

ALPHA VERSION, DELTA SIGNATURE: COGNITIVE ASPECTS OF ARTEFACTUAL CREATIVITY

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ABSTRACT

In this paper I explore the cognitive aspects of artefactual creativity in new media art. Starting with a concept of combinatorial inventiveness which is central to artefactual creativity, I summarize its roles in the arts and culture, leading to its applications in new media art. With regards to the diversity of practices in this domain, I focus on generative art projects created primarily by processing the material from cinema, television and the Internet. These projects blend procedural thinking with bricolage, leverage complex technical infrastructures, foster curiosity and encourage vigilance in our critical appreciation of the arts, technology, culture, society, and human nature. I discuss their methodologies, poetic features, cultural and social contexts in three sections which exemplify the effects and consequences of computational paradigm: database logic, statistical abstraction, and quantification. Throughout each section, I outline the theoretical considerations that can be deduced from the examples, and expand on them in the concluding section which examines the artists' creative motives and circumstances for analogizing and meaning making in relation to the cognitive and ethical implications of generative new media art.

Keywords: Artefactual creativity; Artificial intelligence; Combinatorial inventiveness; Generative art; New media art.

1. INTRODUCTION

1.1 COMBINATORIAL INVENTIVENESS

Combinatorial inventiveness is the ability to use existing ideas or artefacts as malleable components or tools for making new ideas or artefacts. It is essential in all manifestations of human creativity, from language, social and political relations, to the arts, science and technology (Boden, 2004). In language and in the arts, it emerges from cognitive processes such as connecting the existing and the new, comparing the known and the unknown, and analogy-making (Hofstadter & Sander, 2013). Combinatorial inventiveness in the arts and culture manifests in a range of creative procedures such as mashup, remix, pastiche, interpretation, free copy, allusion, citation, derivation, *détournement*, reprise, reference, reminiscence, homage, parody, imitation, forgery and plagiarism (Grba, 2010; Boon, 2013). With continuous recurrence of themes, motifs, forms and techniques, these procedures are among the key expressive and developmental factors in the arts throughout history. Combinatorial inventiveness enhances artistic experience because it induces pleasure through recognition of source materials and models, and their interrelation with new poetic elements. It catalyzes unexpected feelings or meanings which can incite us to reappraise the source materials and models, and learn something new from them. It can also help us envision *ourselves* more clearly in various broader frameworks and scenarios: cultural, behavioral or political. Combinatorial inventiveness usually raises public attention in instances when a new artwork which references some copyrighted, commercially or otherwise prominent artefact becomes itself prominent, inciting the conflict of “creative interest” between two or more parties (Ferguson, 2011). ¹The obvious or implied creative use of cultural artefacts has been legitimized in different ways throughout the twentieth century art: from Cubism and Dada, through Pop-Art, Fluxus and Conceptual Art, to Postmodernism in which it became a critical strategy for undermining the concepts of authenticity and originality (Haber, n.d.). Today it exists in many flavors and plays an important role in new media art.

1.2 GENERATIVE ART AND BRICOLAGE

New media art is a rich repertoire of creative work based upon the experimental exploration of emerging technologies (often in correlation with scientific research), which continuously redefine the notions of traditional and new, and challenge the distinctions between artistic process, experience and product. Combinatorial inventiveness in new media art manifests through applications of diverse techniques for transforming existing ideas, transactions and data, and for exploring the expressive potentials of computational processing of cultural phenomena. It is central in generative art, which includes heterogeneous practices based upon consciously and intentionally interfacing the predefined

¹ Lawrence Lessig extensively discussed the conceptual, legal, political, economic and social issues of combinatorial inventiveness, copyright and intellectual property within the context of new media art and digital culture (Lessig 2001; 2008).

systems with different factors of unpredictability in preparing, producing or presenting the artwork (Grba, 2019, pp. 4-5). These practices explore the uncontrollability of the creative process, underline and sometimes aestheticize the contextual nature of art. Like all other human endeavors, the arts take place in a probabilistic universe and always emerge from an interplay between control and accident, so in that sense all the arts are generative. However, the awareness that it is impossible to absolutely control the creative process, its outcomes, perception, reception, interpretation and further life—which is not always the principal motivation for artmaking—becomes crucial in generative art (Dorin et al., 2012). Generative art appreciates the artwork as a dynamic catalyzing event or process, inspired by curiosity, susceptible to chance and open for change (Grba, 2015). In its broad spectrum of endeavors, generative new media art frequently entails bricolage.

