Shane Ragland

In Search of a Self Reflective Painting (Thesis Proposal)

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Laura Hughes, Thesis Crit Seminar

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am about to embark on a great folly.

In my current practice I have been exploring the idea of painting as a medium through which to think, through which thought arises, and paint as a medium of consciousness. This creative headspace has led me to consider the artistic potential of reflections and how they are deeply connected to the development of the self. In his works on the subject of consciousness, Douglas Hofstadter writes that we are not born with an 'I', a sense of self, but rather our experiences shape our dense web of complex neurological patterns, which he calls symbols, into an "intricate tapestry rich and complex enough to begin twisting back on itself," becoming self-reflective. Think of this blurring of inputs and outputs as a mental Möbius strip, hence the title of his book, *I Am A Strange Loop.* All this leads me to ask, if self reflection is fundamental to consciousness and to the development of an 'i', how can I create a self-reflective painting? How can a painting interact with itself?

I have been fascinated with 'strange loops' for a while now, but for the most part my artistic efforts dealing with this subject has always felt somewhat malformed. I have yet to create a strange loop through art, but maybe that's because I've been approaching it from the wrong angle. In my earlier work on the subject, by focusing on the outcome, the finished product, I was unable to reach what I was looking for. By trying to create a self reflective feedback loop through process rather than product however, I believe a more realized and conceptually satisfying outcome will happen naturally.

My proposed project is this: a canvas stretched across 16 1'x1' panels laid out four by four, creating a matrix in which the painting can fold in on itself in multiple ways and directions.

This allows for planes of thickly painted canvas to press into each other, dry, and tear apart: both faces at once will imprint onto each other and remove paint at the same time. Through this process, the painting as a whole will reflect onto itself, and paint across the canvas will connect to each other in a similar way to neurological symbols. As more and more connections are made, patterns may begin to form and eventually weave an intricate tapestry of color and texture. With each repeating cycle being both additive and subtractive, as the act of pulling the panels apart also removes paint, revealing earlier layers, the painting will be moving both directions, forward and backward, at once. I am planning on limiting my color palette to black and white, using both acrylic and oil paint, to emphasize, explore, and blur the lines between input and output, forward and backward, reflected and reflection.

So in brief, I am attempting to create a self-reflective painting through a feedback loop of process. I am also planning on doing video documentation of the painting process and taking photos of every cycle. With this proposed work I am hoping to find answers to the questions I have been asking. More importantly, I hope what I learn from this project will unveil new questions to ask and explore as I continue working with these ideas in the future.

Shane Ragland
Thesis Abstract

In my current practice I have been exploring the idea of painting as a medium through which to think, through which thought arises, and paint as a medium of consciousness. This creative headspace has led me to consider the artistic potential of reflections, connections, and information and how they are deeply connected to the development of the self. In his works on the subject of consciousness and the self, Douglas Hofstadter writes that we are not born with an 'I', a sense of self, but rather our experiences shape our dense web of complex neurological patterns, which he calls symbols, into an "intricate tapestry rich and complex enough to begin twisting back on itself." Think of this blurring of inputs, outputs, and connections as an abstract mental Möbius strip, hence the title of his book, *I Am A Strange Loop*. All this leads me to ask, is

it possible to create a painting that materially operates in a similar way to the processes that govern the development of our consciousness, and our 'I'? Can a strange loop be created through paint?

To briefly clarify what a strange loop is, the idea when thinking about the self is that we are simultaneously driven by the world of the tiny, the trillions of cells that make up our bodies, and the abstract higher level of the self, the world we consciously inhabit and control. Both are constantly creating, influencing, and dictating the other, creating an abstract loop of sorts. In pursuing this line of inquiry, I am primarily interested in how simple equations and programs, or formal systems of painting can produce the most unpredictable and complex outcomes. So in brief, for a strange loop to be created through paint, the painting needs: to organize and reorganize it's input, "perceiving" the paint added, for the paint to be completely interconnected with and interdependent on itself across the whole of the canvas, to be a feedback loop of process, to be self-referential and self-similar, and to create an non-linear or downward causality.

