Francis O'Connor and Jackson Pollock's Fractals

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Francis O'Connor and I could be called the odd couple. Described by the *New York Times* as "a stately, Old World-style connoisseur with a Vandyke beard and curled mustache," he spent his life mixing with the elite New York art crowd. I'm a physics professor living in the hippy-dippy town of Eugene, Oregon. Its greatest art legacy might well be the tie-dyed T-shirt. We were brought together, first as colleagues and then as friends, through our love of Jackson Pollock paintings.

I first heard of Francis in the early 1970s when I was a ten-year-old growing up in the north of England. I had delved into a box of books my school was giving away and found a book titled *Jackson Pollock*. Francis wrote it. He filled it with page after page of Pollock paintings, and although they were presented in monochrome, there was something mesmerizing about them.

The English educational system notoriously cultivates the art-science divide. When I was fourteen, I could study one or the other even though both subjects appealed to me. Based on advice from my father, I chose science. Based on my older brother's success in physics, I followed his lead. By the mid-eighties I enrolled in physics PhD program at Nottingham University. The university built separate libraries for the arts and sciences, locating them at opposite ends of campus. I contaminated this system by sneaking science books into the arts library. In the evenings I could be found in the back of the arts library with my growing pile of illegal science books. One night I was surprised to find Francis's book, the same one I loved as a kid, on the top of my stack. My thoughts snapped back to Pollock.

I grabbed all of the Pollock books off of the library shelf. Everything I read emphasized the deep connection between Pollock and nature. His neighbor Jeffry Potter remembered the many hours Pollock spent on his back porch staring out at the countryside as if he was absorbing nature's patterns. His friend and sculptor Tony Smith similarly recalled, "One of the things that possessed Pollock was his feeling for the land." Pollock scholar William Rubin compared his painting process to gardening, as if he was nurturing nature on his canvas. Writers often called his paintings "organic" and compared them to nature: "bare trees against the sky", "the texture and thickness of lava" and "comets bursting into frozen visibilities." Pollock himself stated "My concern is with the rhythms of nature" and even declared "I am Nature."

At the back of the arts library, I opened my science books to images of nature and Francis's book to images of Pollock paintings. Although there were superficial differences, the two sets of images clearly shared a profound underlying quality. But what was this quality? My scientific hero at that time was Benoit Mandelbrot. He noticed that nature's patterns-- lightning bolts, rivers, mountains, clouds—repeat at different magnifications. This process builds a complex, rough, and fractured image. Mandelbrot called these images "fractals." Their complexity varies. For example, trees in a forest produce a very rich and intricate pattern while clouds produce a much more open and sparse pattern. Mandelbrot recognized that nature is messy and that the fractal patterns don't repeat precisely but instead simply look similar at different magnifications.

So, when you stare out at nature, you are staring at repeating fractal patterns. The same is true of Pollock paintings. Art critic Clement Greenberg acknowledged this repetition, observing that the artist's drips and splashes are "knit together of a multiplicity of identical or similar elements." This repetition has important visual consequences. In particular, if patterns at different magnifications look similar to each other, it becomes very hard to tell which magnification you are looking at. Because of this, you can't tell if you are looking at a Pollock from the back of the gallery or up close. As journalist Alfred Frankenstein noted: "Pollock is as strong from a distance as he is close to."

In addition to repetitions at different magnifications, fractals also repeat at different locations. The resulting uniformity is responsible for Pollock's 'all-over' style. He celebrated this: "There was a reviewer a while back who wrote that my paintings didn't have a beginning

or any end. He didn't mean it as a compliment, but it was." Rubin also emphasized the presence of "patterns all rough similar in character… over the whole surface of the picture."

Beginning in the late 1990s, I published a number of articles in art and science journals under the title *Fractal Expressionism*. The articles declared Pollock's paintings to be fractal. In a way, I wasn't saying anything new. Many scholars had unknowingly spotted the visual characteristics of his fractals. However, declaring Pollock's work as fractal allows a direct comparison with nature. In particular, scientists had previously developed computer programs to analyze fractals in nature's scenery. When I applied these programs to Pollock's patterns, I found that they were just as fractal as nature's.