Bricolage is a creative approach that combines the affinity and skills for working with tools, materials and artefacts available from the immediate surroundings. Reflecting the necessity-driven pragmatism of Italian neorealist filmmakers in the 1940s and 1950s (Giovacchini & Sklar, 2013), bricolage became popular with *arte povera* movement during the 1960s as a critical reaction to the commodification of the arts. Since then, it has been adopted and explored in various disciplines including philosophy, anthropology, sociology, business, literature and architecture, and has become almost transparent in a wide range of artistic strategies. Discussing the concept of bricolage in *The Savage Mind* (1962), Claude Lévi Strauss noted that a bricoleur accumulates and modifies her handy means (operators) without subjecting them to a predefined objective, but the objective gets shaped by the interactions between operators (Mambrol, 2016) through analogy-making and discovery. Bricolage is therefore integral to new media art projects which constantly push the envelope of methodology, production and presentation through playful but not necessarily preordained experimentation with ideas, tools, and cultural resources.

2. SORTING THE DATABASE CULTURE

In our massive cultural production and consumption, various phenomenological aspects of everyday life can be quantized and approached as datasets. New media artists combine statistical tools with computation techniques to accumulate, categorize, process, transform and interact these datasets into new works that help us discover and compare the analogies, trends, regularities, and trivialities in mass-produced culture. Adding an ironic twist to Jean-Luc Godard's encyclopedic approach to cinema, epitomized in *Histoire(s) du cinema* (1989-1998) (*Histoire(s) du cinema*, 2020), these artists transform the primary database operation of sorting into a conceptual device. Since the 1990s, they explore the supercut² as a generative mixer of cinematic and cultural tropes.

2 Supercut is an edited set of short video or film sequences selected and extracted from their sources by at least one recognizable criterion. It inherited the looped editing style from Structural film in the US during the 1960s which developed into the Structural/Materialist film in the UK in the 1970s (McCormack, 2011). By focusing on the specific elements (words, phrases, scene blockings, visual compositions, shot dynamics, etc.), supercuts accentuate the repetitiveness of forms, routines and clichés in film, television and other media such as literature and music.

For example, Matthias Müller's *Home Stories* (1990) is a collage of different scenes from Hollywood melodramas of the 1950s and 1960s, filmed directly from the television set, and edited into a series of recurring motifs of cinematic thrill such as uneasy sleep, getting up, listening at the door, turning on the lights, being startled, etc. (Anonymous, 2020). In Jennifer and Kevin McCoy's installation *Every Shot, Every Episode* (2001) a strict application of sorting algorithm rearranges the complete television serial *Starsky and Hutch* into a collection of shots organized according to 278 formal and thematic criteria, such as every zoom in/out, every clock, every affirmative response, every disguise, every female police officer, etc. Shots in each category are sequentially arranged on DVDs that the visitors can play freely on parallel displays (McCoy, 2020).

Taking slightly broader selection criteria, supercut morphs into a condensed micro-narrative in the works such as Christian Marclay's *Telephones* (1995) (Anonymous, 2019) and *The Clock* (2010) (The Clock (2010 film), 2019), Tracey Moffatt's *Lip* (1999), *Artist* (2000), *Love* (with Gary Hillberg 2003) and *Doomed* (with Gary Hillberg 2007) (Tracey Moffatt, 2020), or Marco Brambilla's *Sync* (2005) (Brambilla, 2020). These self-referential structures follow thematic and formal logic, and extract the essential components of screen culture. Exploring the possibilities for reproducing film imagery, Virgil Widrich elaborated the supercut micro-narrative in *Fast Film* (2003). It was assembled by making paper prints of the frames from selected movie shots, which were then reshaped, warped, torn and sequenced into new animated compositions. In 14 minutes, *Fast Film* provides an engaging critical condensation of key cinematic tropes such as romance, abduction, chase, fight, escape, deliverance, etc. (Widrich, 2003).

With the explosion of online video sharing since 2005, the supercut became a popular Internet genre, but it has remained a strong artistic device. Kelly Mark's post-conceptual installations *REM* (2007) and *Horroridor* (2008) spiced it up with ironic existential overtones through daily manual aggregation and filtering of television broadcasts (Mark, 2020). In several manually aggregated works such as *Timeline* (2010) (Dyment, 2010) and *Watching Night of the Living Dead* (2018) (CBC, 2018), Dave Dyment expanded micro-narrative supercut into a full feature format which yields generative wonder out of pop-cultural proliferation. To make *Watching...*, Dyment collected hundreds of scenes from movies and TV shows in which people are watching George Romero's film *Night of the Living Dead* (1968). He curated and arranged them along the editing track of the original to reconstruct the complete zombie classic as a *mise-en-scène* of other films and TV programs (Hosein, 2018).



Figure 1: Julian Palacz, *Play it, Sam* (2012). Installation view. Image courtesy of Julian Palacz.

