The use of artificial intelligence as a strategy for natural mimicry in design artifacts

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Abstract: The main objective of this article is to evaluate the effectiveness of using artificial intelligence resources, specifically the Midjourney software, in creating artifacts that adopt natural mimicry as a conceptual aesthetic strategy. To achieve this purpose, the epistemological interactions between design and mimicry will be explored, aiming to clarify the central role played by mimicry as a creative procedure. In this sense, a precise contextualization of the concept of mimicry is essential for this study, involving an analysis of the underlying philosophical issues through the lenses of classical thinkers such as Plato and Aristotle, as well as modern philosophers like Adorno and Walter Benjamin. Additionally, classical design methods such as MESCRAI (Baxter, 2011) and the morphological box (Fritz Zwicky, the 1960s) will be explored in relation to philosophical concepts, aiming to maximize the creative possibilities of artificial intelligence. These methods will be applied in three distinct ways: 1-Drawing inspiration from a specific element of nature, be it a species of fauna or flora. 2-Incorporating natural patterns without being tied to a specific element. 3-Creating a methodological synthesis from the morphological box method. In this context, it becomes evident that artificial intelligence resources through Midjourney are excellent generators of alternatives for the initial phases of the project, although they still do not meet all the design requirements.

Keywords: Design - Metadesign - Mimesis - Biomimetics - Bioinspiration - Creative Method - Alternative Generation - Morphological Box - Artificial Intelligence - Midjourney

[Resúmenes en castellano y en portugués en la página 170]

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1. Introduction

The understanding of the term "mimesis," with etymological origins in the Greek term "mimesis" and maintaining the same spelling in English, can be clarified based on the Michaelis Dictionary (2021), which defines it as the imitation or representation of reality. In design literature, the mimetic concept is often associated with two synonyms: analogy, which refers to the similarity between things or facts; and metaphor, a figure of speech in which a word denoting an object or action is used in place of another to suggest a similarity or analogy, functioning as a symbol (Michaelis Dictionary, 2021).

Thus, the meaning of "imitation of something" in the mentioned terms becomes clear. However, it is essential to explore another crucial aspect: the breadth of mimesis. The concepts of mimesis encompass various areas of knowledge, such as psychology, marketing, architecture, mathematics, history, philosophy, computer science, visual arts, and, primarily, the field of design. However, in the context of design, the mimetic argument is often addressed in a scattered and fragmented manner, lacking adequate theoretical grounding. In this sense, the field of philosophy provides a solid conceptual understanding of this theme.

2. Mimesis in Philosophy

In the classical philosophical tradition, Plato and Aristotle discuss mimesis in their works, generating a dialectic that expands the understanding of the theme. Both view mimesis as a form of representation of nature, but their perspectives diverge regarding its use as a creative method.

Plato restricts mimesis to imitation and considers it negatively in his hierarchy of ideals. According to Grimaldi and Oliveira (2022, p. 120), Plato's view of beauty is closely linked to the perfection associated with the intelligible world, the world of ideas, distant from the tangible reality of the sensible world. This understanding directly influences his conception of mimesis, seen as a devalued imitation, a mere copy of something, considered potentially harmful and dangerous. Consequently, in Plato's view, any artifact created by humans is considered of lesser importance, even if it resembles a divine creation, as it is on a secondary plane in the Platonic scale of virtue.

On the other hand, Aristotle considers mimesis as innate to the human being, fundamental for learning and cultural transmission, granting art a role of complementing and recreating nature. Aristotle values mimesis as a creative recreation of entities, going beyond simple reproduction of the world to offer profound insights into how the world should be. According to Puls (2006, cited in Bosi; Pinheiro, 2019), Aristotle does not limit himself to abstract speculations on the topic but also offers concrete suggestions on how to effect mimetic transformations. He proposes five ways to modify what will be represented to construct the desired mimetic argument *(See Table 1)*:

Table 1. Aristotelian Mimesis Method (Source: Aristotle, cited in BOSI; PINHEIRO, 2019, p. 167).

Aristotelian Mimesis Method
1 - Transfiguration, or change of material, use, or state.
2 - Addition.
3 - Subtraction.
4 - Composition, the union of two or more forms without a predominant one.
5 - Alteration.

The list of mimetic modifications proposed by Aristotle is highly relevant, as it establishes a set of parameters that directly influence the development of an empirical approach to mimesis from a meta-projectual perspective. These contrasting views not only influence the conception of beauty but also the practice and understanding of mimesis throughout philosophical history. Subsequently, philosophers like Theodor Adorno and Walter Benjamin present critical and alternative perspectives on mimesis, addressing antagonistic issues on the subject.

According to Gagnebin (1993, p. 72), a critical aspect involving the concept of mimesis explored by Adorno concerns the passivity of the subject inherent in the mimetic process, as the German philosopher believed that assimilation to the other would be the death of the subject itself, its disappearance.

According to Gagnebin (1993, p. 80), Walter Benjamin adopts a conception of mimesis based on the concept of language and with a universal character. The philosopher argues that humans naturally create resemblances in response to the resemblances of the world, a concept that is widely reflected in the arts, such as writing, painting, theater, dance, and even in children's play that imitates reality or adult life. In this perspective, mimetic activity is always a symbolic form of mediation and is not limited to mere imitation. On the contrary, it enables a new configuration among the signs involved.

3. Mimesis as a creative method in design

At its core, an artifact is considered mimetic when it aesthetically and symbolically refers to another artifact, structure, or symbol, which already has its own relevant aesthetic properties and consolidated semantic content consensually. In this context, the concept of

mimesis acquires a peculiar condition, as it involves two fundamental entities: the "source," which represents the object of inspiration, and the "target," which is the resulting artifact created from the influences of the original source.

