

Fibonacci sequence in the work of Jorge Pinheiro

Sequência de Fibonacci na obra de Jorge Pinheiro

La secuencia de Fibonacci en la obra de Jorge Pinheiro

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ABSTRACT

This paper elaborates on how the Fibonacci sequence is central to several paintings and drawings by the Portuguese artist Jorge Pinheiro. The use of the series is purposeful and recurrent, as the author himself acknowledges. However, it is not always evident *how* Pinheiro applies the numbers. We aim to clarify this application with examples, promoting the author's geometric abstractionism as a bridge between Art and Mathematics.

Keywords: Fibonacci sequence. Geometric abstraction. Art and mathematics.

RESUMO

Este artículo explora cómo la secuencia de Fibonacci es fundamental en varias pinturas y dibujos del artista portugués Jorge Pinheiro. El uso de la serie es intencional y recurrente, como el propio artista reconoce. Sin embargo, no siempre queda claro cómo Pinheiro aplica los números. Nuestro objetivo es aclarar esta aplicación con ejemplos, promoviendo el abstraccionismo geométrico del autor como puente entre el arte y las matemáticas.

Palabras-chave: Sucesión de Fibonacci. Abstracción geométrica. Arte y matemáticas.

RESUMEN

Este artigo explora como a sequência de Fibonacci é central em diversas pinturas e desenhos do artista português Jorge Pinheiro. O uso da série é proposital e recorrente, como o próprio autor reconhece. No entanto, nem sempre é evidente como Pinheiro aplica os números. Nosso objetivo é esclarecer essa aplicação com exemplos, promovendo o abstracionismo geométrico do autor como uma ponte entre a Arte e a Matemática.

Palabras clave: Sequência de Fibonacci. Abstracionismo geométrico. Arte e matemática.

JORGE PINHEIRO

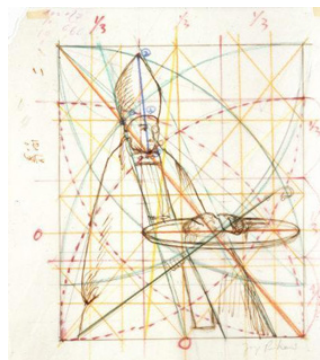
Jorge Pinheiro is a Portuguese painter, sculptor and teacher, born in Coimbra in 1931. He completed the Painting course in Oporto with top marks, alongside artists Ângelo de Sousa, Armando Alves and José Rodrigues, in 1963. A few years later, they formed *The Four Twenties*, an appropriately named group, as twenty is the top mark in Portuguese higher education. In 1966, when travelling around Europe with a Gulbenkian Foundation scholarship, Pinheiro became familiar with geometric abstractionism. From then onwards his art practice oscillates between figurative and abstract, in a rare harmony between visual expressions often considered parallel.

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Figure 1 - *Blue Bishop* Oil on canvas (120x100 cm), 1981



Figure 2 - Untitled (study for *Blue Bishop*) Mixed media on paper (20,2x19,1 cm), 1981



In many of his figurative works, Pinheiro uses geometry as the basis for his compositions; such is the case in the *Blue Bishop*, as made evident in Figure 3. In their genesis, both expressions – figurative and abstract – often have geometry as a basis for visual composition. Joana Dias Completo's PhD thesis (2017) proposes a geometrical analysis of several of Pinheiro's paintings [1], focusing mainly on his figurative works. This paper addresses abstract compositions. It is interesting how in his abstract work, geometry is often the subject of the painting as well. There is a double use of geometry in such cases: formal (as a tool) and conceptual (as a theme). This was made evident at the 2017 retrospective of Pinheiro's work in Serralves Museum (Oporto, Portugal), under the title *D'après Fibonacci and the world out there*.

