Creative Chaos

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"What lies between rigidity and chaos, which both have their art and science? It is change within order." (Stafford Beer, S.A.M.)[1]

Humans have successfully navigated an ever-changing world for thousands of years. Central to this success is our ability to make choices based on limited information. Humans make decisions on many different levels, from how we interpret our surroundings to how we predict outcomes. Scientific research spanning various disciplines, including neuroscience, economics, and cognitive science, focuses on modeling decision-making at different scales—from the neural to the societal and from the organic to the synthetic. Modeling decision-making allows us to study how the systems we maneuver regulate themselves, process information, and respond to change.

In neuroscience, researchers apply frameworks like signal detection theory to dissect how the brain discriminates between signal and noise in decision-making. Decisions for sensory-motor tasks are a form of statistical inference, a prediction of the state of a system given a noisy world, where "even perceptual decisions have at their core, value judgments"[2]. A 2005 study by Michael Spivey et al. on monkeys and their eye-tracking found that the oculomotor system has real-time access to information about a moving target, not just the final outcome of an independent decision process. "This result is inconsistent with the notion that central decision maker completes its operation before activating the motor structures to perform the necessary action... information flow from sensory neurons to motor structures is more or less continuous"[3]. In economics, the study of decision-making is framed around the concept of scarcity. Decision-makers navigate a world where resources are finite but desires are not. Humans were considered rational agents, until Daniel Kahneman and Amos Tversky's prospect theory shook the field by measuring just how inconsistent human decision-making really is[4]. "They found that people often make choices that contradict expected utility theory, especially under risk conditions and uncertainty where emotions may play a role. We are more likely to feel worse about losing $100 than we are to feel better about gaining

1. *Cybernetic Serendipity: The Computer and the Arts* (1968), accessed May 17, 2024.

2. Joshua I. Gold and Michael N. Shadlen, "The Neural Basis of Decision Making," *Annual Review of Neuroscience* 30 (2007): p. 561, ISSN: 0147-006X, https://doi.org/10.1146/annurev.neuro.29.051605.113038.

3. Michael J. Spivey, Marc Grosjean, and Günther Knoblich, "Continuous Attraction toward Phonological Competitors," *Proceedings of the National Academy of Sciences* 102, no. 29 (July 2005): 10393–10398, accessed May 20, 2024, https://doi.org/10.1073/pnas.0503903102.

4. Daniel Kahneman and Amos Tversky, "Prospect Theory: An Analysis of Decision under Risk," *Econometrica* 47, no. 2 (1979): 263–291, ISSN: 0012-9682, accessed May 21, 2024, https://doi.org/10.2307/1914185, JSTOR: 1914185.

$100, regardless of our absolute wealth"[5]. In cognitive science, structured information about the world is exploited by heuristics, simple decision-making algorithms that help us navigate the world with speed and accuracy. "In challenging environments with high variability, low predictability, and little learning opportunity, good decisions may nonetheless be made more often by simple mechanisms than by complex ones"[6]. One example is the recognition heuristic, a bias where people place higher value on entities that are familiar to them. In tennis, novices who make predictions about winners based on name recognition are often found to outperform Wimbledon experts[7]. Over time, interactions between the mind's decision-making and the world's information patterns cultivate a form of "ecological intelligence" (eco intelligence paper). This adaptive wisdom allows humans to navigate a world whose data undergoes structured change, creating a feedback system that further modifies the environment and the system in unpredictable ways.

According to Norbert Wiener in *The Human Use Of Human Beings*[8], feedback is central to cybernetics. "It is my thesis that the physical functioning of the living individual and the operation of some of the newer communication machines are precisely parallel in their analogous attempts to control entropy through feedback". Cybernetics focuses on maintaining control of and adapting to uncertain environments, aiming to "steer artfully toward a goal." It involves designing systems that can be controlled with feedback to achieve desired outcomes. The ground-breaking 1968 "Cybernetic Serendipity" art exhibition by Jasia Reichardt was one of the first to showcase the potential of these algorithmic and systems-based approaches to art. The works demonstrated how artistic practices can visually and interactively represent cybernetic concepts. Stafford Beer, whose poem, "S.A.M.", opens the exhibition catalog, emphasized the application of cybernetics to organizational design. In his "Designing Freedom" lecture series, he focused on control structures similar to nervous systems, advocating decentralization of control to allow for rapid responses to environmental changes and challenges[9].

