Preliminary Investigations on How to Love a Machine: Apprehending art through a science aesthetic

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Abstract

The purpose of science is to interpret phenomena through measurement and analysis to understand why it is the way it is in the world. The art humans are compelled to make is a phenomenon and we reasoned that in many cases, presents measurable attributes. This author – a former scientist – subjected his art process and the resulting works to scientific modelling and scrutiny to see what valid scientific narrative could emerge. The system measured was a machine (termed a stochastic apparatus) with irregular behaviour placed in different environmental contexts. Measurable attributes regarding the machine's behavior as well as its interactions with its environment were analysed. The stochastic apparatus was shown to have regular behaviour at the core and untune-able and chaotic behaviour at its periphery. The untune-able behaviour nucleated behaviours in people interacting with it which could be modelled using a system's theory lens while considering the participant as a component of the system – a peculiarity resulting from the behaviour and particularities of the machine. We concluded that although preliminary, this artistic approach may provide a framework to interact with complex systems that have more degrees of freedom such as emerging generative Artificial Intelligence.

Keywords

Practice-based research, Transformative Methodologies, Experimental Art, Collaborative Approaches, Participatory Art, Interdisciplinary Exploration, Transdisciplinary, non-teleological technology, machines, cybernetics, Generative AI.

Introduction.

A key intent of this study is to see whether this artwork can be discussed *as if* it was science as a way of testing the boundaries between these different disciplines. The work was done in collaboration with a machine that we call a stochastic apparatus which is a mechanical object with ungovernable behaviour. The form of the paper was as close to the structure of a scientific paper as possible.

Matter is not indifferent. Through local or long-range feedback, persistent behaviours and structures emerge – the essence of systems. This feedback between the components of systems leads to a coherence in the patterns of behaviour that gives it internal consistency [1, 2]. The resulting emergent behaviour may be highly constrained (ordered): clock-like. We can calculate future behaviour readily from past behaviour. At the other extreme, the constraints are loose enough that a behaviour or form is not determinable (chaotic) e.g. a storm. A third category of system exists in between the chaotic system and the ordered system. Complex Adaptive Systems adapt and evolve by the feedback mediated constraints changing in response to the environment. Humans are such systems in their individual form and in their different social groupings. Different coherent systems may have the potential to interact or exchange information with other systems if they come into contact through long range or short-range encounters depending on the nature of the feedback.

The machines we build are self-contained systems generally with highly constrained behaviour to perform tasks. Teleological. Constrained behaviour. The first time we encountered automatons we must have felt like we just encountered ourself. A mirror of our own making, not only in form but an echo of our behaviour. We empathise with machines and the more they resemble us, the more we relate to them [3] an effect which can be measured physiologically [4]. At the heart of this encounter is recognition. We have the capacity to recognise the other and if there is empathy then we recognise ourself in that other. We recognise parts of ourselves in the other and essentially use that to construct our "self" [5]. This is how humans interact and emerge as individuals but there is no reason why this should not extend

to the inanimate world and perhaps in particular with machines of our own construction where we reflect on their operation to understand our own function [6]. The process by which we recognise the other must accommodate the potential for variation due to the variation inherent in all aspects of the other. Where are the boundaries of that potential – probably very slippery as noted from studies of facial recognition in humans [7].

There are two kinds of machines. The first – built for a specific task and which predominates is the teleological machine – that has utility. A second type we may consider is one with no intentional purpose. The Mechanised objects of Jean Tinguely fall into this category. If coupled with many degrees of freedom, i.e., not only purposeless but with complicated behaviour, we may become increasingly curious about such objects – wanting to understand them better [8]. Curiosity is a necessary precursor to love [9]. Interestingly, and partly an emerging rationale for this study, is that Large Language Models and Generative Artificial Intelligence can be described this way (behaviour with many degrees of freedom becoming by definition – unpredictable).

The world is a machine that compels (un)certain behaviours – echoed in the fine structure of our mechanized tools [6]. The kind of machines we have will have a large effect on the behaviour we manifest to the point where, as is suggested in this paper, we can say that this behaviour is indeed, compelled. It is not a straightforward relationship. The more open and suggestive and peculiar and strange, the broader and quirkier and unpredictable the behavior would be. Kauffman uses the example of a screwdriver [10] to explain how its possible uses are incalculable. I would suggest though that a screwdriver because of its light, detached, pointy end would – at least in this world – compel or invite more uses than an electric toaster which displays, at least from this authors perspective, a narrower band of possibility.