In the words of Pinheiro:

There is a matrix that informs the two [figurative and abstract] and that seems unquestionable. We could call it composition, or structural organization, or whatever. It can be applied to both situations. In fact, the way in which I approach the canvas in figurative painting, with a huge amount of drawings and preparatory sketches (...) is a stage of consciously working with reasoning, the same that I apply to abstract works, something linguistics call 'the substance of content'(...).[2]

FIBONACCI

Fibonacci is the most common name attributed to Leonardo of Pisa, one of the most relevant Italian mathematicians of the Middle Ages (c. 1170 – c. 1250). In 1202, he published his *Liber Abaci* - Book of Calculus - in which he introduced to Europe a series of numbers such that each number is the sum of the two preceding ones. **Figure 3** shows us a detail of the *Liber Abaci* page where the author enumerates the sequence, starting with 1. The online encyclopedia of integer sequences presents it as: $F(n) = F(n-1) + F(n-2)$ with $F(0) = 0$ and $F(1) = 1$. Although this sequence had been described before in Indian mathematics, we still refer to it as the Fibonacci sequence today. The Italian author did not mention the relation between the series of numbers and the often-called golden ratio (Φ). This twenty-first letter of the Greek alphabet, Φ is attributed to the ratio $(\sqrt{5}+1)/2$; approximately 1,618. This relation is now widely popularised. The German mathematician Simon Jacob (d.1564) noted how the ratio of each successive Fibonacci number converges to the golden ratio. For example: $233/144 = 1.6180(5)$ [3].

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At the beginning of the 1970s, geometric modulations and chromatic patterns of high contrast were joined by an exhaustive exploration of the notions of rhythm and series, their formalization pointed towards the artist's interest in music and numbers in their specific manifestations in Schönberg's dodecaphony and the Fibonacci sequence.[4]

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generous enough to talk to us has turned our effort into a unique glimpse of the author's methodology, that we can now present.

One of the most recognizable uses of these numbers is in an untitled painting from 1972 (Figure 4), a case that illustrates Pinheiro's approach to a visual vocabulary based on the sequence. In it, four symbols are associated with specific colours and clearly have a pattern between them: they are presented either once, twice, three or five times together, followed by a different symbol, which also appears either once, twice, three or five times in a row. After five, each sequence of symbols restarts. Figure 5 illustrates the pattern. The visual play with two of the symbols being Roman numerals (I and X) gives the painting a possible second level of interpretation.

Figure 4 - Untitled Oil on canvas (29,5x36,5 cm), 1972



Figure 5 - Order in which the colours and respective symbols are repeated

Green	Red	Purple	Yellow
1-2-3	3-5-1	2-3-5	1-2-3
5-1-2-3	2-3-5	1-2-3	5-1-2
5-1-2	1-2-3	5-1-2	3-5
3-5	5-1	3-5	2-3
1-2-3	2-3-5	1-2-3	5-1-2
5-1-2	1-2-3-5	5-1-2	3-5-1

This 1-2-3-5 section of the Fibonacci sequence is, as we will see, recurrent in Pinheiro's work; sometimes he also uses the next number of the series, 8. This is the case in **Figure 6**, one of the *Fifteen Essays on a Theme or Pythagoras Playing Chess with Marcel Duchamp*. **Figure 7** illustrates how the black dots were arranged within a grid that is defined by the series of numbers. The first horizontal line has its dots distanced out with proportional 8-5-3-2-1-1 spacing. The second line inverts the spacing progression: 1-1-2-3-5-8. Keeping the same spacing proportions, we see that these two first horizontal lines are distanced 1 unit apart. That is how the vertical line on the left starts out the same 1-1-2-3-5-8 spacing, defining the layout of the remaining horizontal lines, all of them respecting the green and red grid laid out in Figure 7. This approach to a graphic representation of the Fibonacci series is elegant in its simplicity and presents us with a composition marked by rhythm, reminiscent of a musical staff.

Talking to Pinheiro, he has referred to this particular drawing as the "Father" of plenty of other compositions, a type of matrix. This is in fact a pattern that is often recognizable in his work. It is also a process of visual disposition of elements within a surface (in this case within the square) that the author extrapolates to many other compositions.