The supercut became automatic and interactive in Julian Palacz's installations *Algorithmic Search for Love* (2010) (Palacz, 2010) and *Play it, Sam* (2012) (Palacz, 2012). Referring to McCoy's poetic of sorting, *Algorithmic Search for Love* invites visitors to a playful discovery by entering a search phrase that generates a sequence of all video snippets with matching spoken phrases found in the project's library of films. In *Play it, Sam*, visitors can play a classical piano to prompt a sequence of snippets from feature films in which the corresponding piano keys were pressed.



Figure 2: Jonathan Harris and Greg Hochmuth, *Network Effect* (2015). Screenshot.

With *Network Effect* (2015), Jonathan Harris and Greg Hochmuth routed the interactive supercut to the diversity and anxiety of online cultures (Harris, 2015). They designed a web search interface in which the keyword selection returns a media stream from an online database of 10,000 video clips, 10,000 spoken sentences, news, tweets, charts, graphs, lists, and millions of data points. By limiting this overwhelming but addictive experience to between 6 and 10 minutes depending on the average life expectancy in the viewer's country, *Network Effect* confronts us with the reality of corporate online media which often frustrate any attempt at experiential completeness and induce the fear of missing out.

The poetics of the automated supercut reached its radical reduction and critical assessment with Sam Lavigne's open-source Python applications *Videogrep* (2014) which generates video supercuts by searching the input query through subtitle files of an arbitrary collection of video files (Lavigne, 2019), and *Audiogrep* (2015) which transcribes an

arbitrary collection of sound files and creates audio supercuts based on the input query (Lavigne, 2020).

Pushing the conceptual logic of automated supercut further leads to the machine learning systems that construct supercuts by searching through large media datasets for an arbitrarily selected artefact or a collection of artefacts. In *Muse AI Supercut* (2017) commission for the rock band Muse, digital agency Branger_Briz designed an ML system that generates daily supercut music videos in which every word of the Muse's song *Dig Down* (2017) is voiced by a different notable person from the online videos (Branger_Briz, 2017; Muse, 2017).



Figure 3: Branger_Briz (Ramon Branger, Paul Briz, Nick Briz, Brannon Dorsey and Pedro Nel Ovalles), *Muse AI Supercut* (2017). Project case study screenshot. Image courtesy of Branger_Briz.

The innovative approaches to granular database searching and editing in these projects advance our understanding of the formal characteristics of animation, film, television and the Internet, and expand our view on their experiential effects, social roles and consequences. They also demonstrate that there is no such thing as “restricted creativity” but rather that creativity thrives on restrictions.

3. STATISTICAL FLAVORS OF ART

Extending the logic of systematic selection, new media artists have been combining computational tools with statistical methods to explore the narrative and expressive potentials of automated accumulation, rearrangement or interpolation of cultural artefacts. Since the 1990s, Jason Salavon has been processing various mass-media contents into refined visuals with peculiar aesthetic identity between infographics and abstract art. In *Figure 1: Every Playboy Centerfold 1988-1997* (1998), the artist merged all Playboy centerfolds from 1988 to 1997 into a single image using custom mean and median averaging (Salavon, 1998), and in *Every Playboy Centerfold, the Decades (Normalized)* (2002) he merged all Playboy centerfolds by decade from the 1960s to the 1990s (Salavon, 2002a). In *100 Special Moments* (2004), he averaged the sets of one hundred conventionally themed stock photographs taken from the Internet: kids with Santa Claus, winter baseball league, the weddings and the graduations (Salavon, 2004). *Portrait* (2010) comprises four averaged composites of all the portraits by Frans Hals, Rembrandt van Rijn, Antonis van Dyck and Diego Velasquez exhibited in the Metropolitan museum

3 Apophenia is a tendency to establish meaningful patterns within random data in general, while pareidolia is a tendency to recognize patterns within random visual data (Anonymous, 2014).

(Salavon, 2010). In several video works such as *Everything, All at Once* (2001) (Salavon, 2001), *Everything, All at Once (Part II)* (2002) (Salavon, 2002b) or *The Late-Night Triad* (2003) (Salavon, 2003), Salavon subjected TV imagery to radical abstraction through color averaging and slit-scanning. In *Everything, All at Once (Part II)*, for example, a workstation averages every incoming frame of TV video signal into a single line of color and adds it in real-time to an unfolding color strip with original live soundtrack. Using a remote control, the visitors can surf the channels of Time/Warner Cable program to manipulate the continuous animation in which the cuts and channel changes show as sharp horizontals, and zooms or other compositional changes as curves.

