indicated through a discussion on the CRUMB discussion list (Appendix C.1–C.9).

Although it may be short-lived, as technology in the AI field continues to become more efficient, the outcome from research question (1) concerning poetic strategy demonstrates that the vagaries of HAR algorithms can be productively harnessed by artists and understood as components of a remix technique to generate *texts from the body*. The focus on a HAR algorithm and the attempt to conceptually articulate its operations is unique to this artist research. The uncertainties of HAR inferences shown by the research led directly to thinking

around chance operations that have been a perennial concern in art since the time of the historical avant-garde. Chance has been regarded as a key compositional principle in art, functioning as a stimulus towards new forms of artistic creativity. Marcel Duchamp offers another perspective on chance in *The Creative Act* (1957) when he employs the term “personal art coefficient” to describe “the subjective mechanism which produces art in a raw state—a l'etat brut—bad, good or indifferent.” He identified a gap in the chain of reactions that accompanies the creative act: an inability of the artist to express the intention fully—between the intention to realise and what was actually realised. According to Duchamp this is expressed in the artwork through the “personal art coefficient” like an arithmetic relation between the unexpressed but intended, and the unintentionally expressed. Peter Osborne interprets this as “a relation between an art idea (which, as an idea is in a certain sense infinite) and the contingent materiality of its means of actualisation (...)” (2021, p.9).

Through a reconceptualisation of AI/ML as a remix technique in art practice that is open to chance operations, it speaks to Duchamp’s gap in the casual chain of creativity and becomes redefined as a form of production that is contingent as opposed to premeditated. The contribution is an invitation to reconceptualise AI/ML as a way of intentionally governing or curbing artistic agency, where the tensions between the aleatoric and the deterministic can be explored in new ways. This new perspective offers an alternative to labouring under prevailing myths and

misconceptions that might suggest that all AI/ML has to offer artists is suppression of human authorial intent as machines become ever more 'inspired' (Section 2.2.3).

In relation to research question (2) concerning the potential interactivity of AI/ML-enabled art, there have been several taxonomies over the past few decades, which are primarily focused on the dynamics of interaction. In terms of appreciating the dynamics of *Smart-Hans*, the research has drawn from a number of sources, including Alan Peacock's "Domain of Engagement", Joan Soler-Adillon's "perceived interaction" and "emergent communication", and Ernest Edmonds' "influence" concept of interactivity. This has given rise to the speculation that although a *Smart-Hans* participant might not be fully aware that they are entangled with a 'learning' ML-enabled system, awareness of participation could emerge over time. The ambition here is that the "emergent communication" will somehow foreground its underlying technological structure as a link between surveillance and interactivity. Contemporary power has shaped itself along this link, and therefore, as a producer of experience within *Smart-Hans*, the link is open to scrutiny in an original and imaginative way.

4.7 Areas for Future Research

Within the timeline of this research (2018–2021), from 2019 onwards, a human-action-recognition algorithm (HAR) and the OpenAI GPT-2 language model have been significant components as part of an assemblage approach to AI/ML-enabled

artworks. The HAR model was trained on the DeepMind Kinetics 400 human action video dataset, available since 2017. This dataset contains 400 human action classes, with at least 400 video clips for each action. Over the research period the DeepMind Kinetics dataset has been upgraded to 600 and then 700 human action classes. However, on both occasions, it would have been impractical to abandon work already carried out to substitute with a retrained HAR model. Similarly, the GPT-2 language model released by OpenAI in 2019 has been upgraded to GPT-3 in 2020, where both its parameter count—the values that a neural network tries to optimize during training—and dataset size have increased tenfold. The downside to utilising GPT-3 in a project is that it requires a supercomputer to run it made available by Microsoft via a commercial application programming interface (API). It therefore becomes more of an energy problem—the extent of which is largely unknown—as the ML research community has shown little interest in energy consumption “because of their lack of familiarity with the current approaches to estimate energy” as well as the lack of power models in ML frameworks to support energy evaluation (García-Martín et al., 2019, p.75).

Although these upgrades do not invalidate the research already produced, they pose the question of how the assemblage production would change if the HAR and language models were updated. Future research could be carried out to determine if the combinatorial operations of the assemblage are more ‘acute’ with upgraded components. It is imagined that a finer-grained parsing of human action

by a model trained on a significantly larger dataset would generate greater variation in text labels with which to stimulate the language model.

Another avenue for future research in a less socially restricted environment will be whether the motion capture files, the archival British public information films and animated digital puppets that have been employed could be replaced with live human action in a participatory setting as originally intended in the proposal for *Real People* (Section 3.5.2).

Appendix A. Materials related to Practice Based Work

A.1. A is for Asteroid–Python script (snippet)

```
#!/usr/bin/env python3
# -*- coding: utf-8 -*-
"""
Created on Thu Oct 25 17:24:37 2018
"""
import json

with open('query2.json') as json_data:
    movieTitles = json.load(json_data)
    print(type(movieTitles))
    print(movieTitles)

with open('unsilveredGlass.txt') as x:
    reflection = x.read()

list_words = reflection.split()
set(list_words)
unsilveredGlass = list(set(list_words))

alphaGlass = sorted(unsilveredGlass)
print(" ".join(alphaGlass))

with open('movieTitles.txt') as y:
    movieTitles = y.read().lower().splitlines()

keys = unsilveredGlass
values = movieTitles
```

```
dictionary = dict(zip(keys, values))

with open('eclipses.txt') as z:
    eclipses = z.read()

totalEclipses = eclipses.lower().split()

alphaEclipses = sorted(totalEclipses)
print(" ".join(alphaEclipses))

translation = eclipses.split()

magneticFields = []

for word in translation:
    if word in dictionary:
        magneticFields.append(dictionary[word])
    else:
        magneticFields.append(word)

print(" ".join(magneticFields))
```

A.2. Three Examples of Misclassification

Figure 52 shows a film frame from the public information film (PIF) *Dark and Lonely Water*, labelled “driving tractor” by the ResNet HAR. The film frame depicts a cluster of children around some assorted debris in an anonymous wasteland. However, where is the visual evidence of a tractor being driven?



