The Performance of Creative Machines

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Abstract. Cybernetic and robotic agents have long played an instrumental role in the production of 'machine creativity' as a cultural discourse. This paper traces the cultural legacy of the performance of automata and discusses historical and contemporary works to explore machine creativity as a cultural, bodily practice. Creative machines are explored as performers, capable to expand the script they are given by their human creator and skillful in bidding for the audience's attention.

Keywords: agency, automata, computational creativity, performance, robot culture

1 Introduction: Creative Machines as a Cultural Discourse

When we talk about robots, we often implicitly refer to the cultural phenomena that give form to mechanical golems, artificial pets and a cheeky, beeping can-shaped repair droid. Robots play an important role in probing, questioning and daring our relationships with machines. For Chris Csikszentmihalyi, robotics in the 21st century is "part of a dense stew of research, design, pop culture, commodity production, and fetishism" [6]. So far, according to Csikszentmihalyi, "this cultural legacy of the robot/automaton far outweighs its ostensible practical use in warfare, space exploration, or housekeeping." While labour and power (to surveil, govern, kill, etc.) are at the centre of this more or less fictional struggle, intelligence and creativity are the stimulants. Machine intelligence is not only the final frontier but has fuelled the cultural narrative of robotics long before the earliest attempts to engineer an Artificial Intelligence. Creativity as an essential ingredient of machine intelligence was listed as one of the seven grand challenges in the groundbreaking *1956 Dartmouth Proposal for Artificial Intelligence* [17].

A machine's creativity is commonly discussed in relation to anthropocentric projections of creative abilities and attributes [22, 3] or based on a comparison of its outputs to human creations [12], similar to the Turing Test [20, 24]. In this paper we offer a different path to exploring machine creativity and its cultural

potential by looking at a machine's agency through the lens of performance. Applying the concept of performance foregrounds how machine behaviours are culturally coded and part of a network of interactions with other social agents, its immediate environment and the cultural context itself. It heightens the performance of artificial embodied agents as a bodily practice that produces cultural meanings by 'translating' software scripts "into an 'experienceable' reality" [8]. While this pertains to all robotic agents, whether deployed in industry, research or an artistic context, this paper focuses on the potential for artistic robots to extend the script given by their human creators. Capable of being sensitive to their environment and the effects they produce, their performance evolves beyond what has been set in motion by their human creator.

2 The Performance of the Automaton

Since the beginning of Artificial Intelligence (AI) in the 1950s, our idea of machines has expanded from questions of instrumentality to, as Suchman argues, "include a discourse of machine as acting and interacting other" [35]. From a cultural point of view, it could be argued that machines have always been imagined and regarded as 'acting other' and, more so, not seldom have been attributed a spirit. Automated, self-moving machines have been part of human culture since ancient times. Limited to a number of pre-programmed movements, automata derive their evocative power from the skilful embodiment of their 'program'. The inanimate machine acts as if imbued with life, "[w]hat normal representative images only threaten to do, namely come alive, the automaton seems to actually realize" [13]. The automaton's deep cultural entanglement is reflected in the varying levels of "amusement, fascination, unease, and horror at the object ... in accordance to the beliefs, concerns, and needs of each period" [13]. Whether magical, eerie or exposing their machinic nature, they are considered the forerunners of today's robots.

Ancient, elegant, programmable self-propelled machine theatres have been traced back to the 1st century, with references to earlier examples from 200 B.C.E. [31]. In the 15th Century, Leonardo da Vinci realised cunningly life-like movements using irregularly shaped cams and a linking rod to push or pull the automaton's appendages. Whereas these earlier self-moving machines seemed to be driven by mysterious, magical powers, in the wake of the enlightenment, the relationship between man and machine became more complicated. Serving as "the central emblem of the entire mechanistic worldview that was dominant in the period" [13], in this era, the marvellous automaton originated from the same mindset as mechanised labour and factories that configured humans and machines to form an "organic unity" [15]. Vaucanson, the inventor of the first fully automated loom, created three famous automata: the pipe and tabor player (1737), the flute player (1738), and the digesting duck (1738). The flute player brought to life Antoine Coysevox's "Faun playing the Flute" (1709), a statue at the Jardin des Tuileries, through imbuing it with an astonishing animated anatomy. It literally played the flute using its a mechanical lungs, tongue, lips

and fingers. Exposed to view, the automaton performed its mechanical anatomy as much as its virtuous play. In *An Account of the Mechanism of an Automaton*, Vaucanson states that his "Design being rather to demonstrate the Manner of the Actions, than to shew a Machine" [36].