Given the constant evolution of AI it seems reasonable that we can ask the question as to whether we can love a machine, or can they love us? To this end, this artist has evolved a machine which has as its only purpose to display iterative, but irregular behaviour recapitulating the process of evolution where the regularity produces irregular behaviour (mutations) at its periphery. This Machine, called a Stochastic Apparatus, was placed in different environments and its behaviour as well as the behaviour of interactants was analysed. This paper discusses the transition of the machine with its own behaviour to being a novel device to understand systems behaviour and then attempts to get a handle on ways to measure / interpret this emerged behaviour with the end goal of restating our relationship with our mechanised world and finding our way back into it.

Materials and Method.

Construction of Stochastic Apparatus. The approach followed was to have a device with a core with regular behaviour which interacts with a peripheral aspect driving behaviour which displays irregular or chaotic behaviour.

The Evolver (the prototype Stochastic Apparatus) was constructed by using standard store-bought record players and adapting them by making their speed variable by fitting them with potentiometers and in one of them, reversing the direction of the motor. The record players were run at different speeds to ensure they were not in phase. A hinged drawing arm was constructed from umbrella bones and driven by the two turntables to which Pen A was attached. The drawing surface was made from a third turntable which either rotated or was kept stationary during operation. This three-turntable system was the core of the Evolver. Pen A was attached to a construct called an Irregular Pendulum which carries the irregular behaviour. The base of the pendulum is constructed from umbrella components as are the vertical arms leading up to a bicycle wheel upper section. This is attached to a strut on the frame in a such a way as to allow unconstrained movement about the point of attachment.

Measuring the Stochastic Apparatus. The Evolver was used to analyse the behaviour of a Stochastic Apparatus. Recordings were made by attached pens which can be observed directly or subject to further analysis. Pens were attached to the core as well as the peripheral aspect of the Stochastic Apparatus. Pen A was attached via an umbrella-modified drawing arm. This pen was directly linked to the irregular pendulum via a wire “nerve”. Pen B was attached to the irregular pendulum via a longer wire “nerve”. These were either allowed to draw freely or were constrained by wires interacting with them that were attached to the frame.

Data derived from Pen A was acquired by attaching wire to a fixed point outside of, but leaning into, turntable 3. The motion of the pen was recorded by clangs over time. The data was circularized by converting the time between clangs to distance and then each subsequent point was gathered by graphing it at a 22.5^{o} angle from the previous data point. Data from the irregular pendulum was acquired by allowing Pen A to clang into the pendulum at the triangular base. This was allowed to freely rotate about the central axis of the suspended bicycle wheel and whenever a marked point on the wheel passed a stationary external point, it was registered as a “clang”. The data was then circularized as above. The

experiment was run several times – for 10 minutes a time. One is shown here. All runs essentially resembled this. Peripheral data was followed for a 30 minute period.

Interaction of Matt the Physicist with The Evolver Stochastic Apparatus. Matt was given 30 minutes to interact with Evolver, including access to the artist studio which has a diverse array of tools and random objects that may suggest utility. He could access items or machinery in the studio and interact with these things and the machine in any-way-he-saw-fit. The artist – as scientist - observed him: taking notes and attempted to record the behaviour and afterwards recorded Matt's thoughts and reactions to the experiments.

Results.

Principle properties of a Stochastic Apparatus. A Stochastic Apparatus was constructed to investigate the effect of placing machines, with many degrees of freedom and irregular behaviour, into the environment to test their effect on the environment and themselves. These machines were initially constructed intuitively in a direction where they felt more alive – done by repurposing objects of known function such as bicycle components, record players and umbrella parts, which were all initially evolved for one purpose and now operating as a different "organ" akin to the biological process of *exaptation* [11]. The prototype Stochastic Apparatus is The Evolver (Fig. 1).