Fig.52. Video still. HAR analysis of a film frame from the PIF, *Dark and Lonely Water*.

The ResNet HAR model was trained using the Kinetics 400 dataset, which contains 922 videos depicting the act of driving a tractor (Kay et al 2017), four of which have been used in Figure 53 for comparison with the PIF film frame. On inspection, a number of the videos in the Kinetics dataset can be seen to contain images of children driving tractors. Some of these tractors are toys, peddle-driven or motorised, and some tractors are real-scale functioning machines driven by children, sometimes unsupervised, sometimes on the lap of a parent in the driving seat.



Fig.53. Composite of video stills. HAR analysis of a film frame from the PIF *Dark and Lonely Water* with selected stills from the Kinetics 400 dataset labelled “driving tractor”.

In terms of what is shown in the film frame from *Dark and Lonely Water* (Figure 52), nothing in the list of 400 actions within the Kinetics dataset comes close to accurately describing the action depicted. A problem of HAR and machine learning, in general, becomes apparent here: how can a model, trained on a limited number of examples, generalise what it ‘knows’ to examples it has not ‘seen’ before? How can it map what it has ‘learned’ onto novelty? A person looking at this section of the film will perceive images flowing coherently within an unfolding narrative. However, when analysed by the HAR model and classified with a label, it

is open to a different reading. Although fleeting, the outline of a tractor becomes apparent on a secondary inspection of the film frame, and the cluster of children appear approximately where a tractor driver would be found sitting. According to examples in the training dataset, the software seems to be keying into the tractor outline, which is validated by the presence of children who sometimes drive tractors.

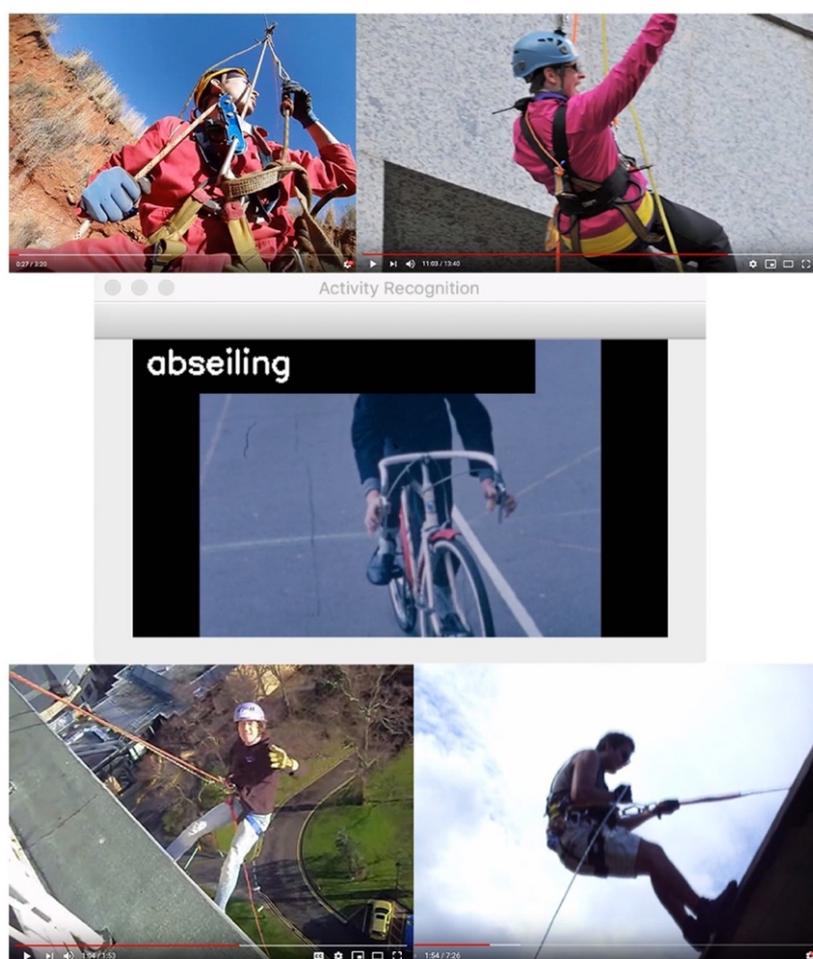


Fig.54. Composite of video stills. HAR analysis of a film frame from the PIF *A Boy Goes Cycling* with selected stills from the Kinetics 400 dataset labelled "abseiling".

Another tangible example of misclassification is seen with footage from the PIF *A Boy Goes Cycling*. A sequence depicting the action of a child riding a bicycle in a school playground is misclassified as “abseiling” (Figure 54). Reviewing a selection of the 1146 training videos in the Kinetics 400 dataset labelled as “abseiling”, a consistent feature is—unsurprisingly—linear ropes under tension. Going back to the *A Boy Goes Cycling* film frame, the painted lines on the playground become significant. In this particular frame, the body becomes the nexus of the converging playground lines. The bicycle frame is also a series of connected lines ‘ensnaring’ the body. It is tempting to create visual analogies where the painted playground lines become abseiling ropes, and the lines of the bicycle frame become the webbing straps of a climbing harness.

The film frame in Figure 55 from the PIF, *Dark and Lonely Water*, depicts a child in distress in the water and has been labelled “swimming backstroke”. This particular scene was labelled variously: “catching fish”; “snorkelling”; “swimming breaststroke”. These classifications are impressive in that they are in the same ‘semantic neighbourhood’—things that happen in the presence of water—but demonstrate that the ML model cannot make a distinction between swimming and drowning.