The performance of these machines is an often over-looked element. Jessica Riskin talks of scientific performances and how they relied on "displaying hidden properties and principle as striking as possible" [26] to not only make them accessible but also theatrically engaging. Yet, skilfully automated scientific entertainers, such as Vaucanson's flute player, also performed the coming to life of a sculpture, the artistry of a musician, and, last but not least, a scientific model of the human body. While automata of this era are often discussed as 'simulating' life, that is, as experimental models for studying properties of natural subjects [25], we argue that they also performed the organic and its mechanisation. Straddling "the edge of life" [33] and seeking to "mechanize the passions" [29], their ability to graciously perform life, emotions and art underpins the cultural dimension and affective potential of automata[1]. The conception of creativity then differed greatly from our contemporary understanding [11], which might explain why, in the 18th century, these automatons weren't admired for their mechanized creative acts. From a contemporary viewpoint, the breathing automated musician, pursing its mechanical lips to play the flute with the subtle nuances of a human musician [33] could easily be considered a (machinic) bodily practice that is embedded in but also produces cultural meanings.

The automaton's mechanical performance is very similar to that of many contemporary robots, whether performing their daily routine in an automated assembly line or drawing gallery visitors into their theatrical, pre-scripted performances. Most robotic artworks perform a sense of life, intelligence or other agencies uneasily attributed to the non-living through an entirely pre-programmed set of movements and behaviours. There is, however, a smaller number of works, in which the machine operates in an open loop, sensitive to its environment and other agents and capable of adapting in response. In the following, we will explore this expanded notion of machine performance, one in which creative faculty is not only persuasively mimicked [3] but materialises from the robot's ability to interact, learn and enact agency.

3 Machine Creativity

Creativity is notoriously difficult to define and the multitude of attempts shows that our understanding of creativity always is culturally situated. Its characteristics and modes of assessment have been widely discussed by researchers in Psychology [27, 14] as well as in the AI subfield of Computational Creativity [4, 28, 12]. The question as to whether machines can be creative is not only

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[1] Interestingly, Vaucanson's Pipe and Tabor Player (1737), advertised in the London Magazine as "outdoing all [human] Performers on the Instrument" (see *London Magazine, or the Gentleman's Intelligencer*, vol. 13), performed early notions of superior, machinic agency, rather than human virtuosity.

a complex, often contentious, philosophical issue but also has become an instrument of the scientific query into the nature of creativity (see [2]). In many ways, the very notion of a creative machine is a cultural construct[2] and whether a machine can be considered creative is much more likely a cultural judgment than a scientific finding [2]. Computational Creativity is concerned with, according to the most quoted definition, developing software "that exhibits behaviour that would be deemed creative in humans" [4], whereby, most commonly, the machine's behaviours or outputs are assessed by human experts in the respective domains [12]. Emily Howell's musical compositions, for example, have been praised to have a quality indistinguishable from human works, and yet Emily is a software-based 'composer', developed by David Cope, with the ability to learn from, and expand upon, existing works [5].

