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# Fractal analysis of Jackson Pollock's painting evolution

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ABSTRACT

By mid-1940s, Jackson Pollock, one of the most influential artists in the twentieth century plastic art, developed a unique painting technique (pouring and dripping) to generate complex non-figurative patterns. It has been argued that methods from fractality theory are suitable for characterizing these complex patterns. In fact, recent studies have shown that, indeed, Pollock's drip paintings are fractal, multifractal, multiscaling and evolved to higher complexity from 1945 to 1950. However, the development of this drip and pouring technique was neither instantaneous nor spontaneous, but influenced by diverse cultural and personal factors along of Pollock's life. The aim of this work is to study the evolution of some fractality indices of Pollock's paintings for the period from 1930 to 1955 and, in this form, detect changes in this painting technique and relate them to major cultural influences. To this end, about 30 paintings are analyzed by applying a two-dimensional detrended fluctuation analysis (DFA). Results indicate two large shifts in the fractality indices. One transition involves a change in the correlations dimension by 1937, while a second transition implicates a shift in the short-scale Hurst exponent by 1945-1946. Based on descriptions from Pollock's biographers, it is postulated that the first change may be strongly influenced by Mexican muralist Siqueiros and the second one by the moving of Jackson Pollock and Lee Krasner for living in the natural landscapes at Springs, Long Island. Our findings in this work support these claims.



## 1. Introduction

Jackson Pollock was a prominent painter in the 1940s American artistic scenario. The main Pollock's contribution to the painting vanguard was the development of a pouring and dripping painting technique with the use of sticks, hardened brushes and basting syringes as paint applicators [6,24]. This painting technique resulted in a nonfigurative, highly abstract plastic art where the aesthetic features result from the complexity of the color and luminance patterns, rather than of specific geometric arrangements commonly found in figurative expressions. Fig. 1 shows the famous Pollock's painting *Eyes in the Heat* (1946, Peggy Guggenheim Collection, Venice) in both original color and gray-scale formats. Figures are completely absent while the perception of aesthetic attributes could depend on the subjectivity of the observer.

The decades following Pollock's death by 1953 witnessed the surge of exciting discussions and controversies on the real contribution of Pollock's work to the American and even worldwide plastic art history. The point is that Pollock's painting challenged the analysis from the traditional framework of the figurative expressions. Given the lack of a minimal figurative structure, it has been postulated that fractal analysis is the suitable framework to characterize the complex patterns emerging from Pollock's drip paintings. Taylor and coworkers pioneered this effort [27–30] by studying the black-pigment (blobs) and multiple color patterns contained in the structure of Pollock's drip paintings. The use of box-counting methods showed that the structure of blob patterns shares some similarity with those formed in nature by trees, clouds and coastlines (which are some of the most typical

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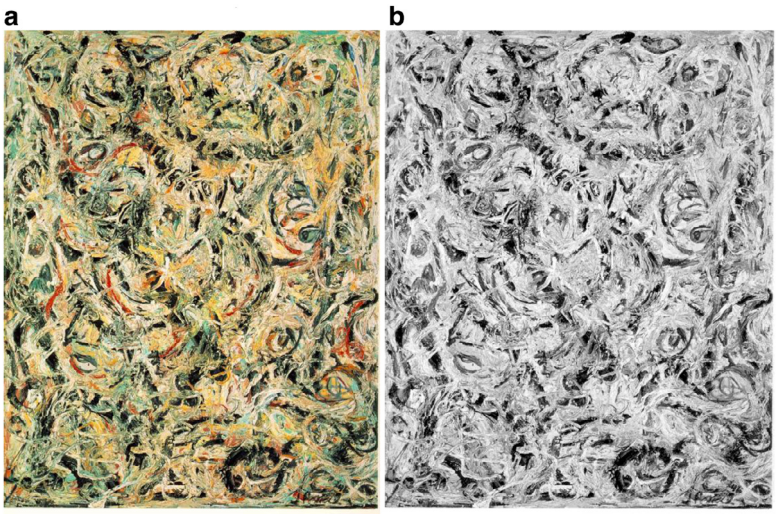