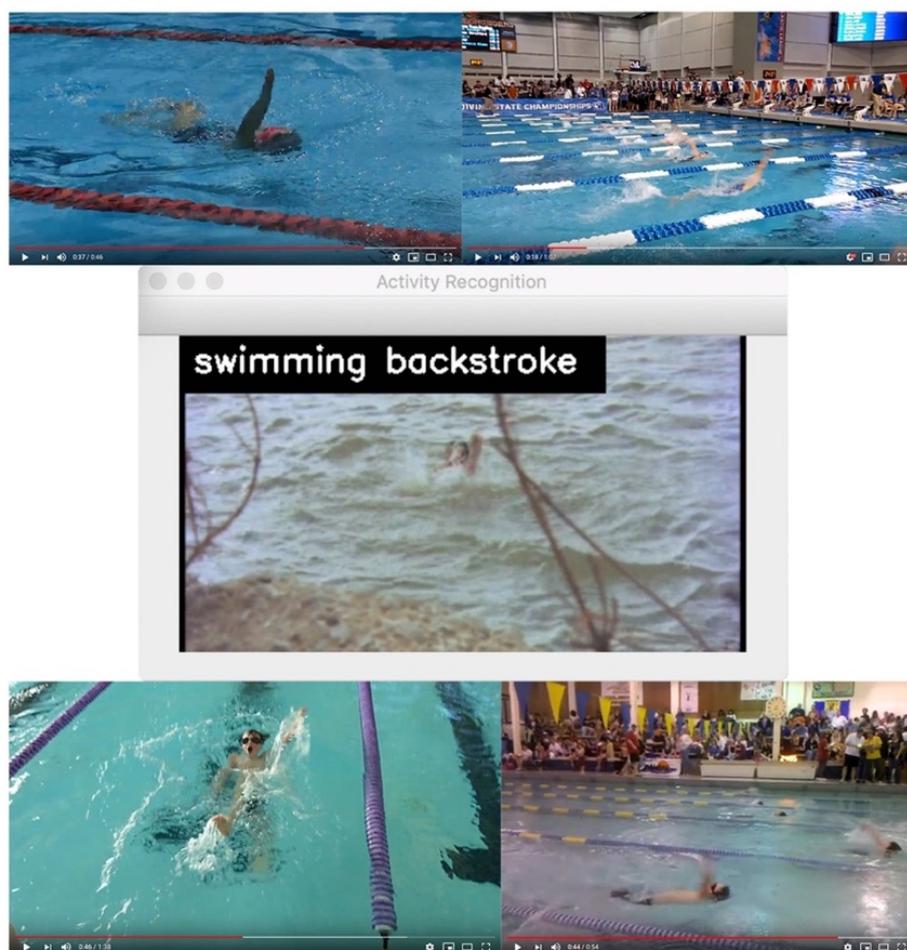


Fig.55. Composite of video stills. HAR analysis of a film frame from the PIF *Dark and Lonely Water* with selected stills from the Kinetics 400 dataset labelled “swimming backstroke”.

A.3. Eating Doughnut

Another example of human actions within 'semantic proximity', but with the nuances between the actions creating classification problems in the Kinetics dataset, include the act of “eating doughnut”, which is often confused with “eating burger” (Kay et al., 2017). As a way of testing for this confusion, Jørgen Leth’s documentary film *Andy Warhol Eating a Burger* was fed to a HAR algorithm (Figure 56). The result is a demonstration of analogical reasoning and adherence to the nearest-neighbour principle, where “playing didgeridoo”—among other instruments—is remapped

onto the triangulation between mouth and hands in a seemingly effortless superimposition.



Fig.56. Composite of video stills. HAR analysis of film frames from *Andy Warhol Eating a Burger*, from *66 Scenes from America*, directed by Jørgen Leth (1982).

Other class confusions are shown in Figure 57, indicating that eating classes are among the most difficult to classify, as they sometimes require distinguishing what is being eaten—and these may appear small and already partially consumed in the video. Dancing classes are also tricky, as well as classes centred on a specific body part, such as “massaging feet”, or “shaking head”.

Class 1	Class 2	confusion
'riding mule'	'riding or walking with horse'	40%
'hockey stop'	'ice skating'	36%
'swing dancing'	'salsa dancing'	36%
'strumming guitar'	'playing guitar'	35%
'shooting basketball'	'playing basketball'	32%
'cooking sausages'	'cooking chicken'	29%
'sweeping floor'	'mopping floor'	27%
'triple jump'	'long jump'	26%
'doing aerobics'	'zumba'	26%
'petting animal (not cat)'	'feeding goats'	25%
'shaving legs'	'waxing legs'	25%
'snowboarding'	'skiing (not slalom or crosscountry)'	22%

Fig.57. Top-12 class confusions in Kinetics. Source: arXiv:1705.06950v1 [cs.CV] 19 May 2017.

The ResNet HAR model has not been programmed to declare that the images within the film footage do not register with its 'knowledge about the world'—there is neither null nor void. Instead, through analogical reasoning, it adheres to the nearest-neighbour principle and finds the closest match from the labelled examples of the training dataset.

In practice, ML learning models are treated as black box methods, often leaving engineers no reasonable idea where the model is 'looking' in the image, and how the model arrived at its final output. This opacity creates authentication problems for the field: how can the decisions of a model be trusted if it cannot correctly be validated how the model arrived at a decision. Geirhos et al., (2019) have been challenging some accepted notions of how ML algorithms use shapes to identify objects. The computational neuroscientist Robert Geirhos explains that the systems work by splitting images up into tiny blocks, where decisions are made about the content of each of the blocks: this block contains evidence of "side kick";

this block contains evidence of “jumpstyle dancing”, or this block contains evidence of “juggling soccer ball”. Without regard to global scale relationships between parts of the image, decisions about the identity of things are made depending on the weight of evidence coming from these atomised blocks. This has proved to be surprisingly accurate but is counter to any assumption that neural networks solve tasks in a way similar to human thinking.