Figure 6 - Untitled Oil on canvas (29,5x36,5 cm), 1972

Figure 7 - Grid that illustrates spa

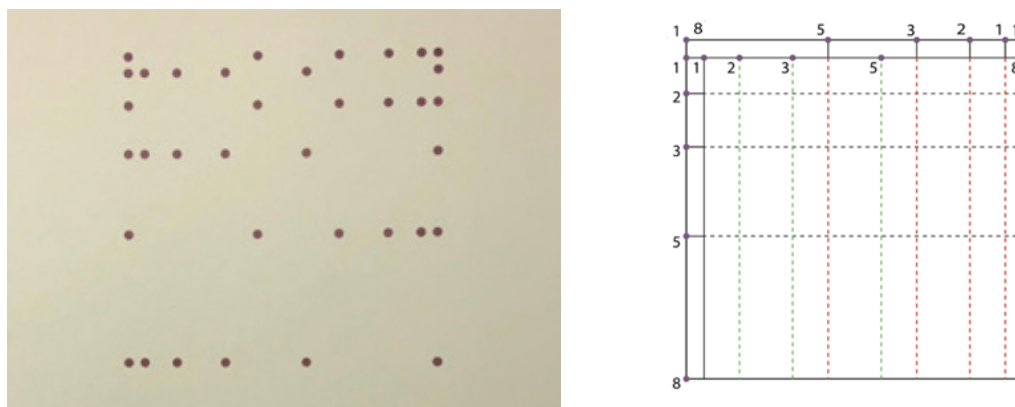


Figure 8 - Untitled Acrylic on canvas (120x80 cm), 1972

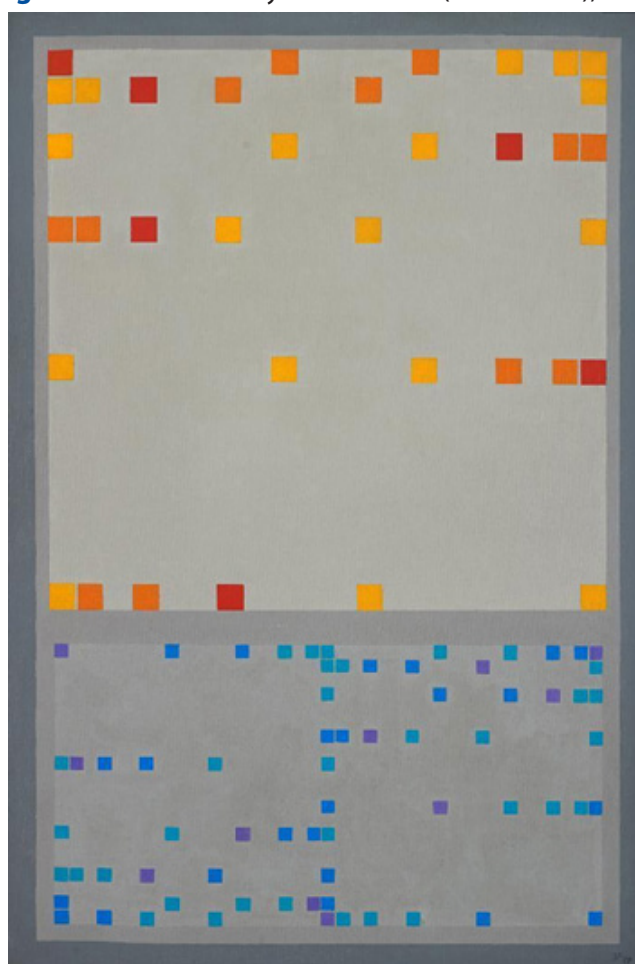
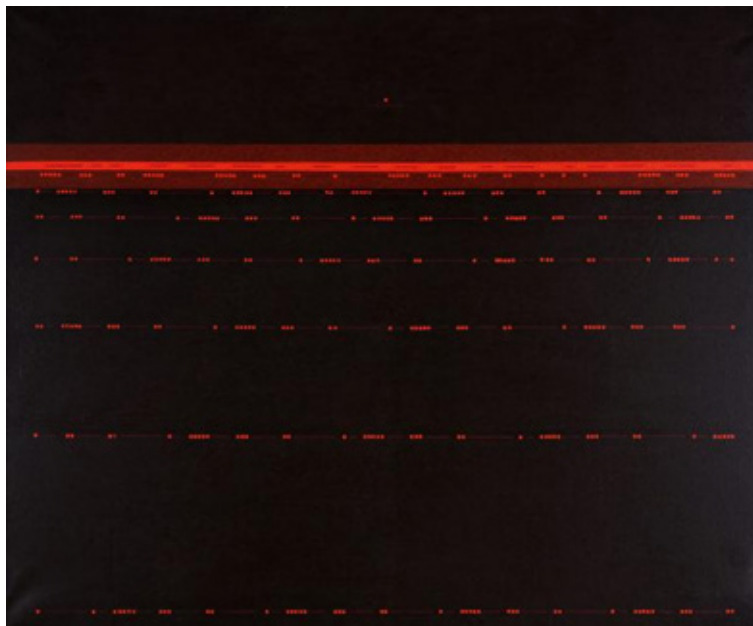


Figure 8 is an example of the application of the previously identified pattern. Let's consider this untitled work from 1972 as a three-part composition: the top square, defined by the various red, orange and yellow shapes, and two other squares under the first one, side by side, with blue and purple shapes.