In a series of prints titled *Motion Extractions / Stasis Extractions* (2007-2009), Kurt Ralske concentrated on the aesthetics of sequential image sampling according to the degree of motion within shots from various film classics such as *Student of Prague* (dir. by Paul Wegener, 1913), *Faust* (dir. by F. W. Murnau, 1927), *Citizen Kane* (dir. by Orson Welles, 1941), *The Seventh Seal* (dir. by Ingmar Bergman, 1957), *Alphaville* (dir. by Jean-Luc Godard, 1965), *2001 Space Odyssey* (dir. by Stanley Kubrick, 1968), etc. For *Stasis Extractions* he sequentially extracted and inter-dissolved only the frames in static shots, and for *Motion Extractions* only the frames in shots with movement (Ralske, 2007-2009).

With his bachelor graduation project *Cinematics* (2011), Frederic Brodbeck rounded up the logic of infographic processing of the moving image into a Python application. It provides an interactive learning experience through “synoptic” analysis of arbitrarily loaded films according to a number of criteria such as duration, average chromatic values, number of cuts, and sequence movement dynamics. It also allows comparison between the original version of a film and remakes, all films by the same director, films by different directors, by genre etc. (Brodbeck, 2011).

Multi-frame layering, averaging or collapsing in these works eliminate the details and reveal the formal and compositional trends in the source material, but also indicate some of the aesthetic preferences, as well as biases, in human visual perception. However, perceptual biases such as apophenia and pareidolia³ can be applied for analytical learning through extraction, rearrangement and comparison. For example, Benedikt Groß and Joey Lee’s online project *Aerial Bold* (since 2016) utilizes pareidolic effects to turn the alphabet shapes found in aerial imagery into a generative typeface. The project features a detailed documentation, a font catalog and an interactive word processor where visitors can enter text and choose the font size, line spacing, different font classes, and locations (Groß, Lee et al., 2016).

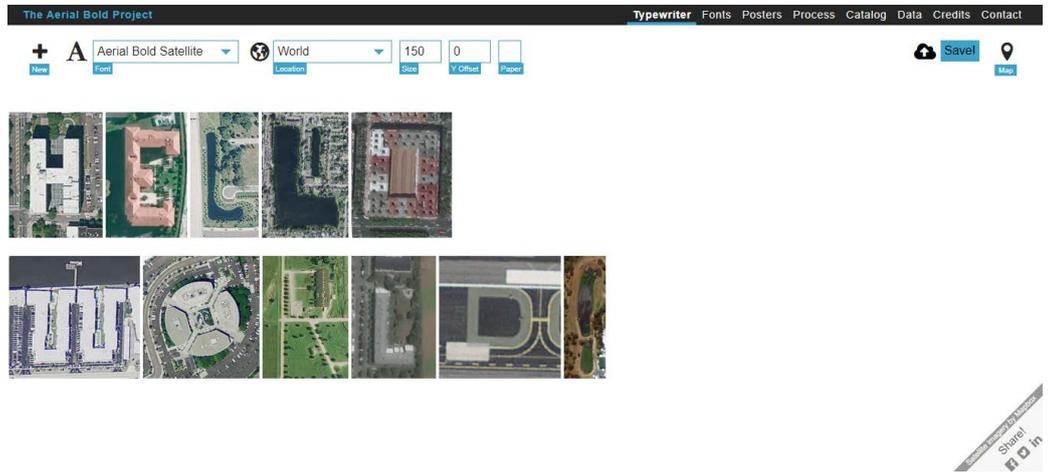


Figure 4: Benedikt Groß and Joey Lee, *The Aerial Bold* (since 2016). Project website: typewriter. Image courtesy of Benedikt Groß.

With cross-disciplinary development of crowdsourcing and machine learning techniques for deriving geodata from aerial imagery and enriching it semantically and experientially, this project also highlights the active role of artists and designers as data producers rather than passive data users.

Since the 2010s, research in artificial intelligence (AI) has been providing various tools for artists to interface and compare human experiential learning with machine learning which relies on large pools of accumulated samples. For example, Libby Heaney's *Euro(re)vision* (2019) is a moving image deep-fake in which two EU government leaders from 2019—Angela Merkel and Theresa May—sing absurd songs in style of Dadaist Cabaret Voltaire performances, but in a setting which mimics the Eurovision song contest (Heaney, 2019).



Figure 5: Libby Heaney, *Euro(re)vision* (2019). Screenshot.

This artwork uses two deep fake models and three character-level recurrent neural network models to create new forms of algorithmic poetry which eerily resembles the nonsensicality of actual EU/Brexit discourse.

Ben Bogart's series *Watching and Dreaming* (since 2014) is an attempt at understanding the algorithmic depictions of popular cinema based on visual and sonic percepts (Bogart, 2019).



Figure 6: Ben Bogart, *Watching (2001: A Space Odyssey)*, 2019. Screenshot.