**Fig. 1.** Sample of a Pollock's drip painting – *Eyes in the Heat* (1946) – in original color (a) and gray-scale (b) formats.

and very first examples of fractality in nature). An interesting result indicated that blob structures can be characterized almost uniformly with a fractal dimension of about 1.7. The complex geometry of Pollock's drip paintings was also considered by Mureika et al. [15,16], who extended the analysis to other artists of the abstract expressionist school (Quebec-based group Les Automatistes).

The aforementioned studies showed a good agreement with those by Taylor and collaborators in the sense that one can associate an effective fractal dimension in the range 1.6–1.8 with the blobs patterns on the paintings. It was also concluded that the fractal dimension is not sufficient to distinguish between different artists when only large size scales are considered [15]. In this way, a final difference between Pollock's drip paintings and the paintings of other contemporaneous artists cannot be established only from a fractality standpoint. Along this line, it has been also suggested that fractal properties of patterns formed by specific colors could be used as an authentication method for artists and their paintings [16,31]. However, additional fractal studies [7,8] have challenged this approach by arguing that Pollock's drip paintings exhibit fractal characteristics over a very small range to be usefully considered as fractal. Indeed, fractality of this type can be generated without the use of, say, Levy motion processes. These studies considered color blobs for characterizing fractality of nonfigurative visual art. In principle, the aesthetic structure in Pollock's drip paintings is a consequence of the whole color structure, and not only of large blobs and color gradients. In this way, in contrast to previous studies that focused on the fractality of blobs and contours, Alvarez-Ramirez et al. [1] applied two-dimensional DFA [3] on gray-scale images to characterize the fractal structure of luminance patterns for Pollock's drip paintings. It was shown that fractality in Pollock's drip painting can be associated with 1/f-noise structures. For spatial scales below 30 cm, it was found that Pollock's drip paintings are organized as 1/f-noise structures, which presumably are linked to pleasant (i.e., aesthetic) perception [20,33].

The evolution of Pollock artistic formation has been extensively documented by several authors [4,17,24]. By 1930, Thomas Hart Benton introduced Pollock into systemic studies of painting techniques at the Art Students League of New York. This phase in the Pollock formation was quasi-figurative and was influenced by native American culture and Benton's rural American. An important event in Pollock's formation occurred at 1936 when he attended an experimental workshop on the use of liquid paint by Mexican muralist David Alfaro Siqueiros. Pollock acquired the painting pouring technique as a central component for the makeup of canvases of the early 1940s. Pollock married the American painter Lee Krasner in October 1945, and in November they moved to Springs on Long Island, New York. In his stance at Long Island, Pollock refined the painting technique of working freely with liquid paint. During this rather long period that lasted from 1945 to 1952, Pollock abandoned the traditional easel layout to begin painting his canvases laid out on the floor. It is apparent that this change allowed Pollock to develop his characteristic drip-and-splash style with some abruptness in 1947. In the last part of this period, Pollock returned to figurative or quasi-figurative by producing black and white works [24].

In principle, signatures of the different artistic phases should be reflected in the fractal structure of Pollock's paintings. Taylor et al. [29] found some evidence of this by showing that, for the drip painting period 1945–1953, the blobs fractal dimension increased with respect to the year the opus was painted. In turn, this suggested that Pollock improved his drip-and-pouring technique through the years, which is reflected as an increase of the box-counting fractal dimension $D_{BC}$ from about 1.12 in his early attempts in 1945 to 1.72–1.89 at his peak phase by 1950–1952.

In this regard, the aim of the present work is to provide further analyses of the evolution of Pollock's painting technique as reflected in the fractal structure of the intricate blobs and color geometry. To this end, the two-dimensional detrended fluctuation analysis (DFA) was applied for studying the fractality of 30 Pollock's paintings belonging to the