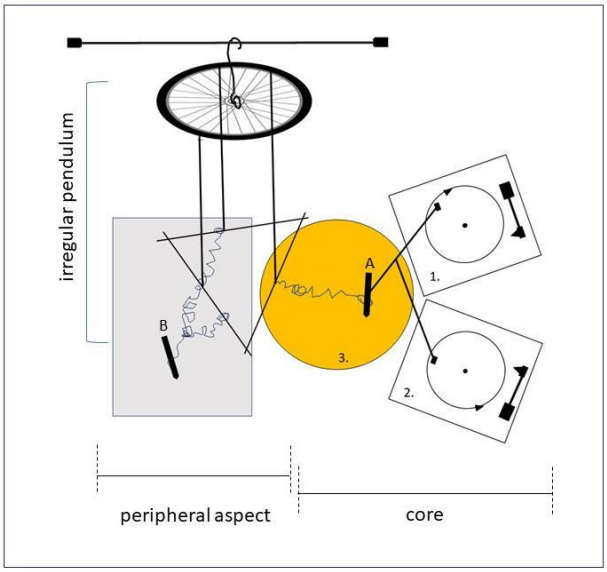

Figure 1. Schematic diagram of the Evolver Machine. 1, 2 and 3 refer to the different turntables. Grey and yellow area indicate drawing (recording) surfaces. Grey is the peripheral aspect and yellow is the core. Pens are indicated by A and B. The connection of pen A to the irregular pendulum drives the irregular behaviour of the pendulum.

This device has as their essential behavioral features a core which drives peripheral behaviour. The behaviour of the core displays a more regular pattern of behaviour (Fig. 2A), where the data was circularized, under the assumption that if the behaviour was regular, or close to regular, it would orbit in a regular repeatable pattern (Figure 2C). This mirrors ourselves where we display a regular aspect (e.g. breathing; heartbeat). The core behaviour is in sharp contrast to the peripheral behaviour which for the duration of the run displayed multiple shapes that were not repeatable. The peripheral behaviour echoes our own uncertain behaviour of reaching into and exploring the unknown to grasp new in/sight.

The raw measurements for the core (Fig. 2A) echo the analyzed data in that they are repeatable. However, the peripheral data is untune-able and reflects the analyzed data (Fig. D) in that a different pattern is acquired from each run.

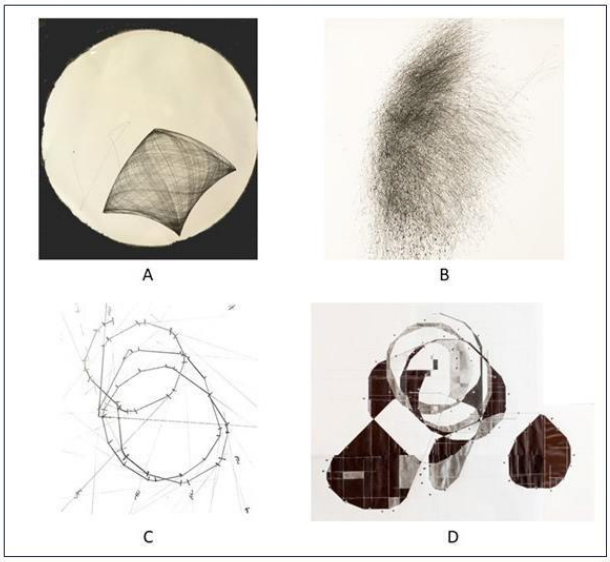

Figure 2. Recordings and data generated by The Evolver. A. Recording of core from Pen A. B. Recording of Peripheral aspect with Pen B attached to Irregular Pendulum. C. data circularized, derived from Core showing regular behaviour; D. Circularised data from Peripheral aspect indicating chaotic behaviour.

Anecdotal Evidence of the effect of a Stochastic Apparatus. When a Stochastic Apparatus is inserted into a public space its behaviour seems to be affected by that space as is the behaviour of those co-located with that space. Two Stochastic Apparatus were evolved during a month-long residence at CSIRO (Lindfield) in 2017, with the intent being that they would illustrate the idea of serendipity in that

their chaotic clunking would experience unexpected encounters of the different components (see Figure 3).