So did I make a strange loop? Well, no, close but not quite. Most of these paintings achieve four of the five requirements needed but none so far have managed to completely break from their upward form of cause and effect. I don't see that as a failure though in any way. I made a recursive, self-organizing painting process that acts in a similar way to these fundamental natural processes, whether or not anyone finds that interesting, I'm pretty jazzed about it, and I'm excited to go even further down this rabbithole. I've learned so much through this process and tried out methods and techniques I never would have thought before. I certainly never saw myself as someone who would end up painting with syringes or starching his canvas. This project has helped me realize about myself that I make to learn, and to seek knowledge is to embark on a journey which will always be incomplete. It's a fine day for learning, and I'm thankful I get to share it with you now.

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Shane Ragland
Thesis Presentation

"To seek self-knowledge is to embark on a journey which... will always be incomplete, cannot be charted on any map, will never halt, cannot be described." - Douglas Hofstadter

In my current practice I have been exploring the idea of painting as a medium through which to think, through which thought arises, and paint as a medium of consciousness. This creative headspace has led me to consider the artistic potential of reflections, connections, and information and how they are deeply connected to the development of the self. In his works on the subject of consciousness and the self, Douglas Hofstadter writes that we are not born with an 'I', a sense of self, but rather our experiences shape our dense web of complex neurological patterns, which he calls symbols, into an "intricate tapestry rich and complex enough to begin twisting back on itself." Think of this blurring of inputs, outputs, and connections as an abstract mental Möbius strip, hence the title of his book, *I Am A Strange Loop*. All this leads me to ask, is it possible to create a painting that materially operates in a similar way to the processes that govern the development of our consciousness, and our 'I'? Can a strange loop be created through paint?

Now in no way am I trying to claim that I fully understand how consciousness or the self works, no one does. Nor am I trying to bring together all the different and conflicting philosophical and scientific theories on the subject into a cohesive whole. I am instead centering my focus on the work of Douglas Hofstadter and the scientific ideas that relate to it as the foundation for this project. This is not just because I agree with it, or how Hofstadter integrates art into the equation, but more importantly it is essential if we are to conceptualize the subject as a material system, and it has already been crucial to the development of artificial intelligence and more.

Before I continue, I should probably ask, why am I doing this? Well, the truth is I can't really point a finger at when or where I began to find interest in the ideas of consciousness and the self, because it's been years. There were a couple key moments however that lead me to wonder if the worlds of art and cognitive science could be fused together.

The first was a quote from Mark Rothko that goes: "A picture lives by companionship, expanding and quickening in the eyes of the sensitive observer. It dies by the same token. It is therefore a risky and unfeeling act to send it out into the world." The second was taking the class "Strange Loops and Metamathematics," taught by Sean Yeager, who introduced me to Hofstadter's work and the ideas that have now become the foundation for my thesis. Despite all this, when asking myself as to why am I compelled by this subject, all I know is that years ago my brain made a connection between these two fields, and the smallest seed of an idea can grow into an obsession.

In pursuing this line of inquiry, I am primarily interested in how simple equations and programs, or formal systems of painting can produce the most unpredictable and complex outcomes. All calculations, and thus these paintings, have two aspects: the data, and instructions for what to do with that data. Sufficiently complicated formal systems, like people, have self-images. The systems that produce chaos, complexity, and self-organization within the natural world are based on, and can be described by, simple mathematical rules. All these rules however have a unique property in common, feedback, where the output of an equation becomes the input for that same equation.

This recursive element can be seen in the form of self-similarity. Underlying nearly all the shapes and forms in the natural world is a mathematical principle known as self similarity, which describes anything in which the same shape is repeated over and over again at smaller and smaller scales. Fractals are the purest example of this, and these concepts of recursion and self-reference are foundational to strange loops.