3.1 Machine performance and agency

If we look at creative machines as a cultural trope and practice, performance provides a useful lens to explore their nonhuman agency and its affective potential. Performance is used in a double sense here: on the one hand it reimagines the machines' acting as both a cultural and embodied practice; and on the other, it directly refers to how the machines act out their script and interact with the world. With regards to creative machines, we need to distinguish between machines that act creatively but can only follow a predetermined script and machines that can sense, learn and adapt and whose performance is open to change. There's a difference between an audience member projecting creative agency onto a robot, a robot designed to perform as if it were creative (pretending)[3], and a robot capable of extending its given script by learning to be sensitive to the effects it produces. The latter is not about assigning genuine creative capabilities to the robot, but acknowledges a robot's potential to expand the performance envelope designed by its human creator(s). An open system as such, from a performance point of view, can be looked at as capable of negotiating its environment; its performance is not entirely pre-scripted or reactive in a limited way.

A machine's ability to extend its script is a question of agency. All machine agents are cultural actors [21], whether they are limited to operate in a closed

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[2] In this paper, we often refer to creative machines, rather than creative robots. From a cultural viewpoint, the term 'machine' is less readily associated with humanoid forms. Creative machines, thus, open up the image of the creative robot to include more complex understandings of the machine as assemblage, always in interaction with other assemblages, including the environment, humans, the cultural context, history, etc.

[3] Cleland argues that "[f]or a robot, [successful acting] is the ability to persuasively simulate or pass as human or alive or intelligent" [3]. Following this argument, if the aim is for a robot to appear creative, its successful performance would be to persuasively simulate creative behaviour, e.g., painting robots. As we have suggested earlier, however, a pre-programmed automaton is capable of delivering such a persuasive performance; it doesn't require the advanced capabilities of a robot.

loop or not. A machine's potential to act and affect that is defined by the audience projecting their knowledge onto the machine or the creators script, however, locates the machine's agency solely within human culture. In contrast, an open, creative machine performer materialises agency as distributed and enacted across human and nonhuman domains. One of the most fundamental differences between software-based agents and machines (robots) is that the latter are embodied; they act and share the world *with* us, in bodily ways. Without disregarding their differences, both human and nonhuman agents adapt and know because they act as part of the world [1]. We argue that, open, adaptive, embodied systems are able to take part in this negotiation, beyond their creator's intent; they perform beyond representation and actively participate in the production and distribution of cultural agency.

4 Creative Machine Performers

Andrew Pickering talks about artworks that foreground a performative rather than a representational, epistemic "aspect of being in the world" as "ontological theatre" [23]. Ontology is about, in Pickering's words, "what sorts of things there are in the world, and how they relate to one another" [23]. Following this conception, performance, particularly if beyond representation, is an ontological practice, and engaging in a creative machine's performance can be looked at as a dynamic dramaturgy of human and nonhuman agents interacting without a given script but with all the emergent possibilities this may produce. One such ontological theatre that Pickering refers to is Gordon Pask's Colloquy of Mobiles, and this pioneering work also excellently serves to materially perform the points about creative machines we have made so far.

4.1 Gordon Pask's *Colloquy of Mobiles*

Gordon Pask was a major figure in British cybernetics after the 2nd World War and, perhaps lesser known, a pioneering artist and theatre designer. *Colloquy of Mobiles* was shown at the *Cybernetic Serendipity* exhibition, curated by Jasia Reichardt at the ICA, London, in 1968. The robotic sculpture performed a dynamically evolving mating scenario between five 'mobiles'—three female robots, with soft fibreglass shapes, and two male robots, made of aluminium rectangles, Figure 1. The work introduced machinic attributes that even today still sound very advanced to museum audiences, including agency, communication, interactivity, intelligence and ability to learn. *Colloquy of Mobiles* physically embodied Pask's cybernetic concept of the Conversation Theory [30], which he developed in tandem with his material, aesthetic experiments [9]. Yet the work is in many ways as much a humorous, social observation of humans and their nonhuman counterparts as it is a technological achievement. Pickering's [23] description of this complex work is worth quoting in full:

> The mobiles [...] were complicated electro-mechanical robots, designated male and female, which communicated with one another via lights

Fig. 1. Gordon Pask's *Colloquy of Mobiles*

and sounds, and engaged in uncertain and complicated matings. The males would emit light beams, which the females would try to reflect back at them. When the reflected beam struck a particular spot on the lower parts of the males, they would be "satisfied" and go quiescentuntil their drives started to build up again. The females, too, had drives they sought to satisfy, and were adaptive in the sense that they could learn to identify individual males and remember their peculiarities.