The evolving machines had their own ideas which they revealed at the point furthest from equilibrium - the point of maximum discomfort and where novel feedback loops can engage because of the transient cessation of equilibrium conditions [12]. During the main performance of the work, scientists at CSIRO were invited to operate the two Stochastic Apparatus separately. These recordings are shown in Figure 3. (C and D). The apparatus were then physically joined and each operated separately to observe and record (in a combined drawing in which the chaotic peripheral appendages were physically linked) to observe the effect (video link: https://tinyurl.com/sidsledge). This led to mechanical difficulties resulting in the chain separating from the machine. Scientists gathered round the machines to coax them back to operation. The data therefore captured in the device's recording (Figure. 3E) was the result of both the operation of the machine but notably also the involvement of the scientists who nudged and prodded the device at different locations to get-it-to-work. The data therefore represented a meaningful collaboration between humans and machine that was captured in the recording. In a sense and from a systems point of view, the machines had already formulated the question in a complex nuanced feedback loop involving this author and the scientists at CSIRO - a system extending beyond the machine.

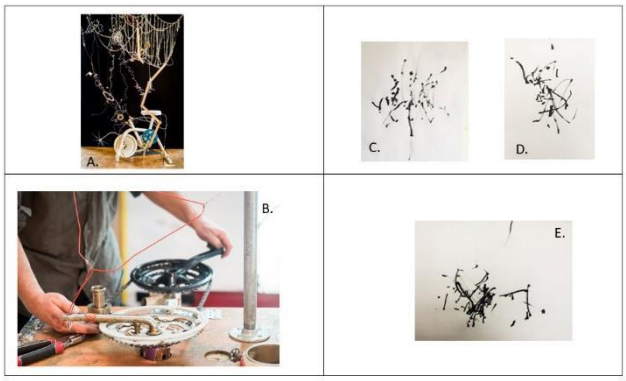

Figure 3. Machines evolved in the common area of CSIRO (Lindfield). A. Serendipity Machine I and; B. Serendipity Machine II. C and D are recording made by machine I and II respectively. E shows the combined recording from the final performance. The machines were connected to each other by a crude system of umbrella bones.

These anecdotal encounters led me to bring Dr. Matt Broome, and experimental physicist and long term collaborator, to attempt to refine the question. In other words, to try and unpack what the intention of the machine is.

Interaction of a physicist and The Evolver. To understand the interaction of a human with a Stochastic Apparatus, a physicist (Dr. Matt Broome) was placed in the vicinity of The Evolver (the prototypical Stochastic Apparatus) and given a period of time to interact with it in-any-way-he-saw-fit to see what kinds of interactions could be observed and recorded (a measure of a sort) and subjected to analysis to gather information about the nature of the types of interactions that Matt could have with this machine.

Matt evolves to a nearly decomposable system. The behaviour of the system [Matt and Evolver (M+E)], where Matt (M) is the perturbation of the Evolver (E), is perhaps more accurately seen from a system point of view rather than as two separate things. In this sense we see an interesting pattern emerge (see Fig. 4).

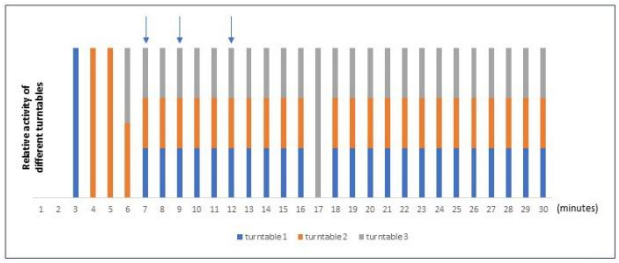

Figure 4. Temporal behaviour of Matt with Evolver. Showing the behaviour of the overall system over the 30-minute recording period. Where the different colours representing the different turntables reflect the proportional contribution to the motion of the machine at each time point. The arrows represents the points where Matt left the room to go to the studio to collect objects for addition onto The Evolver.