Hofstadter defines consciousness as a "strange loop", a tangled hierarchy in which by moving up or down a multilevel system, one returns to where they started. A strange loop in a sufficiently complex system can give rise to a "downward" or "non-linear" causality instead of an upward one. Essentially, upward causality is where the small stuff (atoms, chemicals, etc…) drive the big stuff (consciousness and the body) while downward causality is, well, the opposite. Non-linear causality occurs when events interact bi-directionally with each other. A key characteristic nonlinear causality is, once again, feedback, which comes in three forms:

self-reinforcing loops, micro-macro dynamics, and reverse causation. The first one is the best known. Self-reinforcing loops can lead to disproportionate outcomes, think of the butterfly effect as an example, which in turn leads to indeterminism.

This brings us to the paradox of self. Hofstadter describes the paradox of self as a rift between two levels of being that the self seems to simultaneously occupy:

> "On one hand, 'I' is an expression denoting a set of very high abstractions: a life story, a set of tastes, a bundle of hopes and fears. And yet on the other hand, 'I' is an expression denoting a physical object made of trillions of cells, each of which is doing its own thing without the slightest regard for the supposed 'whole' of which it is but an infinitesimal part."

Although we know intuitively that there is an 'I', we can't empirically prove it exists without referring back to ourselves. The self confirms and reinforces its own existence.

In this framework, our 'I' can be seen as an illusion of sorts, we believe in our identities and that our 'I' is the controlling force of our thoughts, experiences, and interactions. In reality, the 'I' is more akin to the optical illusion known as the Kanizsa Square. The square that your eye perceives is implied by the surrounding shapes, without which there would only be empty space. The same can be said for the self, which while not physically grounded, is an emergent property of all the material actions, reactions, and complex patterns of the brain and its relationship to the world around it, but it cannot exist independently without them. The self cannot exist in a void, but it is the space between spaces, the room inside the walls.

There are two crucial elements that make the self a strange loop. The first is an ability, the ability to think: not simply receiving input, but perceiving it. In doing so, our minds distill and organize an incomprehensible amount of raw information into abstract symbols that we can conceive of. The second element is an inability: the inability to peer below the level of said symbols.

The self could be reduced to a bunch of squirting chemicals, which it is, but that reductive analysis would be meaningless. If the self is, at its core, the result of atoms randomly bumping into each other, why does it feel like you're in charge? I am speaking, atoms are not.

The brain has to simplify and abstract information, jump up to the human level to reach any meaningful understanding. We couldn't possibly perceive all the tiny microscopic interactions that gave way to me presenting to you now, so instead we abstract the information to a level we can conceive of: Shane is speaking. At this level, the I is in charge.

Simultaneously we are driven by the world of the tiny, the trillions of cells that make up our bodies, and the abstract higher level of the self, the world we consciously inhabit and control. Both constantly creating and dictating the other, hence non-linear causality.

To return to the realm of art and my line of inquiry, let's look at one of Hofstadter's favorite artists, and an illustrative, if somewhat incomplete, diagram of a strange loop: *Drawing Hands* by M.C. Escher. The lithograph depicts two hands armed with pencils, arising from the paper, each one creating, drawing, the other into existence. There is a shift from drawn to drawer yet each hand owes its existence to the work of the other. Out of all of Escher's work dealing with paradoxes and tangled hierarchies, this picture conveys the core idea of a strange loop more simply and directly than any other.

To clarify what I hope to accomplish, I am not asking how I can make a painting that illustrates what M.C. Escher already has with this image, I am asking if I can make a painting that does what *Drawing Hands* only illustrates. How can a painting be its own painter? How can a painting paint itself?