Pickering's description emphasises the robots' performance of their drives, how they move and reconfigure themselves to fulfil them, and learn to select and adapt to particular sensations. While their behaviours evolved based on their own inner dynamics and interactions with the other robots, they were also open to outside interference. Visitors were keen to interact when they discovered that they could use mirrors and flashlights [37] to participate in this strange mating ritual (albeit only on machinic terms). *Colloquy of Mobiles*' self-driven, dynamic performance doesn't create an artefact, but produces an endlessly emergent cycle of relations, meanings and desires; a conversation across nonhumans and humans. In Pask's own words, 'an aesthetically potent environment should [...] respond to a man, engage him in conversation and adapt its characteristics to the prevailing mode of discourse' [19]

5 From Human–Machine Performance to Machine–Machine Performance

Pask's 'conversational machines' explore the emergence of unique interaction protocols between humans and machines and between machines themselves. In the following, we look at recent works investigating similarly emergent forms of interaction.

5.1 Ruairi Glynn's *Performative Ecologies*

Performative Ecologies: Dancers by Ruairi Glynn is a conversational environment, involving human and robotic agents in a dialogue using simple gestural forms [10]. In this installation, the Dancers are robots suspended in space by threads and capable of performing 'gestures' through twisting movements, Figure 2. The fitness of their gestures is evaluated as a function of audience attention[4], independently determined by each robot through face tracking. Audience members are able to directly participate in the evolution of the machine performance by manually manipulating the robots, twisting them to record new gestures.

Fig. 2. Ruairi Glynn's *Performative Ecologies: Dancers*

In a way, the audience is invited to physically choreograph the machines' dance in order to expand the dancers' gene pool of gestures to generate new dance sequences. The robots collaborate with each other by sharing their most

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[4] Jon McCormacks' sonic ecosystem *Eden* uses a similar attention-based reward system to drive the musical performance of artificial agents [18].

successful moves. That is, gestures that attract the most audience attention are shared between the robots over a wireless network. Glynn's work directly links the creative act of producing new gestures with their attention-seeking performance. At the same time, the audience's attention serves to evaluate the dancers' new creations. Thus, while from the audience perspective it may appear as if these creative machine dancers perform for them, the robots in fact elicit the audience to perform with them in order to expand their dance repertoire.

5.2   Alex Straschnoy's *The New Artist*

The New Artist, developed by Axel Straschnoy in collaboration with researchers and engineers from the CMU Robotics Institute at Carnegie Mellon University, is an artwork with the objective to create purely robotic art—art created and performed by robots for a robotic audience [32]. A significant part of Straschnoy's research included discussions with roboticists, neurobiologists, philosophers, theatre directors, and artists to examine what 'robotic art' could be and why we would want robots to be creative performers and appreciative audiences. Some of the researchers questioned the validity of the enterprise, arguing that there is no reason for robots to make art for other robots. While others considered it to be part of a natural progression in creative development:

> "We started out with human art for humans, then we can think about machine art for humans, or human art for machines. But will we reach a point where there's machine art for machines, and humans don't even understand what they are doing or why they even like it." [34]
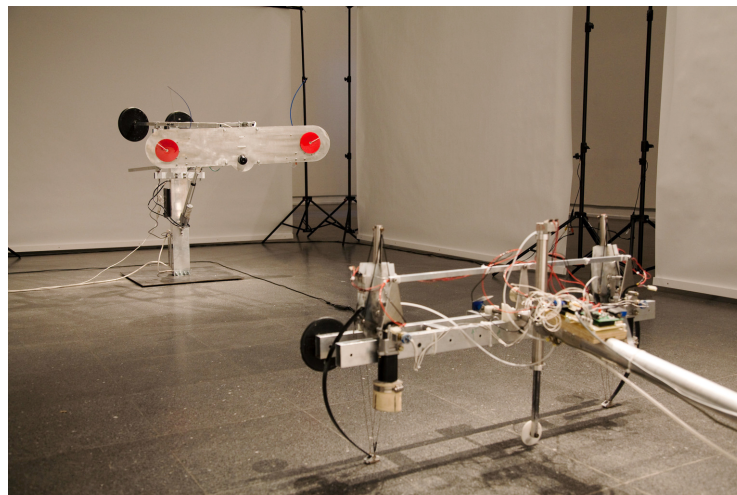
Fig. 3. Alex Straschnoy's *The New Artist*