From Table 1 and Figure 4 we can see that up to 5 minutes into the experiment, Matt the physicist is controlling the system in the way that he *wants* to. From about 6 minutes into the experiment all turntables are turned on - operating almost all the way through the experiment. In the observations (Table 1) the machine was described by Matt as going 'wilder'. Matt in his reflection on the experiment said that things were initially quite systematic, but that did not continue. He then started, "…coupling things to personality". This can be interpreted through Simon [1] who talks about systems that are *decomposable* and those that are *nearly decomposable*. A system that is decomposable is one where the parts of a system are indistinguishable whether they are with the system or not. A system that is nearly decomposable is one where the identity of the components of the system are affected by the system they are in. Matt before entering the system with Evolver was Matt the father; husband, Steve's friend and colleague and also physicist. When Matt entered the experiment he entered it as Matt the physicist. He set about measuring the system to assess its

behaviour under certain parameters. About 5 minutes in, when the system went *wilder* Matt's identity was wrapped in the interaction with the machine and the two components M+E started influencing each other's behaviour in a more agitated and frenetic way. This expressed itself in a shift in observable behaviour of Matt, where he underwent an apparent phase transition from scientist to something entering into a dialogue. In his reflection he spoke of the machine getting 'annoyed' 'feeling frustrated'; 'trying to express itself', which are not objective phrases but suggest inter-relationship.

time remaining (minutes)	behaviour observed	comment
30		
29		
28	Turntable 1 was switched on and turntable 2 was moved manually; lid of pen 2 was kept on.	
27	Turntable 2 was switched on; turntable 1 and 3 are left off; Matt is (gently) manually moving turntable 1.	Machine is like a lazy river. All motion is gentle and respectful at this stage.
26		
25	All motion of turntables extept turntable 3 is off. Turntable three is squeaking repeatedly: na-tee-da na-tee-da-na-tee-da	
24	Behaviour is wilder; pen A jumped off turntable 3; Matt quickly returned it.	
23	Matt went to adjacent studio to get tools. Pen A snagged. Matt has brought a random object into the story to interact with the pendulum.	Between 23 minutes remaining and 18 minutes remaining an array of objects were brought into the system
22		
21		
20		
19		
18	Pen from peripheral paper is unmoving at this time	
17	Turntable 3 dumped its dampeners; Matt is bringing more pens into the system and complicated wires; Matt said, "interesting," As Pen A snagged off turntable 3.	
16		
15		
14	solid snag; dampeners placed on turntable 3; pen A is snagging quite a lot but Matt keeps returning it to turntable 3	
13		
12		
11		
10	Matt is doing novel reconfiguring of Pen A and coupling it to irregular pendulum, directly *touching* turntable 3; paper on core is ripping and revealing underpaper.	
9		
8		
7	top layer of paper is thrown off turntable 3	
6		
5		
4		dampener on turntable 3 is producing interesting behaviours (top paper thrown off in a beautiful ballet at about 7 minutes left)
3		
2		
1	Matt couples sharpies directly to irregular pendulum.	
0		

Table 1. Observations of Matt interacting with The Evolver.

The coupling, between M and E appeared to be enough to partially integrate M with E, but there is evidence of Matt escaping the system. At 15 min. Matt was heard uttering the word, "interesting." Which suggested that at that moment he was reflecting on what had happened. Observing it as a scientist.

If Matt was interacting with a toaster he would have remained decomposable. We are suggesting that there is something about The Evolver that drew Matt into the system. It has two properties that make it different from a toaster. Firstly it is non-teleological, i.e. it has as its purpose to carry irregularities. Secondly, it is not tunable and

therefore frustrates / subverts efforts to map its behaviour in a reasonable way. Both M and E have behaviours that cannot be predicted and as Matt states in his reflection, "*If you are unable to predict the movements of the machine is that not the definition of something making its own decisions*." It is therefore adopting behaviours that are appropriate to its environment, or as a result of its environment, which is all any system can do!

The types of things Matt and The Evolver are, will affect the ways they can interact with each other and therefore affect the way they affect each other. We have already claimed that Matt is a nearly decomposable component of the M-E system, however (and almost by definition) they are in the granularity of observation still distinguishable and we can observe and categorize their separate behaviours and effects. Here an effort will be made to engage interactions which are notable / observable and where the interactions affect either's trajectory appreciably into the future.