Consider this analogy: the brain is like a dictionary. In the dictionary, every definition for a word is composed of words that are defined by other words. One can follow this rabbithole until it eventually loops back around to the word you started with. The complex web of neurological patterns, Hofstadter's 'symbols,' within the brain are all intertwined in a similar way to signs in language. When you think of "milk," symbols connected to the idea of milk are immediately triggered in the mind: cow, white, soy, glass, breakfast, cereal, etc. Not only do these concepts within the proximity of milk define and reinforce the concept of milk, they too are also being defined and conceptualized by the idea of milk.

Think of it like a web, all concepts and symbols exist in the points of intersection between strands of silk, they are not the strings themselves but rather where they meet. Concepts cannot exist in isolation. This is why Hofstadter writes that "analogy is the core of cognition." Without concepts there could be no thought; without analogy there could be no concepts. Consider this analogy: the brain is like a dictionary.

The reason I bring this up is because to create a strange loop through paint, every bit of paint and it's location, texture, and density on the canvas, all the material information of it, must be completely defined and organized in direct relation to all the paint around it. As you can imagine, this complex and intricate weaving of information is practically impossible for any individual painter to manage when thinking of the act of painting traditionally. To this end, let us think of the substance of paint as simply material information, raw data. Consciousness isn't a what but a how after all. In this case, what the paint itself does as a material substance on the canvas is of utmost importance.

This frame of thinking is of course nothing new or revolutionary, in fact it's very in line with modernist approaches to painting so, by contemporary art world standards, it could be seen as decidedly old-school, but it is absolutely integral to this exploration.

The painting and its process must be a formal system which takes the raw data of the paint added to the canvas and converts it into something interconnected, reflective, and recursive.

Binary signals, from neurons or code, are the quarks of consciousness. Like music, one note alone and without context is meaningless, meaning is found when notes are arranged in a pattern. Depending on the arrangement of quarks, protons and neutrons are formed, the atoms, molecules, etc… ever increasing in complexity and variety. By extension, consciousness could hypothetically consist of any medium that could convey a binary signal. With enough of them in a particular pattern, they too can function like our neurons. So to extend this line of thinking, paint can be treated in a similar way to a binary signal: black and white, oil and acrylic, any form that conveys a fundamental difference.

Each particle of black or white paint can be analogous to a bit, 1 or 0. Paints of the same medium mix as we would expect them to, the blacks and the whites blend together creating complex patterns internally, becoming various shades of grey. On the other hand, paints of different mediums, say oil and acrylic, interact with each other very differently. Since oil and water don't mix, the black and white never become grey and instead stay somewhat separate, never quite resolving into each other.

It's easy to imagine how a painting receives input signal, the addition of paint itself to the canvas, but to 'perceive' it in a sense, the first ability of a strange loop, the painting would have to reallocate, reorganize, and reflect on that material information. One way to achieve this, the only way I've currently found, is to make the canvas do the work.

By folding the canvas while the paint is wet and pressing the painted surface together, like a two way print or ink blot painting, paint is transferred and reorganized between the surfaces. Fold the painting enough times and in enough ways and patterns will begin to emerge through the painting's interaction with itself. Like the dictionary or neurological web, every part or section of the painting becomes defined by its contact or intersection with other parts across the canvas. In doing so, the painting becomes a feedback loop of sorts, the outcome of the input becomes the input to create the next output and the cycle continues. After all, consciousness is a constant transformation, a blurring of inputs and outputs.

So in brief, for a strange loop to be created through paint, the painting needs:
1. To organize and reorganize it's input, to "perceive" the paint added
2. For the paint to be completely interconnected with and interdependent on itself across the whole of the canvas
3. To be a feedback loop of process
4. To be self-referential and self-similar
5. To create an non-linear or inverted causality

So down to the nitty gritty, how exactly are all these ideas brought together into these paintings? What's the process? Well for each of these works I began with a square canvas which

was folded in a way to create an 8 by 8 or 16 by 16 grid. Before adding paint, I typically spray starched the back of the canvas, making the canvas a bit more rigid to avoid bends that would distort the data. From there, a standardized amount of black and white paint is added to each square of the grid, either by just squirting it straight from the tube, or in some instances I used a syringe for extra accuracy. All but one of the paintings use both oil and acrylic paint, each medium color coded to either black or white to allow for the material information that the process produces to be clear and useful.