In this series, various film classics are interpreted and represented through hundreds of thousands of percepts which consist of millions of image segments grouped by color and shape similarity, and serve as a visual vocabulary for the machine learning system to recognize, and eventually predict, the structure of the processed films.

By abstracting and re-concretizing the spatial, temporal, visual and sonic qualities of their source materials, these statistically informed works open new perspectives for envisioning, assessing and appreciating cultural phenomena. By emulating the semantic, narrative and expressive capabilities of human-made artefacts, these works also question the nature of creativity.

4. INSIGHTFUL MIRRORS OF INFORMATION SOCIETY

Not only cultural artefacts, but all social structures and relations that involve the frequent exchange and processing of information can be envisioned and treated as databases. Data-mining, behavioral tracking, prediction and manipulation of decision-making have long been essential strategies for large-scale systems such as governments, industry, marketing, advertising, media, finance or insurance. Computationally enhanced and virally exploiting the human need for socialization and communication, the new iterations of these old corporate strategies of quantization and statistical reductionism refresh our appreciation of privacy and our need for anonymity in a constant arms-race between systems of control and tools for individual advantage (Grba, 2019, p. 4). This is most evident in the interfaces of social media, whose design and functionality delineate their statistical logic, often by clumsily trying to hide it. Some new media artworks reveal this bizarre strategy in humorous and provocative ways. They emulate the models of corporate information services by virtually approaching online participants as more or less complex datasets, but slightly repurpose their objectives for ironic revelatory effect.

Paolo Cirio and Alessandro Ludovico made several strong points in this context with their *Hacking Monopolism Trilogy* that began with *GWEI* and *Amazon Noir* (both 2006).



Figure 7: Paolo Cirio and Alessandro Ludovico, *Face to Facebook* (2010). Artists as Catalysts exhibition in Alhóndiga, Bilbao, Spain. © Image courtesy of Paolo Cirio.

For *Face to Facebook* (2010), the final project in the trilogy, the artists created a bot which harvested one million Facebook profiles, filtered out 250,000 profile photos, tagged them by facial expressions (relaxed, egocentric, smug, pleasant, etc.) and posted them as new profiles on a fictitious dating website called *Lovely Faces* (at <http://www.lovely-faces.com>). *Lovely Faces* had been fully accessible and searchable for five days, during which the artists received several letters from Facebook's lawyers, eleven lawsuit warnings, and five death threats (Gleisner, 2013).

For his project *A More Perfect Union* of the same year, Luke DuBois made a shrewd interpretation of the technical term "relational database" (Relational Database, 2019) to draw a socio-cultural outline of contemporary United States according to the preferred identities and intimate aspirations of its population. He designed a software application which sampled 19 million user profiles posted on 21 dating websites, and used the associated United States zip codes to geographically arrange them into 43 maps. In state and city maps, the artist replaced the names of cities, towns and streets with the most frequent keywords in dating profiles of local citizens (blonde, cynical, funny, happy, open-minded, lonely, optimist, etc.). In federal maps, the brightness/saturation ratios of red and blue color show the relations between female and male preferences for the most frequent keywords in each state (DuBois, 2011).

A number of artworks in language hacking and data visualization adapt this seemingly ambivalent strategy to reveal the socio-political logic embedded in cultural artefacts. They refrain from explicit interventions or explanation, but enable us to probe different layers of digitally mediated contemporary culture and identify in it the various interests, animosities, struggles, inequalities and idiosyncrasies. Examples include Fernanda Viégas and Martin Wattenberg's *Word Tree* (2007) (Viégas & Wattenberg, 2007), *Web Seer* (2009) (Viégas & Wattenberg, 2009), *Phrase Net* (with Frank van Ham 2009) (Viégas et al., 2009) and *Fairness in ML* (with Moritz Hardt 2016) (Viégas et al., 2016), Pitch Interactive's *The Holy Bible and the Holy Quran: A Comparison of Words* (Pitch Interactive, 2011a) and *Globe Small Arms Imports and Exports* (both 2011) (Pitch Interactive, 2011b), and Kate Compton's *Tracery* (2012) (Compton, 2012).

The uneasy positioning of the individual toward or within online systems of control has been well analyzed by Alexander Galloway in his book *Protocol* (2004), and reverse-engineered in a number of works by new media artists and activists such as Joana Moll (Moll, 2017), Adam Harvey (Harvey, 2017) and Vladan Joler. For example, Vladan Joler and SHARE Lab's project *Exploitation Forensics* (2017) snapshots in a series of intricate diagrams the algorithmic logic and functionality of the Internet's infrastructure, from network topologies and the architecture of social media (Facebook) to the production, consumption and revenue generation complex on Amazon.com (Anonymous, 2017).