A.4. Method Is The Error–A Prompt For Two Language Models

As a way of exploring the language model’s latent space as a remix engine in Section 4.4, an identical prompt text was fed to two different GPT-2 language models (Figures 58–59), the first being trained on volumes of Michel Foucault, the other trained by OpenAI on a corpus of random of web text.

<p>GPT-2 Model Trained on Foucault</p> <p>Prompt = “method is the error”</p>	
1.	<p>Method is the error that it secretly gives rise to; error as such, in its very appearance, escapes the power of all criticism; it plays no part in the history of an art or of any other science. Criticism, in fact, runs the risk of rediscovering its ultimate secret, of revealing the precise character of error in general. It must be said that in fact this critique does play the role of a valid scientific method, but that, in so far as it defines a scientific method, it is not based upon a judgements of fact...</p>
2.	<p>Method is the error to be eliminated from empiricity, and the root from derivation; that is, we must not lay stress on its nonexistence, since it is in ourselves that we are. Hence a positive, conceptual attitude of inquiry, one that avoids that spiritual, spiritualizing dream, which conceals error, but which nevertheless eludes its expression. We must admit to error, and find its element in ourselves. As if there were a certain number of conditions in this attitude that could not fail to produce transcendental...</p>
3.	<p>Method is the error that keeps a useless discourse, and makes it perpetual, perpetually alternating between reproaches and indulgences. It is the discourse that is never excited again about anything. But it is not always the original difficulty of denouncing a lie or showing that it was not foisted upon men, but a discourse that tries to avoid being said, a difficult one - or which seeks to show that one cannot speak of such things. In the naturalist-science-discourse where truth appears as a single...</p>

Fig.58. GPT-2 Model Trained on Foucault.

<p>GPT-2 Model Trained on Random Web Text</p> <p>Prompt = “method is the error”</p>	
<p>1.</p>	<p>Method is the error ----- something went wrong. Go ahead and try again.</p> <p>Step 2 - Test the generator</p> <p>There are three basic ways you can test the generator:</p> <ul style="list-style-type: none"> -Start with the print command with the non-conformation command. Since the generator is always end up like the final string, look to see how it works: -Make a call. -Since we use this function, you have to change our default value to set the generated sequence to as far as possible. -If the generator generates a set of example numbers, you might want to add (1 to 1, 2 or 3) numbers or join those. To see how it works, check out: -Make random array assignment. -Remember to do the extra sorting with many digits! <p>For example, you might want to apply the least current number without any intervening loops. Lastly, the generated sequence can be written into a string as long as the length of its length is longer than the possible number.</p> <p>Next, let's look at the following examples:</p> <p>'Highlight' : \$1:2, \$2:3, \$3:4, \$4:5, \$5:6, \$6:7</p> <p>Result: \$2:4, \$3:4, \$4:5, \$5:6, \$6:7, \$7:8</p> <p>Res...</p>
<p>2.</p>	<p>Method is the error !!! At this point it would be hard to remember when this piece has been correct in the real world. The question is how did the sqlepack file include a Perl script and what does the Perl script support that?</p> <p>I have always assumed we should use a query language instead of code. But my first clue is that it is a Perl script and shouldn't be released without the Perl script. I have also previously discussed this issue with our authors. And how does one break those sections into a Perl script which b...</p>
<p>3.</p>	<p>Method is the error idshut.the_freetype flag and so on for the globals of ullibool(title, ullibool) instead of the object ullibool(title), so on the globals of ullibool(title, ullibool) instead of the object ullibool(title,...</p>

Fig.59. GPT-2 Model Trained on Random Web Text.

A.5. Text Outputs From The Three Fields Of View (FOV)

In Section 3.6.3, three different FOV were chosen for the same digital human animated with the same “idling” file. Figures 60–61 tabulate the following:

- 1) The text label produced by the HAR, which is fed to the Markov chain generator.
- 2) A selected output from the Markov chain generator, which is fed to the GPT-2 model.
- 3) The selected output from GPT-2. For the sake of brevity the character count was limited to 256 characters.

FOV-1		
1) Text label produced by ResNet HAR	2) Selected Markov chain generator output used as a prompt for GPT-2	3) Selected GPT-2 output
“tying tie”	“Tie a game with a sleeper”	“or a lover that you shouldn't have, or either at all. For there are times when you will be so exhausted from practicing that you will simply have to yield, and then there are times when, having shown affection for that person and considering the reason...”
	“Fasten or emotional ties”	“must also be cut: not that my body, my passions, my appetites have anything to do with them; nor are they even the effects of these desires; they have their cause in the mind, in the very movement of the soul, and in the slowness and muddled flow of d...”
	“Equality of the team”	“and the unity of the team. The normal formation, the principle that should guide his directness (if not, perhaps, his whole exercise of behaviour) and his ability to imitate the general style (if not, at least, his eagerness to play the part of philosoph...”

Fig.60. FOV-1.

FOV-2		
1) Text label produced by ResNet HAR	2) Selected Markov chain generator output used as a prompt for GPT-2	3) Selected GPT-2 output
“stretching arm”	“Any projection that is attached at the limits”	“of knowledge may, in fact, at any moment be undone: the unreality that joins all non-quantitative scales, the analogical scale, the unity of representation, the mathematical scale, to a single starting-point, a single cause, is not that of modern thought...”
“exercising arm”	“Some parents exercise their victims on the Iraqi border”	“in the desert or in the marshes where there are no other houses, so that in that region, one can draw a dividing line that can be used to separate the young boys from the older ones (who are sent back to the town); and finally, that one must keep i...”
	“He was licensed to carry a little rice”	“with him, and he was able to use it in daily life in several ways: to make soup, to wash his hands, to soak his feet and hands, to rub on sores, and so on. The fact that he was able to do all this shows that there was a specific way of living for him and for others in the city. It was not because of some kind of primitive...”