Now the process really begins as I fold the canvas in various patterns vertically and horizontally, typically into halves, then quarters, then eighths, and occasionally sixteenths, before turning back, folding the canvas into eighths, quarters, and halves again. Like ripples on a pond, information is shared and reflected outward into smaller areas, then must come back inward towards the whole. A few pieces variate or add to the process, like adding more inputs after a cycle is completed, inverting the folding pattern, or running through multiple folding cycles, mostly just to see what would happen, but overall that is the template.

So to clarify my methodology, I have a theory, practically a hunch, that this mechanism of painting might be able to create a strange loop, and each painting is an experiment to test that with different applications. Each different experiment helped me learn more about the material I was working with and how to adjust for or accommodate the unique physical qualities of paint and canvas. My thinking on the matter is that I'm searching for the right equation to solve this problem. The base format of the painting process is the mechanism, the structure of the equation, and every tweak or addition for each new painting to it is an attempt to figure out the right variables. The paintings themselves are almost secondary in this regard. This project at its core is really just about discovering the right process.

Now, looking at some of the painting experiments that were produced by this process, we can see that this operation creates a self-organizing system of sorts. Self-organization is a process in which some form of structural order arises from the local interactions between parts of an initially disordered system. Unlike most man-made objects, self-organizing objects grow, acquire their form, and function as a natural process, without the need of intent or intelligent creator.

These processes can be found everywhere in nature, including the formation of clouds, cellular structures, the ripples of sand blowing off a dune, galaxies etc. Just as well, as you might have already guessed, the human brain can be considered to be a self-organizing system.

I'd like to note the ways in which these paintings have self-organized. While the paint in some organize into their singular units on the grid, others create shapes and patterns across it. Looking at these two pieces, both extremely similar as they are composed of white oil paint dots surrounded by black acrylic, I find it interesting that both these paintings had completely different patterns for their initial inputs. While they started from different places, they both arrived at the same conclusion, likely by having the same folding pattern. Alternatively these two paintings, both divided into sixteenths, arrived at very different conclusions because the folding pattern on the second piece was inverted. It seems fair to say that the process of folding the canvas is more consequential than the arrangement of paint applied.

I'd also like to point to the pieces whose composition can be seen to be defined by the shape of the square, presumably influenced by the shape of the canvas and the grid. These paintings seem to be pointing in the direction towards the notion of self-similarity, which I mentioned earlier, and contain at the very least some form of self-reference.

Before moving on I'd like to point out some other interesting things that occurred as part of this process. Firstly, with all of the paintings that used both oil and acrylic paint, the acrylic would spread across and dominate the canvas early on in the process, but as the folding continued, the oil paint would always rise up through it, taking its turn in the spotlight.

I mentioned earlier that simple equations and programs can produce the most unpredictable or chaotic outcomes, and a few of these paintings certainly delivered. With this piece, after enough inputs and iterations of the folding pattern, the oil and acrylic paint began to tear apart, ripping whole grid squares of paint off the canvas. It organized itself then dismantled itself. Looking at this other painting too, we can see that the paint is tearing apart in a specific way, where the removed paint almost seems to be haloing squares across the grid.

However, one of the strangest occurrences I've noticed can be seen in this painting here, where you can see by way of the process documentation, that in areas of the canvas that are consumed by black oil paint, in the last images you can see that a little bit of white acrylic paint is starting to shine through again. This is weird, and sadly the paint had dried up too much by this point to see how much further it would go or if it was just a fluke. That being said, it almost looks like the black oil and white acrylic paint were beginning to oscillate, just a little bit. I don't have an explanation for this but it felt worth noting.