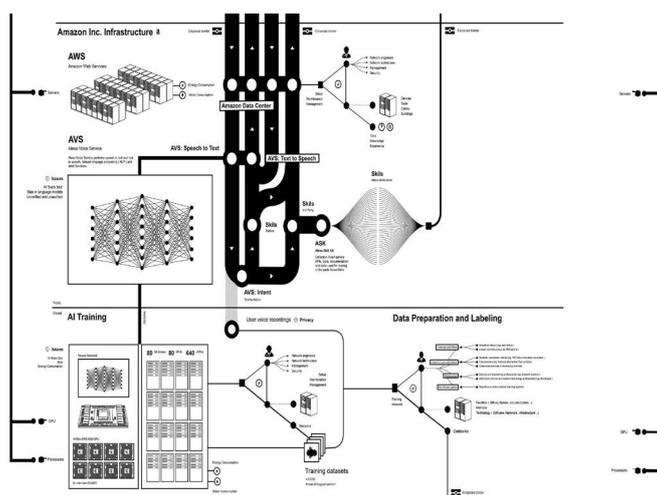


Figure 8: Vladan Joler and Kate Crawford, *Exploitation Forensics: Anatomy of an AI System* (2017). Detail. Image courtesy of Vladan Joler.

These artworks skillfully criticize the digital implementations of governing mechanisms, point out their sophistication and pervasiveness, but also remind us that we are neither innocent nor completely sincere parties in this relationship. By adopting and using profit-motivated digital platforms, our inertia, ignorance, selfishness and other fallacies (un)willingly support the functionality of these platforms, build up their social authority and stir them to further exploit our participation explicitly (searches, clicks, selfies, stories, news), and implicitly (behavior patterns, intentions, desires, socio-economic profiles). By extracting and representing the manifestations of our participatory-exploitative online strategies, these artworks also imply that only our fetishization of privacy protects us from realizing that the *stories of us* (as told by metadata and algorithmic systems logic) are often much more interesting and meaningful than the *stories we tell about ourselves*. As long as we avoid dealing with our narcissism and our delusions of self-importance, we will fall prey to dishonest signaling, exploitative agendas, and socially constructed apparatuses with mundane interests (Todorović & Grba, 2019, p. 55).

5. ARTEFACTUAL CREATIVITY

The projects I discuss in this paper are a sample of the divergent artistic exploration which contributes in different ways to the expansion of

creative AI. Contemporary AI research centers around a biologically-inspired programming paradigm called a “neural network” which enables a computer system to refine and optimize the methods for solving a particular problem or a set of problems by being trained with observational data and by dynamically modifying its own code (Bishop, 2017; Nielsen, 2019). Recent innovations in AI science, technology and art target the elusive high-level cognitive functionality (which includes manifestations of human intelligence in artistic creativity), and rely heavily on large training datasets of annotated texts, drawings, pictures, photographs, 3D models, sounds, music, videos, films, etc. (Mitchell, 2019, pp. 52-107). Being designed on various models of brain functions, the artefactual basis of the AI reflects the fact that human learning and creativity also rely on existing models and examples, although with much higher efficiency and clarity. With all their shortcomings (Mitchell, 2019, pp. 188-229), the AI technologies enhance the realm of artefactual creativity which I define as the application of combinatorial inventiveness to the specific qualities, meanings, contexts or implications of existing artefacts in order to produce interesting new artefacts.

5.1 CULTURAL CONVERGENCE AND ARTISTS’ OPPORTUNISM

Creative flows and trends in science, engineering and in the arts are shaped by cultural convergence—the perceived or unperceived mutual influences and crossbreeding between analogous modes of thinking that render similar ideas, sometimes in different domains. Although the discovery in any field often relies upon well-established conceptual models or recognizable narrative structures, this reliance is nonlinear and frequently leads to unpredictable directions with unexpected consequences. Bricolage is the epitome of this largely self-organizing and accidental *social life* of creativity, pronounced by the practitioners’ expressive or aesthetic unorthodoxies. It also illustrates the power of interaction between cognitive evolution, mature and emerging technologies, which sets up the conditions for novel concepts. In that regard, the artworks I discuss in this paper contribute to discrediting the myth that everything has already been thought of, invented or discovered. Similar to science and technology, they always start with(in) existing artefacts, but analogize, process and reconfigure them with finesse and freshness which make us realize that they could only have emerged just now. They help us appreciate the difference between innovation (gradual) and invention (sudden change), showing that both have the potential to transform their contextual values and enrich human experience, thinking, knowledge, and the world (Poole, 2016).