Fig.61. FOV-2.

FOV-3		
1) Text label produced by ResNet HAR	2) Selected Markov chain generator output used as a prompt for GPT-2	3) Selected GPT-2 output
"stretching arm"	"Unfold the entire body"	"or even the whole history of time in a single instant, and, by accumulating several moments of it all, one can reconstruct the passage in time that begins with the thought, and that ends with it and by linking the moment when it takes..."
	"Supply with arms"	"is a principle of defence; it is the right of the armed individual to own arms, that is the basic reason for the availability of arms, the economic necessity of arms, and for their historical development. The policy of restricting arms underli..."
	"Lie down comfortably"	"willing to close your eyes if need be. Proceed calmly through the night, working only as little as possible in order to strengthen the convulsive movement and thereby alleviate the headache. Lastly, the most important precaution, which I would like..."

Fig.62. FOV-3.

Appendix B. Materials related to Contextual Review

B.1. AI Art Manifesto

The AI Art Manifesto was created by the artistic collective of Natalia Fuchs, Peter Kirn, Chris Salter, Emilio Vavarella and Moises Horta Valenzuela during *A Postcard from the Future* online residency at the Futurological Congress in the frame of Transart Festival 2020 in Bolzano, Italy. The contextual review in Section 2.2.1 mentioned five statements, which were the most salient concerning the idea of apprehending a comprehensible and unambiguous working definition of AI. The fifteen statements are as follows:

1. Redraw the boundaries of what defines “intelligence” and “consciousness,” and distinguish our own perspective from the unknowable nonhuman perspective.
2. Employ AI as a means of breaking down systemic biases and limitations in our societies—and be empowered
3. Expose uses of AI that shift or hide accountability of the humans, corporations, and states that use it.
4. Be informed about biased datasets and approaches, instead constructing our own frameworks and techniques.
5. Root our work in a knowledge of the history of science, technology, and cultures.
6. Combine aesthetic approaches with ethics and responsibility.
7. Reveal AI as disembodied cognition, as an extension of human thought and culture, rather than promoting illusions of AI as autonomous where it is not.

8. Credit human labour and culture where it is used in AI datasets and frameworks, and reveal their impact on the results.
9. Develop literacy around machine learning that extends to non-engineers and artists, as those new audiences make use of AI techniques.
10. Favour accurate and transparent descriptions of AI over misleading anthropomorphising descriptions.
11. Use AI as an expressive means of illuminating rather than mystifying the realms of science and data, so that artists can be more fluent in their use of data as medium.
12. Reject AI as black box, in favour of openness and human-centred intelligence.
13. Re-embody the products of AI, re-centre them around the intelligent human user, rather than limit our notion of intelligence to a virtual abstract.
14. Embrace AI as creating originality, rather than copying and repurposing dead, already-produced output.
15. Work toward an AI of difference, rather than a singularity.

B.2. Trust Territories—in conversation with Albena Baeva

Having seen the work *Trust Territories* online, Natalie Fuchs and Albena Baeva were asked the following question: “I understand that you have trained the GPT-2 model on a corpus of ‘artworks-instructions’, but can I ask how you are ‘prompting’ the GPT-2 model to generate the instructions?”

Subject: Re: Trust Territories

Date: 9 August 2021 at 14:16:08 BST

Dear Bruce,

Thank you for contacting us.

We use google colab notebook to train and generate the Gpt-2 model when needed. The model is not active and accessible online at all times. The instructions are generated by giving the model initial sentence or word. For example The initial sentence for the following instruction was "Suitcase":

Suitcase

Suitcase[, 0][, [1 , 2], [3 , 4][, [5 , 6]];\n\n

I found the center of the suitcase and stuck my hand out, inviting the wind to pass through me and create sound in the new world.\n\n

The suitcase vibrates\n\n

And suddenly two large balloons float into view\n\n

One is full of fruit\n\n

The other with nuts and bolts\n\n

That is how I felt at first\n\n

Like I was dreaming

In response to the initial reply above, some clarification was requested regarding where the prompt word came from—was it generated through computation or imagined? Baeva responded:

Subject: Re: Trust Territories

Date: 9 August 2021 at 15:50:28 BST

The input comes from human imagination. The first thing we tried was using the titles from the original artworks, then we experimented with different phrases that we came up with. For the exhibition the phrases were connected with the process of drawing and sculpture

Appendix C. CRUMB Discussion List

C.1. Machine Learning in Art as a Remix Technique

As part of the research methodology, several respondents were invited to participate in the January 2021 CRUMB discussion list: Mark Amerika; xtine burrough; Scott Eaton; Rebecca Edwards; Luba Elliott; Julie Freeman; Natalia Fuchs; Andy Gracie; Hannah Redler Hawes; Libby Heaney; Nathan Jones; Irini Papadimitriou; Dr. Ellen Pearlman; Anna Ridler; Danielle Siembieda; Joel Simon; Jen Southern; Alexa Steinbrück; Nye Thompson; Addie Wagenknecht; Joanna Zylinska.

Short participant biogs can be found on the CRUMB list archive, available at:

<https://www.jiscmail.ac.uk/cgi-bin/wa-jisc.exe?A2=ind2101&L=NEW-MEDIA-CURATING&O=D&P=1008>

The respondents were prompted with the following text:

Current art employing artificial intelligence (AI) technology has been largely defined by a spectrum of activity, from the deep learning explorations of neural network researchers to artists critiquing the broader social implications of AI. While Dieter Mersch suggests that the myth of the *inspired machine* is perpetuated by the continued opacity and mystery of the algorithmic black box, it has been observed, as an underlying condition, that outside of the scientific domain there is a dearth of language with which to discuss AI in an art context. It seems that the language and understanding needed to discuss art created using AI and its subset machine learning (ML) has yet to be fully formed. The introduction of ML as a tool in art has increased the complexity of human attribution, and recent controversy around AI/ML-enabled art has been concerned with questions of authorship, copyright, appropriation, collaboration and remix. All of these terms are keywords in remix studies, which leads to the question—can the conceptual repertoire that exists for remix studies open up to art enabled by AI/ML?