Computer analysis allows us to answer a central question about Pollock: "Are fractals an inevitable consequence of pouring paint and any way of pouring will generate them? Or are fractals the result of the specific way Pollock poured paint?" It turns out that the latter is true. For example, the patterns on Pollock's studio floor – the patterns that missed the canvas – are not fractal. Clearly, Pollock manipulated the fractal generation process. But where are the fractals coming from?

Pollock was an Action Painter, and his patterns served as a record of his physical motions through the air. In the world of medicine, a whole field of study is focused on understanding the body motions that allow us to balance. Researchers have shown that our balancing motions are a fractal mixture of big sways and small sways. Perhaps Pollock tuned into this fractal physiology to create his art.

Around 2002, Francis and I discussed this. He knew that Pollock had poor balance and believed it had an important impact on his art: "Pollock's birth trauma (strangled by his mother's umbilical cord) and the attendant symptomology of loss of manual dexterity was decisive in his art." We decided to put this idea to the test. Reading through the medical papers on fractal balance, we predicted that people with good balance would have fractal motions of higher complexity than those of poor balance. We therefore asked adults and 5 year-olds to create poured paintings. We then compared the paintings' fractality. Indeed, Francis and I found that adults painted much higher complexity paintings than the kids. Significantly, Pollock's paintings were of relatively low complexity for an adult.

Francis was right. Pollock did have poor balance and this translated into his art. This is not to say that Pollock was a victim of his physiology. Far from it. He exploited his balance and spent a decade evolving the complexity of his paintings by refining his pouring technique. Thus, the myth that it is easy to paint a Pollock is exactly that – a myth. A good copy-cat would need a similar physiology to Pollock and spend a decade learning to refine it.

This has practical consequences. In his role of a Pollock authenticator, Francis estimated that 350 un-authenticated poured paintings "circulate the planet, like the detritus rings of Saturn, seeking the blind to buy them." Francis encouraged me to consider using fractal analysis to help separate the real from the fake. He noted: "The fractal occurrences in Pollock's pourings can be read as a very personal signature that can be found in all of his works" and described fractal analysis as a "tool with which the connoisseur can perceive falsity in a fake Pollock." Our first collaboration took place in 2005 when the Pollock-Krasner Foundation asked us to help investigate a group of recently discovered works known as the Matter Collection. The computer

analysis highlighted differences between this collection and established Pollocks (the paintings were later found to have pigments that dated from many years after Pollock's death). Today, computer analysis can spot real Pollocks with a 93% success rate.

Crucially, fractal analysis is not intended to be a stand-alone technique. It should go hand in hand with visual inspections by Pollock experts. Through the subsequent years, Francis sent me images of un-authenticated paintings that landed on his desk. I returned the favor. There was a perfect consistency between what Francis's eye told him about the paintings and what my computer-analysis revealed. We started to suspect that Francis's eye was as good at spotting fractals as my computer. Perhaps this also applied to Pollock. After all, he moved from Manhattan to the countryside of Long Island in the mid 1940s and started to generate his major poured works when surrounded by nature's fractals.

Over the past decade, I collaborated with neuroscientists using sophisticated techniques such as eye-tracking, EEG and MRI to determine how well our eyes can detect fractals. Because we have evolved in fractal surroundings, our vision has evolved to process their patterns with ease. We call this fractal fluency – our eyes have become fluent in nature's visual language of fractals. This has positive consequences. Our research shows that people relax dramatically when viewing fractals. This could explain the feeling of resonance that many people report when staring at Pollock's works. In a sense, their brains are 'wired' to appreciate his fractals.

This is the story of Fractal Expressionism, a story that would have gone untold if not for two great scholars – Benoit Mandelbrot (1924-2010) and Francis O'Connor (1937-2017). About fifteen years ago, I introduced them to each other and this triggered a series of fascinating discussions about Pollock's fractals and beyond. Fractal Expressionism serves as a great example of defeating the art-science divide. Thank you, Francis and Benoit!