5. *Prospect Theory*, https://thedecisionlab.com/reference-guide/economics/prospect-theory, accessed May 17, 2024.

6. Peter M. Todd and Gerd Gigerenzer, "Environments That Make Us Smart: Ecological Rationality," *Current Directions in Psychological Science* 16, no. 3 (June 2007): p. 167, ISSN: 0963-7214, accessed May 17, 2024, https://doi.org/10.1111/j.1467-8721.2007.00497.x.

7. Gerd Gigerenzer, *Gut Feelings: The Intelligence of the Unconscious* (Penguin, 2007), ISBN: 978-0-670-03863-3.

8. Norbert Wiener, *The Human Use Of Human Beings*, New edition (New York, NY: Da Capo Press, March 1988), ISBN: 978-0-306-80320-8.

9. Stafford. Beer, *Designing Freedom / by Stafford Beer ; with Sketches by the Author.*, Massey Lectures ; 13th Ser. (Toronto: Canadian Broadcasting Corporation, 1974), ISBN: 0-88794-075-7.

While many applications of cybernetics focus on controlling from the top down, other approaches to system design construct from the bottom up. An example is agent-based systems, which simulate the interactions of autonomous agents to study how complex behaviors and patterns emerge from an environment consisting of rules and local interactions. They are used to understand social decisions in markets, organizations, and communities. Central to this research is the examination of feedback loops, system dynamics, and algorithmic interactivity, elements that are all also inherent to cybernetics. An early example of agent-based systems in art is Gordon Pask's contribution to Cybernetic Serendipity called "Colloquy of Mobiles", which featured machines interacting with one another. The installation exhibited large, mobile structures equipped with lights, mirrors, and other sensory devices, designed to interact with each other and exhibition participants. The piece presented principles of conversation and adaptive learning within a cybernetic system and was programmed to achieve success only when the agents frequently communicate and interact, resulting in unpredictable feedback systems and an early form of generative art. Pask viewed his designs as social allegories, playfully simplifying the complex, interconnected web of communication that dominates our daily lives. However, Pask's piece was more than just art – by revealing concealed data structures within systems, it functioned as a public experiment.

Pask's thoughts on cybernetic environments highlight the aesthetic and interactive richness of these primitive yet sophisticated social systems. He noted that "An aesthetically potent environment encourages the hearer or viewer to explore it, to learn about it, to form a hierarchy of concepts that refer to it; further, it guides his exploration; in a sense, it makes him participate in, or at any rate see himself reflected in, the environment"[10]. The emphasis on communication as a criterion for success pushes systems towards adaptability, requiring agents to engage in the exchange and modification of information to achieve system goals. In complex systems involving multiple agents, this requirement for communication often leads to enhanced cooperation and coordination, which can lead to sophisticated emergent properties. However, it can also spiral into undesirable states, where agents can get stuck and refuse to interact.

Both Gordon Pask and Stafford Beer used diagrams when modeling the dynamics of systems. In my time in industry, system diagrams were heavily relied upon when architecting software. In interviews for engineering roles, a common format is a system design interview. The strategy for the interviewee is to enumerate all relevant nouns within a system and then illustrate their relationships, exclusivities, and the directions in which information and resources flow. For example, designing

10. *Cybernetic Serendipity.*

a social media platform involves Users, Posts, Comments, and Notifications. Users are connect to Posts that they author and can interact with through Comments. Notifications are generated based on activities within Posts and Comments, such as new comments, likes, or mentions, directly linking Users to real-time updates on interactions throughout the network. This methodology aims to create controlled, predictable, and maintainable systems to efficiently organize information within a specific domain. While traditional systems of control emerge from having to regulate environments, my own creative practice seeks to construct unpredictability itself. Stafford Beer underlines the moment when feedback takes over the input of a system, transforming it from a static structure into a dynamic and responsive organism. The question is, how does one design a system to be out of control? My approach—**creative chaos**—endeavors to use existing models from cognitive science to reverse engineer emergent behaviors within agent-based systems. The elaboration of these problems through aesthetic systems creates not just art but an instrument of research that allows for a deeper investigation into societal structures and interactions.