The resulting work opens up a radically nonhuman view onto machine creativity by developing a performance scenario that only involves a machine artist and a machine audience member. The artist seeks to entertain the audience member by continuously evolving its performance, while the audience's role is to follow the artist's movements and express its appreciation, Figure 3. Interestingly, this intimate scenario remains exclusive to machines and is not presented as a spectacle for humans. The installation of the work includes four opaque screens that form the performance arena but at the same time shield the robots from the prying eyes of the human audience. Thus *The New Artist* as an artwork performs the idea of a robot culture without humans—machine artists making art for machines.

5.3   The Authors' *Accomplice*

Accomplice is a large-scale robotic installation that embeds a group of autonomous robots into the walls of a gallery. The work explores machines as self-motivated, intelligent entities and their alien, social expressions when nestled into the close and unexpected contact surface of our built environment. Each robotic wall-inhabitant is equipped with a punch and a camera, which they use to interact with their surrounds. They are programmed to be 'curious agents', driven to explore their world and discover things (visual patterns) they didn't expect. With a punch 'at hand', they are able to introduce changes to their world, whenever it seems already too familiar and they get 'bored'[5]. The punch enables the robots to sculpt their immediate environment by piercing wholes that eventually cause the wall to break open. Moving along the wall they share, they also use their punch to develop rhythmic knocking signals to communicate their presence to each other. As a result of this ongoing piercing and signalling activity, the walls are increasingly marked with configurations of cracks and patterns that trace the machines' appetite for change, Figure 4.

The robots' performance is shaped by their curious disposition; driven to seek novel 'experiences' expands their performance envelope beyond what they have been programmed to do. To these curious machines, learning and adapting are not goal driven but are based on what they discover and interpret as 'interesting' [28]. The material coupling with the wall contributes to the unpredictable evolution of the performance as the seemingly passive wall resists or accelerates the machines' eager work.

Accomplice acts out a slice of our machinic ecology—a dynamic co-mingling of processes, matter, beings and things, while foregrounding the affective potential of nonhuman, socially behaving, intelligent agents. The work is staged in an unusual way in that the robots are hidden, at least at first, behind—what

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[5] Gordon Pask already developed an ambitious architectural machine that would reconfigure itself when it got 'bored' for the Fun Palace project, a collaboration with architect Cedric Price. Unfortunately the project was never realised. More details on the Fun Palace and Gordon Pask's pioneering concept for its dynamic architectural machine can be found in [16]

Fig. 4. Accomplice, installed at NAMOC, 2015.

audiences believe to be—an existing wall. Similarly to Straschnoy's work, we were not interested in creating a machine spectacle. Rather, robotics is deployed as a medium of intervention to shift the focus from representation to the machines' performative agency. While the audience plays a part in the work's wider ecology, the robots don't necessarily respond to or perform for them. This is a conception of interaction that, in Simon Penny's words, "has been expanded beyond user-machine, to larger ideas of behaviour between machines and machine systems, and between machine systems and the world" [22]. The work's affective potential is thus not in the dynamic feedback loop between the robots and the audience, but rather in their haunting physical presence and the allien-ness and unpredictability of their behaviours.