The continuous zeitgeist-relative interferences between the arts, science and technology should be further addressed from the perspective of the unequal socio-political power and cultural hegemonies which keep some creative achievements unjustly overlooked, while disproportionately advertising others. This reflects in a tendency to praise certain creative

models due to their good fortune of appearing within the right ideological authority, but without critically assessing their originality or merit. Nevertheless, in art and science only the “fittest” survive by default, there is no copyright on ideas and one must fight their own place in the sun (Miller, 2019, p. 39). That is why feeling the zeitgeist, intuiting paradigms and understanding cultural convergence are strong motivational factors for the artists’ appropriation of ideas, themes, techniques and tools trending from other disciplines.

Within the context of code-based new media art, however, we also need to acknowledge the conceptual cogency, technical elegance, consequential power and aesthetic sophistication of work in the related fields of computer science, engineering and robotics. This work sometimes manifests artistic overtones regardless of the ambitions or the awareness of its practitioners. In that respect, new media artists can be criticized for rarely going beyond smart or amusing spectacularization of the emerging techno-sciences and their cultural effects (Taylor, 2014, p. 233). New media art can be beneficial for making science and technology more accessible to the public and more open to critical insight (Taylor, 2014, pp. 113, 242, 243), but its representational discourse often—willingly or unwillingly—contributes to diverting our attention from many already misrepresented features and issues of science and technology. Conversely, the hyperbolic, pretentious or otherwise misleading narratives about the arts diminish their wonders and social impact rather than enhancing them. The artists, the media and the cultural sector should outgrow the delusion (or cease promoting the illusion) that the arts can influence our world in the same way, to the same extent and with the same relevance as science and technology. Without critical self-consciousness, the artists’ pragmatism easily slips into superficial, naive or exploitative strategies which support the hypothesis that the arts, among other components of human culture, have evolved as a suite of virtue signaling adaptations for sexual selection and social competition—one of the very views that the artists and art promoters oppose the most (Miller, 2001). If they want to be at the cutting edge of human experience, creatives in all fields need this edge of critical self-consciousness. Respecting, exploring and cultivating it, they can discover new emancipatory horizons to question our ethical standards, assess our social norms, tackle our ever-changing present and anticipate possible futures. This can foster new research in the arts, science and humanities to define a more robust concept of creativity, and map its perspectives.

5.2 ABOVE THE DRIVE

A deeper understanding of the cognitive aspects of creativity in new media art is instrumental for the artists’ critical self-consciousness, and essential for our recognition of their achievements. Creativity integrates three overlapping modes of learning: sensual (perception, abstraction and

insight), interactive (physical experience and coordination), and symbolic (procedure and language). At first sight, the artworks in this paper may suggest that creativity is somehow degraded if its procedural components can be presented as algorithms and converted into program code. But the executable procedure of any process—if clearly defined—can be algorithmized and coded. Plasticity and adaptability in mimicking natural processes are the defining factors of a universal computing machine which lays the conceptual foundation for modern computer science (David & Martin, 2000; Watson, 2012). Achieving that plasticity and adaptability, however, is itself a creative enterprise which requires ingenuity, multidisciplinary research, and critical understanding of accumulated knowledge.

The development of generative new media art projects involves two interrelated levels of thinking. One is matching and interfacing the algorithmic and the unpredictable elements into a coherent system. It relies upon experience, knowledge and intuition to anticipate if the performative qualities of the system will match a desirable proportion. The algorithmic elements need to be clearly defined, controllable and reasonably predictable, their logic and functionality should carry a narrative or a message. The unpredictable factors have to be well chosen for a meaningful interaction with the algorithmic elements.⁴ Finally, the artists' motivation for arranging this interaction needs to be interesting and engaging. Another level is the construction of algorithms as multi-purpose or task-specific tools, which requires procedural literacy and programming skills. It runs in three steps: dematerialization of certain phenomenon into a set of signs which describe it properly, resolving that sign-set into pure syntax (removing the semantic layer), and translation of the syntax into a series of operations (for example within a coding environment) (Nake & Grabowski, 2011).⁵ Procedural literacy—the ability to think, read and write processes in order to engage procedural representation and aesthetics—implies that programming is not a mechanical task but an act of dynamic communication and symbolic interpretation of the world (Reas et al., 2010).