With the emergence of and increasing access to new tools and techniques that can repurpose and manipulate material in unprecedented ways in the making of 'new' work, the terms associated with remix resonate strongly. However, there is an implicit understanding that the cut-copy-paste metaphor has become redundant. So how are these types of operations to be thought about in high dimensional vector space?

I would like the invited respondents and anyone from the wider list community, to consider any artistic work (something you have curated, made

or experienced) that has been enabled in some way by AI/ML, and elucidate potential relations to any of these selected terms from the lexicon of remix studies:

appropriation / archive / authorship / bricolage / collaborative / copyright-fair use / creativity / cut-up / deconstruction / intellectual property / mashup / memes / parody / remix / sampling / transformative⁵⁶

Wed, 6 Jan 2021 10:18:02

C.2. Trustworthy AI–Manuela Naveau

(...) based on your email and the keywords like AI and parody, deconstruction and EU-expectations like “trustworthy AI”... I would like to highlight the latest work from my students at Interface Cultures Linz/Austria. The Chiromancer is a hand reading AI that writes predictions about a person’s life. This machine upgrades the ancestral practice of palm reading, hybridizing biometric data with a cybernetic infusion of cloud-based knowledge. Like many of the other devices we are using today it collects, stores and extrapolates user data. The Chiromancer explores how trust, hopes and wishes are put into seemingly cold machines. The Chiromancer is a collaborative work that is part of the artists separate ongoing research at the Interface Cultures department in Linz, Austria. One of the artists is Giacomo Piazzi (IT). He focuses on human’s innate tendency to project intelligent behaviour and meaning onto inanimate objects; as part of his research he builds thinking machines connected to the Internet and employing artificial intelligence. Matthias Pitscher (DE) focuses on the impact of artificial intelligence on society, specifically how the

⁵⁶ Terms selected from “Keywords in Remix Studies” (Navas, Gallagher and burrough, 2018).

extraction of large datasets from the web are forming unintended biases in current machine learning applications. The main question is TRUST here: Do we trust in AI? Shall we trust in AI? Is it even an old thinking in trusting in technology? What does trustworthy AI (as highly promoted on EU level) actually mean? But is this not exactly what Chiromancers are doing? Asking you who you are and presenting actions that are vague and open for multiple interpretations, as it is just about probabilities? But above all: Shouldn't we humans be as critical of AI as we are of hand readers? Or maybe even the other way round, meaning: if we ended up in a world, in which we trust AI systems, why don't we give more space to those of us, who search for other ways of believe and trust or even a value system based on diverse forms of spirituality? (...) I absolutely agree in terms of language and AI/ML... this is why I am highlighting Wittgenstein in one of my courses __)

Wed, 6 Jan 2021 21:07:36

C.3. AI/ML Techniques in Remix Studies–xtine burrough

The author posted:

I am curious why, with references being made to remix practices of 20th century avant-garde literary experiment by the likes of Allison Parrish, Algotit, the cryptic tweets of Horse_ebooks from 2011 and others, there is no mention of AI/ML-enabled technique in either "Keywords in Remix Studies", (2018) or "The Routledge Companion to Remix Studies", (2015). Perhaps there will be in future iterations?

Fri, 8 Jan 2021 17:00:47

xtine burrough replied:

I would like to share a couple of works of art that are on-topic for the theme this month—I’m sure I’ll get a chance to do that in a bit; for now I will prioritize responding to your question with: YES! Eduardo Navas, Owen Gallagher, and I are just right now sending proofs to the publisher for a third anthology, *The Routledge Handbook of Remix Studies and Digital Humanities*. In it there are multiple chapters that address AI/ML-enabled techniques in the context of both remix studies and DH. I wrote about the projects I will share on this list (later); Alessandro Ludovico wrote about machine-driven text remixes, Eran Hadas and Mark Amerika both wrote about their creative practices, which include remix, AI, and ML. I am excited for these creative practices to be narrated and shared in this context. You can see a TOC at the landing page on the publisher’s site⁵⁷

Sat, 9 Jan 2021 10:16:02

C.4. Data/Set/Match and remix–xtine burrough

Thank you for sharing your works, Nathan, Nye, and also the Real-Time Constraints exhibit, Rebecca. I wanted to also share with you a couple of projects on this month’s theme, as I note similarities in approaches to interrogating ML/AI (in my case, especially looking at a data training set) with remix.

In 2020 I was part of The Photographers’ Gallery (London) year-long program, “Data/Set/Match”.

<<https://thephotographersgallery.org.uk/content/data-set-match>> I think all

⁵⁷ <https://www.routledge.com/The-Routledge-Handbook-of-Remix-Studies-and-Digital-Humanities/Navas-Gallagher-burrough/p/book/9780367361426>

of the artists and pieces developed for the media wall at The Photographers' Gallery would be relevant to our discussion.

The pieces I made, *A Kitchen of One's Own*⁵⁸ and *Epic Hand Washing in a Time of Lost Narratives*⁵⁹ were developed with my collaborators Sabrina Starnaman and technical director, Dale MacDonald. Both projects confronted the training data—a set of videos—from the Epic Kitchens 2018 data set. For both projects, we created a parallel set of data (quotes) to transform what we imagined the researchers to have considered “neutral” video footage of people working in their kitchens into visual narratives that forward stories of women in the domestic and professional kitchen spaces. The resulting display (the “Kitchen” piece for the media wall and “hand washing” for the browser—a piece we made, rather quickly, in response to being confined in our homes starting in March last year) remixes those videos from Epic Kitchens into stories about women and the #MeToo movement (Kitchens) and stories about humans and hand washing during plagues and epidemics (Hand Washing).