With all that being said however, have I created a strange loop? Well, to be perfectly honest, no.

One problem with creating a strange loop this way is the infinite or at least continuous aspect. Outside the fact that I'm working with an inherently limited surface, the paintings would have to continuously transform and reorganize, which so far is not achievable on two levels. The first being that I am just one human being, so the paintings have to stop at some point. The second being a problem with the material itself: paint inevitably dries, and the process ceases to function with a dry surface. Even when adding additional inputs of paint, the paint that has already dried becomes problematic.

All that however could possibly be worked around, most of these paintings achieve four of the five requirements needed. The real obstacle is, again, that notion of non-linear causality. While a few of the works I mentioned earlier seem to almost, just maybe, hint at it, none so far have managed to completely break from their upward form of cause and effect. Despite the process being a feedback loop, and the strange interactions between the oil and acrylic paint, the material information of the paint still progresses and self-organizes in a mostly linear fashion. Some form of oscillation or inter-level action between the micro and the macro of the painting would have to take place.

So no, I have not made a strange loop through paint, but that doesn't mean I've answered my initial question. I originally asked if it was possible to accomplish this, and while I cannot at the moment say yes, I can't say no either, as the results are so far inconclusive. Even though I

haven't accomplished what I would have liked to, I don't see this project as a disappointment or a failure. I made a recursive, self-organizing painting process that acts in a similar way to these fundamental natural processes, whether or not anyone finds that interesting, I think it's really cool, and I'm excited to go even further down this rabbithole. I've learned so much through this process and tried out methods and techniques I never would have thought before. I certainly never saw myself as someone who would end up painting with syringes or starching his canvas.

Most importantly though, I'm really close to finding an answer, at least closer than I've ever been before. Just like Zeno's paradox in which Achilles is constantly catching up to the tortoise, the finite distance between them being divided infinitely, forbidding Achilles from ever reaching his target, the answer to my question has and probably will always be out of reach, into the infinite, no matter how close I get. And maybe that's why I'm so fascinated by it, maybe that's the point. This project has helped me realize about myself that I make to learn, and to seek knowledge is to embark on a journey which will always be incomplete. It's a fine day for learning. I've learned a lot through this process, and I'm thankful I get to share it with you now.

Thank you.

Bibliography

Shane Ragland

Al-Khalili, Jim. *Quark Science*, no. 3-4. BBC, March 21, 2011.

Not only are the scientific ideas explained here deeply interwoven with my line of inquiry, helping me connect these concepts together, but it also taught me how to explain the more theoretical/scientific aspects of my work in an understandable, jargon-less way for my thesis presentation. Like, I actually took the script to this film and analyzed how Jim Al-Khalili delivers information point by point. In short, this documentary and it's series helped me fully understand and put in human terms the concepts of self-organization, self-similarity, feedback, and my painting process as a formal system based on simple rules that produces complexity and unpredictability.

Basile, Jonathan, and Jorge Luis Borges. "Library of Babel." Library of Babel. Accessed May
     13, 2020. https://libraryofbabel.info/.

     Everything I am about to write has already been written, and has always been written.
     Borges' short stories are referenced by Hofstadter in *Gödel, Escher, Bach* because of
     their mind bending, sometimes cyclical nature. I am personally deeply inspired by the
     Library of Babel and its infinite nature. More than that, what it has to say about symbols,
     language, and the power of, well, nonsense.

Elkins, James. *The Object Stares Back: on the Nature of Seeing*. San Diego, CA: Harcourt,
     1999.

     This has been a tremendous influence on me and my thinking on the humanization,
     anthropomorphization (is that a word?) of art. This book delves into the nature of seeing
     and being seen, the connection between the two, and how objects reflect back at you. The
     exploration of these dynamics is crucial to this project, not only in how a painting can
     interact with it itself but also its environment and audience.