This counterintuitive disassembly of experience requires a spectrum of cognitive skills which include: the sense for selecting an interesting or relevant phenomenon, the ability to assess if that phenomenon can be algorithmized under given conditions, the imagination and flexibility of reasoning, the clarity of distinction between rational and irrational aspects in our mental concepts of natural phenomena, and the attention to the scope and limitations of the algorithmic system. For the artists who use coding, the semantic and performative rigidity of programming languages is often a generous source of frustrations, but also a drive for improving their precision and discipline. Whenever a previously incomputable natural phenomenon or creative process gets algorithmized, it is human intelligence doing the complex job of scrutinizing, symbolically structuring and encoding it into a functional system. This complex relationship between human creativity and human-built emulation of creativity reveals the essential flexibility of the human mind which can allow itself

4 Arbitrary use of randomness as a factor of unpredictability usually does not work well (Watz, 2006).

5 This process is equivalent to the core technique of observation-based drawing, so it is probably just mental inertia that makes many visual artists struggle to learn programming, and vice versa.

to be influenced by technology, and simultaneously absorb, repurpose, transform and invent it.

Procedural thinking faces some systemic challenges within the context of code-based new media art. The conceptual constraints of programming languages and hardware architectures can impose certain solutions and unwillingly spin the creative process. The fixed capabilities of the hardware systems can reflect in roughness and lack of spontaneity (Watz, 2010). These limitations are compounded with current issues of the creative AI such as the various modes of anthropomorphizing (Mitchell, 2019, p. 227; Todorović & Grba, 2019, pp. 55-56), the translation of sociopolitical biases into training datasets (Mitchell, 2019, pp. 88-90), the misleading discourse about capabilities and consequences of the AI (Marcus & Davis, 2019), the misconceptions about artistic creativity in relation to the AI (Miller, 2019, pp. 289-295), and the insensibility to authentic creative potentials of the AI (Todorović & Grba, 2019, p. 56). Ultimately, there are the undecidable problems in computability theory, and the more general limits of mathematical formalization established in Gödel's incompleteness theorems (Penrose, 1994).

5.3 PLAYING OUT SENSE

Notwithstanding the applications of procedural thinking, all human activities take place within certain material, formal or procedural boundaries. So, while the optimization of productivity and expressiveness within restrictive frameworks requires significant mental effort, the ability to break out of these frameworks is the essence of creativity (Kay, 1997). In science, technology and in the arts, this ability often emerges through a combination of hard work and experimentation which can be pragmatic, playful or frivolous, but always implies broader ethical aspects. Artists are motivated by the anticipation of poetic values and effects of their projects, but they also need to acknowledge the risks, to be open to unwanted outcomes or failure, to evaluate and react by improving their methodology or by redefining their approach. Similarly, the agents of scientific, technological, economic or political experiments should be capable not just to consider the projected impact of their enterprises but to acknowledge the unpredictability of their short- and long-term consequences, to be ready to critique and improve their projects.

⁶Within such contexts of high stakes and high responsibility, new media artworks which signify artefactual creativity are instructive because they demonstrate the artists' desire to overcome the fact that our experience is stronger than our imagination (Kay, 2013), and that we predominantly understand new concepts through the existing (old) categories and models (McLuhan, 1964).

The poetics of successful new media artworks is distinguished by artists' abilities to transcend the conceptual, productive, aesthetic, and ethical constraints of algorithmic thinking and procedural expression in a complex interplay with their own idiosyncrasies, wonders, obsessions or

⁶ Unsurprisingly, the notions about cognitive robustness and ethical responsibility in large-scale socio-technical experiments are conflicted. Generic claims that political experimentation has always embraced an adaptive approach to emerging and indeterminate situations (Lehman, Nelson et al., 2014) face ample evidence of socio-technical myopia, ignorance or negligence throughout the twentieth and twenty first century, for example in the work of Adam Curtis (2002, 2011, 2016).

passions. Motivated by keen awareness of their sociotechnical contexts and informed by their cultural environments, the artists consciously interface their ideas, knowledge and skills with uncontrollability and surprise, and share this interplay with the audience intelligently and engagingly. In a broader perspective, the explicit or implicit unpredictability in their artworks rearticulates the intricacy of ecology, economy, personal relationships and everyday life. Less dramatically but more sensibly and often more meaningfully than global crises, they point out that our notions of permanence and coherence are useful delusions while uncertainty and instability are the fundamental features of nature.

By leveraging the combinatorial inventiveness into the original structures, they offer inspiring, emotionally and intellectually rich experiences with unique aesthetic and ethical values. These experiences highlight the appeal of ludic, proto-scientific experiment driven by curiosity to actually taste—not just imagine—what will happen within certain preconceived but not fully controlled circumstances, and to build concepts and predictions from the incoming information. They are powerful cognitive tools for blending the elements of unrelated matrices of thought into the new entities of meaning through comparison, abstraction, categorization, analogies and metaphors. In a straightforward way, easy to understand and to empathize with, they affirm wit as one of the most attractive human capacities. They tell us stories but, more importantly, they stir inquisitiveness, stimulate imagination and further motivate creativity by revealing or suggesting their mental models which can be addressed implicitly or explicitly and incite new configurations and ideas.

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