Let's consider Matt's action on The Evolver first. (i) Matt can gently touch the Evolver in a *non-adjustable* way, i.e. where the impact leads to no discernable behavioral change. This would be like a bee landing on a leaf, where the changes resulting are not directly discernible at that scale. A bee landing on a flower is a whole different matter. Here the effects are massive from such a soft touch, leading to the transfer of pollen and potential fertilization. The flower essentially carries a massive quantity of potential activity. Therefore by non-adjustable we can say that The Evolver's behaviour does not change discernibly. Here E appears to return to an equilibrium state immediately from such a touch. (ii) Matt can also contact The Evolver in an *adjustable* way, i.e. where an observer can see a shift in the relative internal spatial coordinates of The Evolver. For example, switching on a motor, where such a small adjustment has such a massive internal effect. Or bending a wire (resulting in much smaller – non-linear effects; or returning the pen to the rotating table if it came off. These adjustments are either to RETURN it to its 'basal'[1] state (e.g. if the pen jumps off the turntable or the paper snags) or to encourage NEW behaviours, like tweaking a wire or shifting its position. For Matt to be able to do these things he needs to be a thing in the world that can have such extraordinarily nuanced feedback-mediated motion in the first place. The third type (iii) of discernable interaction of Matt with Evolver is where Matt can introduce (*additive effect*) an object from outside the system, into the system which may or may not change the dynamic behaviour or properties of the system. The last (iv) discernable interactive behaviour displayed by Matt was a *subtractive effect* where Matt would remove an object which could either have an appreciable perturbation or no evident perturbation of the system. Sometimes this mode would be frantic, where Matt noticed something BLOCKING its behaviour and sometimes gently removing an object. This aligns it with the adjustable mode of behaviour in that the intention is to change behaviour.

There are limited ways that actions made on the Evolver may be recorded. The most obvious way of measuring effects on the Evolver are: the recordings made on the two drawing surfaces (pens A and B) (see Figure 1); and the placement or removal of an object into or out of the 'theatre of play.'

We will now consider the observable actions that The Evolver can make on Matt. This may seem an absurd notion that The Evolver can be said to initiate an action passively and does raise the philosophical quagmire of agency and causation [13]. The only thing we can convincingly say is that Matt's behaviour during the period of the measurement *was* contingent on the Evolver being there and can thus be said to be caused, or at least strongly correlated with the presence of The Evolver. Unlike Matt's observable effects on the Evolver, the effects of the Evolver on Matt may be non-local in that it could not be directly observed but surmised upon his reflections after the fact (not shown), but what must be true is that much of his responding motion was as a result of an interaction, directly or indirectly, with The Evolver.

Discussion.

The initial intention of this work was to see if we can talk about art *as if* it was science – to test the boundaries between these two disciplines. The fodder for this study was in the context of a continuing exploration of evolving systems, initiated in my years as a scientist now extending to my life as an artist. A stochastic apparatus was evolved which echoed evolution in that it displayed regular iterative behaviour but carried irregularities (mutations) at its periphery. We must consider the narrative potential in this, as what was essentially done is take what was an eccentric drawing machine that was meant to model evolution and was then "allowed" to evolve into much more.

Science is the systematic study through observation; theoretical apprehension and measurement of any apparent

[1] Basal state can be seen as the starting behaviour or setup of The Evolver and any shift from that is a shift from equilibrium – a novel state.

phenomena that exists. This art object and its interaction in the world are such a phenomenon. We were curious as to what scientific narrative would emerge through its apprehension.

The only way this could happen was the Stochastic Apparatus had to be placed in the world – generate novel environments to observe its behaviours and thus more importantly the behaviours that encountered it. Place it essentially in a performative context – far from equilibrium [12], which is in a natural and theatrical system where evolution takes place. Current feedback loops which hold a system in steady state are thrown off and novel ones can 'hook into place' when the system is taken out of its comfort zone [14]. It was in these iterative circumstances that evolution was observed. The machine became necessary for the evolution to nucleate around. This was first seen with the scientists at CSIRO who gently coaxed the Stochastic Apparatus back to functionality – captured in the measurement / drawing (Figure 3E). If this was the only measure of the system, we would have to conclude that the scientists were a part of the system. To explore this further, an experimental physicist (Dr. Matt Broome) chosen for his fastidiousness of operation and prior partnerships was co-located with The Evolver Stochastic apparatus to see whether interactions could be measured.