The top square applies the pattern illustrated in Figure 7, in the exact same orientation. It is fundamentally a version of the same matrix, using coloured squares instead of dots. Under it, all the blue and purple shapes are within a 2x1 rectangle, divided into two squares that also apply the referred matrix. In the bottom left square, the matrix has been rotated

180°; it is the same disposition of shapes, upside down. In the bottom right square, it is simply the repetition of said matrix, as we know it.

Figure 9 - Untitled, Acrylic on canvas (150x180 cm), 1977



Within this framework, it is possible to recognise more applications of the Fibonacci sequence in the author's paintings. In the untitled work from 1977 (Figure 9), each horizontal line is filled with groups of dots with different spacings between them. The dots are either isolated (1) or in groups of 2, 3, and 5. The spacings are a transposition of the length of the groups of dots. **Figure 10** illustrates how lengths are added up to create the spacing between dots. In white, yellow and green we have reproduced the lengths of 1, 2 and 3 respectively, to show how they are applied adjacently.

Moreover, the vertical spacing between each horizontal line increases progressively in the same fashion. From top to bottom, each new distance is the result of adding up the previous two, which is the premise of the Fibonacci sequence.

Figure 10 - Edited detail of Figure 9

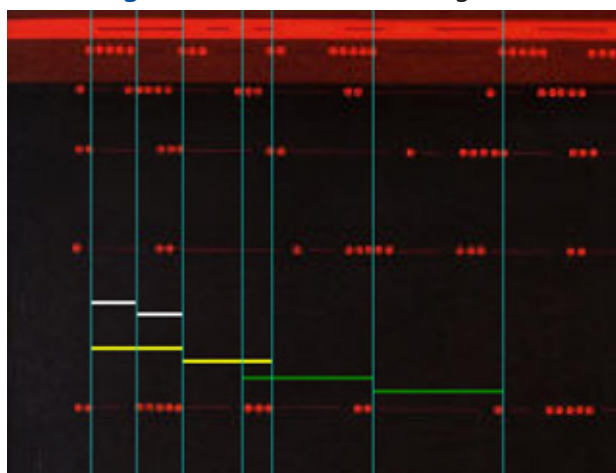
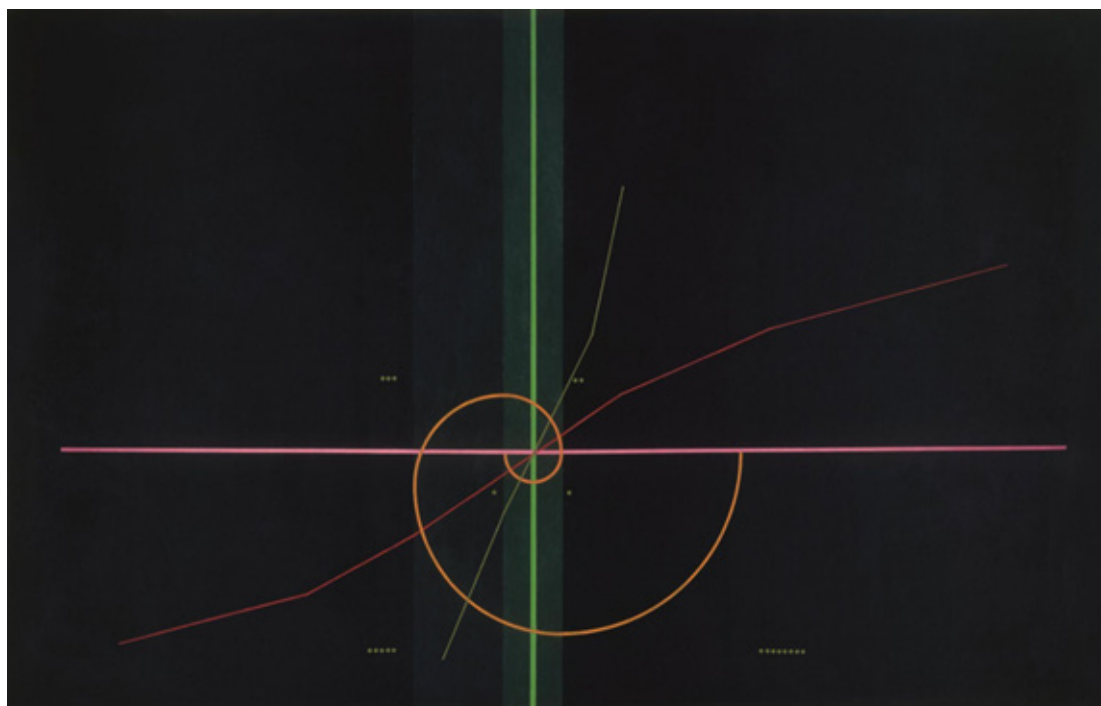