Danielewski, Mark Z. *House of Leaves*. New York: Pantheon Books, 2000.

     This book is actually partly inspired by *Gödel, Escher, Bach*, I even got Danielewski
     to sign it when he was in town. This metatextual behemoth deals with the absurd
     cosmic horror of an infinite, ever changing and rearranging house. The house in the
     novel functions as a strange loop of sorts. It's a great example of how this concept can
     be represented in art.

Escher, M.C. *Drawing Hands*. 1948

Hofstadter, Douglas R. *Gödel, Escher, Bach: an Eternal Golden Braid*. New York: Basic
     Books, 1999.

     I just wanna thank Sean Yeager for his class in which this book was the main focus. I did
     not expect going in to have my entire creative direction for the next few years formed by
     what we learned in this class, but I'm glad it was. This is the book where Hofstadter
     organizes a range of different theories, artworks, and various other studies to craft and
     explain his theory for the strange loop. Thank you Sean.

Hofstadter, Douglas R., and Emmanuel Sander. *Surfaces and Essences: Analogy as the Fuel
     and Fire of Thinking*. New York, NY: Basic Books, 2013.

     This is Hofstadter's third book on strange loops and cognition, I haven't read it yet but I
     am hoping to this summer. From what I have read though, this one is more focused on the
     material and practical understandings of cognition and how they are connected through
     language.

Hofstadter, Douglas R. *I Am a Strange Loop*. Basic Books, 2008.

> This is the big one, clearly. After reading his other book, *Godel, Escher, Bach*, and this I became convinced that there was a way to incorporate these mathematical and philosophical ideas into art. Is it possible to create a conscious painting? Hofstadter describes consciousness as a "strange loop", a tangled hierarchy in which by moving up or down a multilevel system one returns to where they started. A model for this can be found in the Möbius strip, a band of one continuous side. This book and it's ideas are foundational to this project and have an influence, however large or small, on almost everything I work on.

Kanizsa, Gaetano. *Kanizsa Square*. 1955

Monro, Gordon. "Emergence and Generative Art." *Leonardo* 42, no. 5 (2009): 476–77. https://doi.org/10.1162/leon.2009.42.5.476.

> In this article, Gordon Monro explores the practice of generative art, how it came to be and how it can take place, and attempts to give a definition to the concept of emergence, laying out the different types of emergence that can occur through generative processes. A generative art practice is one where the artist creates a process that acts, to some degree, as an autonomous system that creates an artwork or experience. For an artwork to be generative, either interactivity, chance, or indeterminacy is required. In this way, the role of the artist is changed; they are not as much a creator but rather someone who gives the work the tools to make itself. This approach, one of making art through a formal system, represents an intriguing interaction between art and science, particularly the scientific discipline called Artificial Life. Understanding these ideas was essential to creating an emergent painting process.

Rothko, Mark, and Achim Borchardt-Hume. *Rothko: The Late Series*. London: Tate, 2008.

> This book is a holy text almost entirely because of the three pages where the conservators chemically analyze and graph out Rothko's paint mixtures for his Seagram Murals. It's an incredible, albeit reductive, resource to understanding how his paintings create the effects they do through their dynamics between matt and gloss. I'm considering utilizing the mixtures explained here within my own practice to more deeply explore the material aspect of the process.

Shannon, Claude Elwood, and Warren Weaver. *A Mathematical Theory of Communication*. Urbana, IL: University of Illinois Press, 1949.

Schoder, Will. "*You Are A Strange Loop.*" Youtube, 8 Apr. 2018, https://www.youtube.com/watch?v=hQsnHkfs3sA.

Spivak, Gayatri Chakravorty, and Jacques Derrida. *Of Grammatology*. Baltimore: The Johns Hopkins University Press, 1998.

Turing, Alan Mathison., and Peter T. Saunders. *Morphogenesis*. Amsterdam, Netherlands: North-Holland, 1912.