While I do think of these projects as remixes, I don't think of them, strategically, as efforts in “cut, copy, and paste” (which sounds very physical). I tend to think of artworks in their formal and conceptual dimensions. Formally, these are works in juxtaposition and computation. Conceptually, they are narrative interpretations and translations; and their complexity is a result of the way this interpretation hinges on understanding that the “cutting and copying” from multiple players—the stories (the quotes in our datasets), and the machines (rules for the Ai/ML, keywords tagged to training data information, and the videos in the training set) are in conversation with the media wall display itself (which also includes a set of rules or constraints) or

⁵⁸ <https://thephotographersgallery.org.uk/akitchenofonesown>

⁵⁹ <https://thephotographersgallery.org.uk/epichandwashing>

the browser (another set of constraints—both in terms of how media is played and how people view/interact with it). As these various factors are conceptually “processed” by humans (myself, Sabrina, and Dale) in the production of art (the “something new”)—“cut, copy, and paste” may seem like an identifiable way to explain the process. But, I prefer how “remix” conjures appropriation, juxtaposition, and computation.

Sat, 16 Jan 2021 16:21:29

C.5. Introduction to AI-art—Joanna Zylińska

Bruce’s opening statement that “outside of the scientific domain there is a dearth of language with which to discuss AI in an art context” was something that drove my own modest attempt to explore how we can approach the recent outpouring of artefacts and discourses around AI. This attempt took the form of a short open-access book called */AI-art: Machine Visions and Warped Dreams/*, which I hope will be of interest to the members of this list. The book can be downloaded from Open Humanities Press’ website.⁶⁰ I start there from a critique of the dominant AI aesthetics. Much of the AI-art that has recently gained public recognition seems to be premised on generating visual and algorithmic variations within the enclosed system. This kind of ‘generative’ AI-art celebrates the technological novelty of computer vision, fast processing power and connection-making algorithms by regaling us with a dazzling spectacle of colours and contrasts as well as the sheer volume of data. As a result, it becomes a glorified version of Candy Crush

⁶⁰ <http://www.openhumanitiespress.org/books/titles/ai-art/>

that seductively maims our bodies and brains into submission and acquiescence.

Naturally, this assessment of the situation is aimed as a provocation—but it is also an invitation to the art community to seek more complex and more inquisitive forms of artistic practice produced with (or about) AI and ML. And it's also meant as a call to acknowledge the important historical antecedents of AI-art, be it in robot art or netart. Myself, I have looked at Leonel Moura's Robot Art, Katja Novitskova's 'Art for Another Intelligence' and projects by the intersectional feminist collective voidLab included in the 'Feminist Climate Change: Beyond the Binary' at the 2017 Ars Electronica as practices that open the emergent field of AI-art in some interesting ways, both aesthetically and conceptually. As part of the book, I have also engaged in a faux-collaborative art project with a view to investigating questions of human and machine labour in the contemporary production of images and values. Conceptually, I wanted to challenge in the book the frequently posed question: 'Can computers be creative?', by showing why this may not be the best question to ask about AI. For me, the question is quite reductive because it is premised on a pre-technological idea of the human as a self-contained subject of decision and action. The 'computer', be it in the shape of a data-processing machine, a robot or an algorithm, is only seen here as an imperfect approximation of such a human. But we should rather be asking (with Flusser, Stiegler and others) whether the human can actually be creative, or, more precisely: in what way can the human be creative? Bruce's and xtina's ideas about the remix and appropriation are some possible avenues that allow us to explore this question in practice, beyond the fantasy of creativity as creation /ex nihilo/ that is driven by the originality and self-sustaining agency of the person called 'artist'. Mark America's idea of the artist as 'An average of me's, a movement in the crowd', as evidenced in his

and Laura Kim's book */Remixing Persona/*, is such an apt performance of this point.

In this context, I find the questions posed by Andy Gracie about the use of platforms and tools such as ML Runway, and about the possibility of doing something new, interesting and 'original', very thought-provoking. His *Catastrophe Jangled Hideously Out of Process*, in which an algorithm tried to imagine the world 'after us', looks like a beautifully smart example of an art project that both explores the limits of ML-generated aesthetics while challenging the notions of imagination and the image as predominantly human-centric. It's also great to hear Mark, Bruce and xtine talk about their own and others' exciting experiments with writing, texts and concept-generation, i.e. about works that go beyond /just/ the exploration of visuality, as part of the creative AI/ML field.

Sun, 10 Jan 2021 12:54:24

C.6. High-dimensional Space Remix Metaphor–Danielle Siembieda

Can the conceptual repertoire that exists for remix studies open up to art enabled by AI/ML? In the article "DataRemix: Designing the DataMade" in Leonardo journal the authors define DataRemix as "the reappropriation and recombination of data in any and all states along the continuum of its transformation from raw to processed." While remix culture may traditionally be associated with sampling, cut/paste, it has also seen the data as moldable and in many cases collaborative (...)

Bruce thank you for introducing me to the clear overview of high-dimensional vector space. I've had an image in my mind of this the entire year but didn't have the words to accurately describe it. What I find missing from the ML

connectors is additional context, empathy and ephemera. I can see this as an open window for artists. If you are, for example, taking in thousands of hours of transcripts and trying to identify patterns, you may find common words or connectors, yet the non-verbal cues, the hesitated paused and inflections the engine may miss. This gap is an opening for the artists in this field.