Figure 11 - *Ulysses against Polyphemus* Silkscreen on paper (50x70 cm), 1981



The work *Ulysses against Polyphemus* (Figure 11) uses adaptations of the aforementioned methods and an additional geometric tracing, often related to the Fibonacci sequence: a spiral. The same spiral is applied in several of the author's compositions, particularly in the series of works dedicated to the character Ulysses (of which this silkscreen is part). The construction of such a spiral is well disseminated, as exemplified in Figure 12. Each of the squares' sides increases progressively according to the sequence of numbers, and in each square, a quarter-circle is drawn with the same radius. This is indicated by Pinheiro with the groups of dots (1, 1, 2, 3, 5, 8), lined out horizontally just outside the vertices of the squares - not visible in the final work - that determine the quarter-circles.

Figure 12 - A spiral constructed according to the Fibonacci sequence.

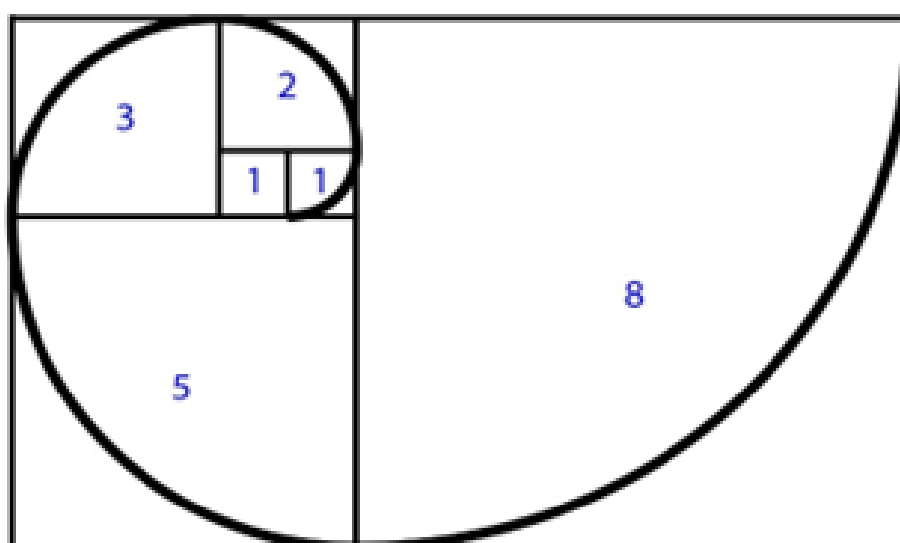
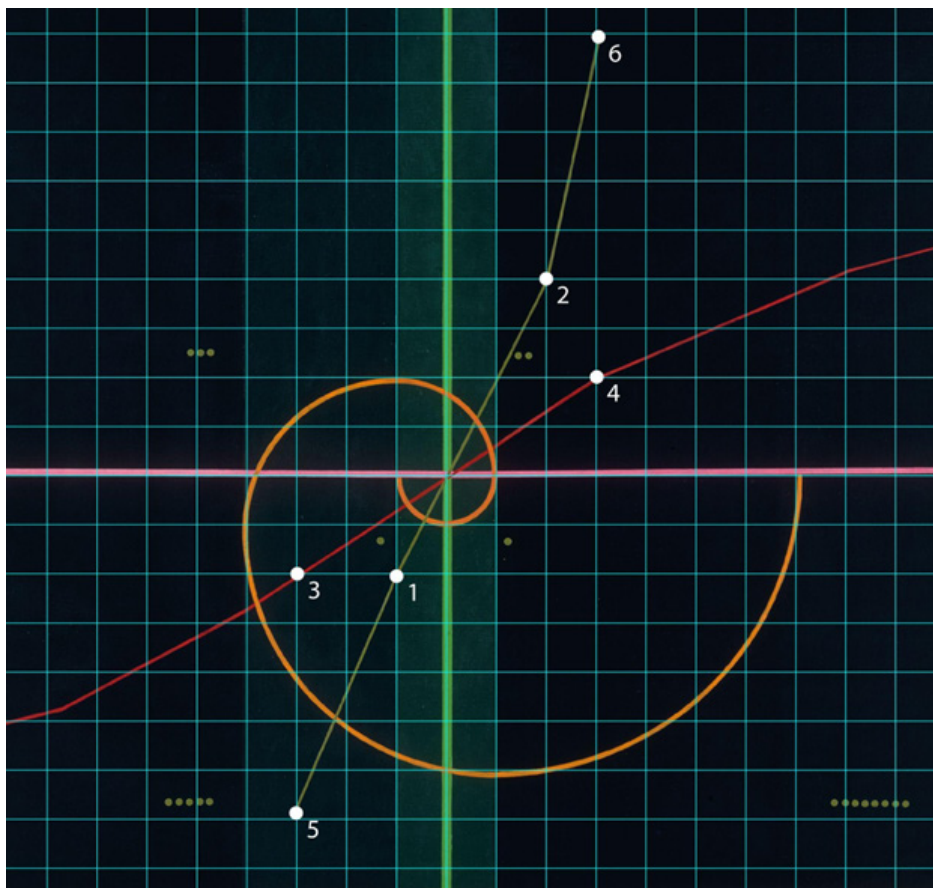