Since starting graduate school, my creative practice has focused on programming simulations to be dramatic and entertaining. I was inspired by a paper published over the summer called Generative Agents: Interactive Simulcra of Human Behavior[11]. The authors proposed an memory architecture that augments a Large Language Model with the ability to store a comprehensive record of the agent's experiences in natural language. The system synthesizes these memories into higher-level reflections over time and dynamically retrieves them to inform behavior planning. This paper helped spawn a fountainhead of new research that focuses on AI-powered agents. I have leveraged my background in software and economics to focus on research in cognitive architecture that extends this model, focusing specifically on hot cognition, or the effect of emotion on decision-making. This feedback mechanism of thoughts and emotions can power generative agents to create behavior that is not only believable but dramatic and entertaining. In tandem, the rise of tools like Unreal Engine allow for visualizations of this research not previously possible, digitally producing immersive, investigative art systems much like Pask's at a fraction of the cost. Rapidly simulating entire systems with machines allows me to experiment with reality itself.

Before coming to MAT, my art practice was driven by a similar desire to catalog the world around me. I started field recording during the pandemic, which completely transformed the soundscape of my Brooklyn neighborhood. I began to appreciate the significance of what were once

11. Joon Sung Park et al., *Generative Agents: Interactive Simulacra of Human Behavior*, arXiv:2304.03442, August 2023, accessed May 21, 2024, https://doi.org/10.48550/arXiv.2304.03442, arXiv: 2304.03442 `[cs]`.

mundane sights and sounds of the bustle of my street. When I walk through a city, I am captivated by the behaviors and idiosyncrasies of the people around me. I observe their interactions, both the discrepancies between what they say and what they mean, and how they express themselves consciously and subconsciously through actions and emotions. What are the possibilities of art when you can simulate the dynamics of an environment as complex as an entire metropolis? Machines that can illustrate ideas are a powerful tool for creating generative art, but, they are just an input to a larger narrative. For my practice, introducing chaos within agent-based systems is merely the beginning. My ultimate goal is to design from a macroscopic perspective in order to zoom in to the microscopic details. I aim to elevate the mundane and languishing aspects of life—those relatable experiences that resonate with most people. Entertainment comes from the unexpected, and human interactions, the essence of our identity, are complex and messy. While the concepts that connect us universally might not always seem profound, they are fundamental to understanding and portraying human experiences in art and media. My goal for my Master's thesis is to create synthetic reality TV, my fascination for which is aptly summarized by artist Ian Cheng:

> "You don't watch The Real Housewives for gripping story. You watch it first for this immediate observation of behavior and the kind of moment-to-moment situational melodrama where relationships are threatened and repaired. If you blur your eyes across 10 seasons, of course, you see that each character has lived her own history and story. So you get both... I wanted this kind of quality where you could flicker between appreciating the moment-to-moment changes that are occurring, and then knowing that the emissary character had determined at the start of the episode a certain desire or goal they're heading toward. It's like 40 percent orderly story and 60 percent just chaos."[12]

There's an appeal to the irony of a machine-led system that reveals uncomfortable truths about humanity, where the system we design and the data we provide creates a feedback loop that eventually mocks us. There's also a relative lack of cynicism in generative art, where most mainstream "AI art" bounds blindly forward. Virtual worlds and AI are constantly used as a form of escapism, depicting alternate realities and utopian metaverses instead of questioning the role of technology in the existing problems of today. AI is a sensitive technology with both reward and risk. The advent of generative AI creates the potential for significant short-term job loss. In an

12. *Ian Cheng's Emissaries — Magazine — MoMA*, https://www.moma.org/magazine/articles/40, accessed May 17, 2024.

era of job insecurity driven by technological advancements, it is important to critically analyze the role of technology in our progress – and whether its net impact is actually positive. Cybernetic principles could guide the creation of AI systems that are more sensitive to human needs and less likely to exacerbate social inequalities, but a broader rethinking of the role of technology in society is necessary. Unlike "ecological intelligence", machine intelligence arguably transforms life into "a standing stockpile of resources waiting to be plugged in and plundered"[13]. These technologies infringe on privacy, perpetuate biases, and treat individuals as information to be harvested – ethical considerations of all AI applications are called for. My work walks a knife's edge–while trying to preserve and uplift human experiences, I risk losing them entirely.

13. Artist Sahej Rahal in the blurb for his upcoming 2024 workshop series, "Ghosting the Machine"