6   Discussion

In this final section, we will take a closer look at creative machine performers as cultural participants. Robots as cultural artefacts [21] are commonly considered as being constructed by a human creator, who is situated within a specific cultural context, and re-constructed by the audience, again within a given cultural context, as they project their ideas of intelligence, social agency, creativity, etc. onto the robot. Put differently, a robot is a cultural construct, with much of *what it is* and *what it can do* arising from the human cultural environment, rather than the robot itself. The argument we present in this paper, in a way, identifies a loophole for embodied, open systems—those that we consider creative machines—while acknowledging that to-date no machine exhibits genuine creativity with respect to human culture.

As discussed earlier, open, adaptive machine systems can be considered creative machines that actively participate in an interactive conversation or an open-ended narrative, due to their capacity to adapt and learn and, thus, extend their script beyond what they have been given by their human creator. As performers, they are capable of improvising as they become increasingly sensitive to the effects they produce. Following this line of thought, they can also be considered active participants in the creation of culture, and—this is the loophole—they do so from inside their machinic context, thus extending *what a robot is* and *what a robot can do* to a nonhuman cultural view. Creative machines, operating across human and nonhuman domains, thus provide us with a glimpse into nonhuman robot culture.

What distinguishes the creative machines, discussed here, from machinic agents commonly considered, as being creative, is that they don't produce cultural artefacts in the traditional sense. Rather, their cultural contribution is their nonhuman performance. Importantly, they don't perform for us but rather with us (or in the case of *The New Artist* neither for nor with us). As an ontological theatre [23], the here discussed creative machine performances provide a stage for playing out different scenarios and relations across human-nonhuman cultural domains. All four works comprise more than one individual actor and present a small-scale machinic ecology with machines interacting and learning with each other. However, apart from *The New Artist*, their ecology is open to human intervention.

Pask's *Colloquy of Mobiles* and Glynn's *Performative Ecologies* both invite social interactions with humans, albeit they also evolve independent of human input. It would seem that the robots in *Colloquy of Mobiles*, playing out a machinic mating scenario, actually get on better without human interference. Yet, only people attempting to take part in trans-species mating, can experience the openness of the system without having a deeper insight into the machines' learning abilities. The Performative Ecologies, on the other hand, are actively expanding their dance gene pool by interacting with the human species. Straschnoy's *The New Artist* and the authors' *Accomplice* both perform an ecology that is more overtly insistent on acting out 'a machine's world'. Yet, while *The New Artist* does away without humans and apparently their culture altogether, *Accomplice* situates itself into a conflict zone between the two. The dramaturgical strategy of the latter is based on it being a independent machine world that has nestled itself—perhaps too close—into the human world. Creative machines as such contribute to culture because they are not only staging (i.e. representing) our relationship with machines but allow us to explore them and act them out together with our nonhuman co-performers.

Finally, returning to the thought of creative machines providing us with a glimpse into nonhuman culture also opens up a view onto machine learning and its cultural implications. The creative, open systems discussed here all use machine learning in some form to allow the machines to evolve their performance based on past 'experiences' to fulfil their machine desires, learn to dance with a human, entertain another machine or to turn their world into a playground.

Machine learning can be said to have already become a powerful engine driving much of our so-called human culture as it mobilises big data projects, the internet of things, the stock market, Dr. Watson, and the near future of self-driving cars. Google has long bet on machine learning to give it a competitive edge in the market, with its search algorithm allowing us to navigate the vastness of the world-wide-web and its recently rolled out Google Photos using machine learning to "make memories not manage them," in the words of director Anil Sabharwal [7]. Amongst the computer savvy, 'machine learning' has become as much a household phrase as 'artificial intelligence'.

Creative machine performers provide a different, more intimate window into machine learning and its cultural potential. They bring learning machines into our messy, embodied world and create scenarios in which we can encounter the sometimes whimsical, other times creepy, and often playful nonhuman. Here, machine learning activates a cultural, bodily practice mobilising subjective, embodied, culturally embedded experiences, rather than vast quantities of data. Perhaps their most significant cultural contribution is to open up a space for us to ask what a creative machine is. Or what it could be. Or whether we would want to live with one. The space for creative machines to exist is still an utterly human one. Just as well, given how unlikely it is that we will be able to recognise genuine nonhuman creativity.

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