Sat, 23 Jan 2021 05:53:50

C.7. High-dimensional Space Remix Metaphor—Julia Kaganskiy

I was quite intrigued by Bruce’s question regarding how the metaphors and operations of “remix” culture might need to be reframed and re-conceived in relation to high-dimensional vector space. For me, this constitutes a key point of difference from traditional remix practice and bears further scrutiny. In my experience, rather than produce a mash-up or bricolage, ML tends to transmogrify its material in ways that feel more hybridised, chimeric, and elastic. The original material is not simply reproduced and recontextualised but rather distorted and warped, as if seen through a funhouse mirror. This makes me think that the notion of “diffraction”, inspired, in part, by the writing of Haraway and Barad⁶¹ could be a useful concept to introduce here. As an optical metaphor, diffraction typically refers to the bending and spreading of light, producing interference patterns. As Barad explains, citing Haraway, “diffraction is marked by patterns of difference” yet does not simply map where differences appear but rather “maps where the *effects* of differences appear.”

To me, this is reminiscent of the way ML models spatially map information according to categorical similarity/difference—perhaps we can say that AI-art

⁶¹ <http://www.shandakenprojects.org/otherassets/intensive2014/barad.pdf>

does not so much “remix” material as “diffract” it, or filter it through “diffraction patterns” produced through the process of categorisation. Pasquinelli and Joler similarly use an optical analogy to describe the material-semiotic effects of AI in their Nooscope⁶² “the information flow of machine learning is like a light beam that is projected by the training data, compressed by the algorithm and diffracted towards the world by the lens of the statistical model.”

Sat, 23 Jan 2021 20:59:47

C.8. High-dimensional Space Remix Metaphor–Libby Heaney

I’ll pick up the thread around hybridity and diffraction in relation to ML as it’s something I’ve been thinking about for a while. What you said Julia makes total sense to me. I wrote an article for the V&A’s Digital Design Weekend 2018 on the topic of diffraction in relation to NLP chatbots⁶³: This is what I wrote at the time: “Here for brevity, I turn solely to the concept of diffraction introduced by Harroway and subsequently developed by Barad. Diffraction is a physical process by which a seemingly coherent signal consisting of light or matter splits into several beams travelling in different directions. Diffraction stands up to reflection, by mapping where the effects of differences occur. Reflection displaces the existing, whereas diffractions (re)imagines and (de)constructs. This *material* dispersion is contingent on the constituent components of the signal (including any noise) and the apparatus. Chatterbots may diffract canonical histories and stories into strange new forms. For instance a deep learning algorithm generating text at character

⁶² <https://nooscope.ai/>

⁶³ https://digitransglasgow.github.io/ArtificiallyIntelligent/contributions/15_Noisy.html

level, trained on, for instance, a data set of speeches by western world leaders, might be expected to replicate typical western rhetoric. Whereas by experimenting with the parameters of the neural net and the quality or quantity of the data set, 'good noise' may form the signals, diffracting a canonical history into multiple worlds.

Diffraction plays a crucial role in storytelling in two ways. Firstly, it provides a model for how dominant narratives become dominant in the first place. At any time, a multitude of signals are present for any phenomena, containing an ecology of histories, potentialities and fragments. Power structures enable certain discourses to be given more weight than others. These discourses are repeated and strengthened and are materialised.

Alternative narratives that were present in the sea (for instance correctly identifying the NSA drone targets as civilians), cancel each other out and are diminished. However, unconventional uses of machine learning algorithms may fracture this. Particularly when the data set modelling a phenomena is incomplete or has unusual features. By shifting the apparatus and altering the input, diffraction may strengthen hidden patterns, splitting up dominant ones."

In my opinion, ML/NLP can be used either to reflect or diffract information or anything in between, depending on the intention (or lack of it), by the human coder/user. Remembering that information is always physical (Landuaer 1961), Barad posits reflection as a counter to diffraction. My practice explores how working with ML/AI etc (and other tech) diffractively may move away from the biased fixed categorisations (or reflections) ML models usually propagate, which can increase alienation/control e.g Automating Inequality (Eubanks 2018; "Algorithms of Oppression", Noble 2018). Rather, how can diffractive processes with ML (or any tech) open up new potential for future change?

My recent video essay *FIGURE, figur€\$, go figure!?* explores these themes again albeit in relation to representations of the body in computer vision (particularly OpenPose algorithm). A diffractive methodology is implicit within the video, but the ideas around multiple signals, potentialities actualising into categorisations is present. There's so much to explore in this area—I'm currently fleshing out ideas around diffraction/hybridity in relation to ML further in a book chapter, and also in forthcoming artworks.

Sun, 24 Jan 2021 09:30:35

C.9. Conceptual Blending and Machine Learning—Alexa Steinbrück

I would like to throw in the idea of “conceptual blending” (Fauconnier/Turner) and “combinatorial creativity” (Margaret Boden), which seem to have many links to remix studies.

Margaret Boden, an AI researcher and cognitive scientist, describes three types of creativity: combinatorial, exploratory and transformational.

Combinatorial creativity generates novel combinations of preexisting ideas, states, concepts or objects. The combinatorial perspective is particularly interesting for Artificial Intelligence because it allows creativity to be modelled as a search process through the space of possible combinations.

The cognitive psychologists, Gilles Fauconnier and Mark Turner developed the theory of Conceptual Blending, which describes the process of combinatorial thinking. Conceptual blending involves two input concepts that, according to a given structure mapping, will generate a novel concept, called blend. This new concept will maintain some structure from the input concepts, but sometimes also exhibit new structural features that emerge through the process. In my bachelor thesis for Artificial Intelligence at the

University of Amsterdam, 2013⁶⁴ I developed a simple framework for conceptual blending in the visual domain. It describes the automation of the image construction process which “copy-pastes” image parts whose labels have a big semantic distance. To gather semantic knowledge I used the ontology “Wordnet”. Needless to say, this (naive) approach was before the big machine learning hype. So how does conceptual blending manifest itself in the “Machine learning era”? Machine learning’s capability to encode meaning in vectors and then do maths with these encodings adds an exciting new set of tools to implement conceptual blending.

Mon, 25 Jan 2021 17:28:44

⁶⁴ <https://staff.fnwi.uva.nl/b.bredeweg/pdf/BSc/20122013/Steinbruck.pdf>

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