Science operates at different scales depending on what is being studied. Physics occupies the most basic scale where the feedback mediates the most basic forces and then up through chemistry to biology, psychology, society and culture. At every scale the properties get more complex. The interaction between two atoms can be grasped with relatively simple maths (quantum mechanics may be hard to explain but it is easy to calculate), but by the time we get to our scale there is no arithmetic to unpack a conversation between two people. The scale we operate at is loaded with complex ideas like consciousness, intelligence; love, hate and God. It's hard to get our mathematics around that! The approach we decided to follow, we believe is quite a novel one and attempts to observe and record interactions as a naïve observer, i.e. makes no assumptions about what machines are or humans for that matter. This would be akin to an interplanetary observer coming down and trying to understand what these things were that were interacting i.e. without being encumbered by prior knowledge from fields more accessible to studying this phenomenon - an encumbrance that would limit our ability to fully integrate / de-centre ourselves from the vast "out there". This approach was inspired by the quantum physicist Erwin Schrodinger in his 1945 book "What is Life" [15] where he treated a living system as simply a physical system and gained remarkable insights into how molecular processes are ordered in living systems as compared to non-living systems. And not insignificantly, a similar approach is being suggested by interdisciplinary researchers for the study of Artificially intelligent systems [16].

By observing the effects Matt has on The Evolver as well as effects The Evolver has on Matt we are not prioritizing him over the machine. In so doing we were broadening the meaning and reach of Agency where the machine nucleates behaviours in Matt – very different behaviours that if he were interacting with a toaster, suggesting that: yes we may have agency but the resulting behaviour patterns that emerge is completely dependent on and a function of the specific structure of the environment. In this case where the Stochastic Apparatus was a proxy for an environment (and by extension, Matt an environment for The Evolver), the range of behaviours was dependent on the type of thing that The Evolver was. Since it was untunable and non-linear in its peripheral behaviour, Matt became 'lost in it' and therefore more integrated with it, and something greater than or at least different from the sum of its parts [1, 17]. He identified with it as being more alive:

"Allowed the machine to speak for itself, like a child"

and

"Machine felt annoyed. But it was learning because it learned to go back to a steady state,"

in a way that would be unlikely to happen if The Evolver was more like a toaster.

And from Matt again, "What decisions it makes and how it makes them are based on environmental factors. It *chooses* how to describe itself based on what the environmental factors are." The suite of behaviours Matt exhibited were canalized by the object-environment that The Evolver is. The Evolver places probabilistic limits on what Matt is going to do, but not in a way that is very predictable unlike the social media teleology which is almost completely designed to determine our behaviour [18]. If we are going to draw any conclusions from this and extract meaning then it is that: our behaviour is contingent on and compelled by the specific parameters (form and behaviour) of the specific context of the environment that we find ourselves in. The looser the environment, i.e. the more degrees of freedom, then the more ways there will be to interact with it. The more opportunity for novelty; the more possibility for play and unexpected engagement to emerge. Our curiosity - the precursor to love [9] – is activated. Toasters are wonderful, but we know exactly what we are going to do when we encounter them. There is the very low likelihood you'll use it as a hammer [10] but chances are you'll use it to make

toast. Our world is not a toaster it's a Stochastic Apparatus and increasingly the tools of our making, generative AI, feels like a stochastic apparatus with degrees of freedom that we can't yet conceive of.

Conclusion.

In this study we believe we have apprehended an art process and artwork using the aesthetics and formalisms of science. In other words, we have treated the work as a phenomenon, and like any phenomenon, it can be subjected to scientific enquiry. In addition to this we feel the narrative that we have apprehended can be considered as a proxy to engage with systems that have no teleology and many degrees of freedom like The World and like generative AI. We have shown that by using a naïve approach, like an interplanetary scientist with no prior knowledge, we can consider the components of this system to gain a foothold of an alternate way to engage with complex systems. I was asked if this work was satire and to some extent it is, but I believe that to engage with this area between art and science there had to be some irreverence so that new ways of knowing could sneak up on us through the back door.

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