Figure 13 - Edited detail of Figure 11



There is more to be said about this spiral, as it determines several other elements. Visually, it seems to revolve around the point defined by the intersection of the light-green vertical and pink horizontal lines. This point is the centre for the two initial quarter circles (or half circles with radius 1). The diameter of this circle determines the width of the medium-green stripe, which is the same width of the next quarter circle (marked 2 in Figure 12). The width of the dark-green vertical stripe is the same as the radius of the next quarter circle (marked 3 in Figure 12).

In the composition, these dimensions also determine another element that Pinheiro uses recurrently in his works: straight lines with specific slopes. In Figure 13 the overlapped grid onto a section of the silkscreen is defined by said dimensions, allowing us to see how the slopes are defined. From point 1 to point 2 there is a green line that passes by the centre, with a slope of $2/1$. From point 3 to point 4 there is a red line that passes by the centre, with a slope of $2/3$. Slopes shift as the straight lines reach certain points: for the remaining green line, from point 5 to point 1 there is a slope of $5/2$, and from point 2 to point 6 a slope of $5/1$. As for the red line, the further it stems from the centre, the more difficult it is to identify the slopes; but from our observation it seems that from point 3 onwards the slope is $5/9$ before it changes again and from point 4 onwards it is $7/3$ before it changes again. Identifying all the slopes would still not complete an analysis of the work as we have not referred to the position of the original pink and light-green lines relative to the height and width of the composition (190 x 120 cm). Much like we haven't done for the red line in the untitled work of Figure 9. This is because with this paper we wanted to focus on clarifying the use of the Fibonacci sequence in Pinheiro's work, as an introduction to some of his methodological resources.

Describing every aspect of each composition would become exhausting reading, but unveiling some of the artist's approaches to a specific set of numbers brings us closer to the creative, even ludic, side of his exploration of geometrical potentials.

An author as prolific as Jorge Pinheiro, with a production that spans for decades, would deserve a full-scope analysis of all the applications of the Fibonacci sequence in his geometric abstractionist works, as well as the plain geometry used in his figurative paintings. Particularly because the variations in his designs are numerous. We hope this introductory approach disseminates and encourages interest in Pinheiro's visual vocabulary and might incite further research on the subject.

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