Thus, a relationship of greater complexity is perceived in the perception of the mimetic artifact, as it not only transmits the inherent information of its own configurative elements but also encompasses pre-existing aesthetic and symbolic elements derived from the original source of inspiration that was used as a reference.

In the realm of design, mimesis can occur in various ways, whether focusing on the practical, aesthetic, or symbolic function of something. This source of inspiration can be diverse, ranging from material elements like architectural buildings, artistic, cultural, historical elements, or even something completely abstract like ideas, concepts, thoughts, music, or even mathematics. All these elements can be reconfigured and reinterpreted in a process of mimesis.

Initially, it is pertinent to separate the types of mimesis into two major groups: **1**- Mimesis of natural elements, originating from natural elements and phenomena, being the focus of interest of bionics and biomimetics; **2**-Mimesis of artificial elements, derived from cultural elements created by humans at various levels of abstraction.

However, the specific focus of this article will be exclusively on natural mimesis, as the main objective is to evaluate the effectiveness of artificial intelligence as a creative tool in this modality of mimesis.

In the methodological field of design, some questions arise regarding mimesis, especially considering the epistemological distinction between natural and artificial mimesis. There is a specific theoretical and methodological gap in relation to artificial mimesis, as discussed in the systematic literature review article (Nogueira, 2021). This study found that mimesis is a recurring technique but often used without a previous methodology or a solid established theoretical basis.

On the other hand, in the context of natural mimesis, the situation is inverse. This area encompasses a wide range of research, especially related to bionics and biomimetics. However, many of these studies do not necessarily focus on formal aesthetic issues. Instead, due to its breadth, they often explore functional analogies or aspects of sustainability, which are not the focus of this article.

As an example, we can mention Janine Benyus's Biomimicry DesignLens (1997), which focuses on three fundamental components: the essential elements, the principles of life, and biomimetic thinking. The essential elements encompass Ethos, symbolizing respect; Reconnection, emphasizing integration between humans and nature; and Emulate, which encompasses the principles and patterns of nature that inspire design.

Another example is Amilton Arruda's taxonomic method (2020), which encompasses not only morphological issues but also functionality issues of structures based on the observation of natural parameters such as: energy systems; joints; natural packaging; locomotion systems, etc.

In this sense, it was found in previous research that some creative design methods would be useful in creating the mimetic argument because they have characteristics similar to other methods that were previously raised. These include the MESCRAI method (Baxter, 2011) with similarities to the Aristotelian method of mimetic modification and the mor-

phological box, which has similarities to the Blended Method (Wang, 2015) found in the systematic literature review (Nogueira, 2021), which also uses blends.

3.1. MESCRAI Method-Modify (increase decrease), Eliminate, Replace, Combine, Rearrange, Adapt, Invert

The MESCRAI method developed by Baxter (2011, p. 79) is an acronym for "Modify (increase decrease), Eliminate, Substitute, Combine, Rearrange, Adapt, Invert." These actions are modification procedures in the product. The purpose of the procedure was to verify the possibilities of alteration in the product with the aim of reducing costs, optimizing production, use, or assembly. However, due to the similarity with the procedures suggested by Aristotle, the possibility of evaluating the functionalities of the MESCRAI method to create mimetic artifacts from the modification of the source of inspiration was considered.

3.2. Morphological Box

The Morphological Box is a structured method for creatively solving problems and generating ideas, developed by Fritz Zwicky, a Swiss astrophysicist, in the 1960s. It stands out for organizing various characteristics in a table (matrix) and is widely used in design for alternative generation. This approach is particularly useful when dealing with multifaceted problems or when trying to create innovative solutions by combining different elements.

3.3. Natural Mimicry

According to Theska Soares *et al.* (2021), bioinspired artifacts are those that have a clear reference and inspiration from nature, whether living (animal, plant) or non-living (mineral, phenomena). This occurs through analogies of shapes, functions, structures, principles, processes, systems, movements, characteristics, behaviors, and other elements, aiming at solutions in artificial systems. This approach allows establishing several analogies based on this interpretation.

The main analogies discussed are: morphological, functional, movement, behavioral, and symbolic. Given the aesthetic focus of this article, our main emphasis will be on the morphology of the artifact. Morphological analogy, as defined by Bonsiepe (1992, cited in SOARES *et al.*, 2021), involves the experimental exploration of elaborate models that translate structural and formal characteristics for their application in projects. This approach aims to understand the logic behind natural form, investigating the interrelationships of its geometry.

3.3.1. Morphological patterns of nature

Among these morphological characteristics, we can identify recurring patterns found in nature. The main patterns described by Theska Soares *et al.* (2021) include: symmetry,

scale, modularization, structural efficiency, complexity, organic shapes, geometric shapes like circles, triangles, pentagons, hexagons, spheres, and spirals, as well as fractals and spirals *(See Table 2).*

Table 2. Morphological patterns of nature (Source: Theska Soares *et al.*, 2021)

SYMMETRY	Refers to the conformity or similarity between two or more parts based on a line, a central point, a plane, or an axis. Thus, symmetry can be bilateral, radial, or asymmetrical.
SCALE	The hierarchy of scales can vary from microscale, which refers to microscopic objects, to macroscale, visible to the naked eye, and megascale, which are gigantic dimensions such as those used in astronomy, following ascending or descending orders.
MODULARITY	Modularization refers to the regular and predictable repetition of components or parts in structures.
STRUCTURAL EFFICIENCY	Refers to material efficiency in nature, where the absence of waste is evident, especially in structures like the porous bones of birds, optimized for flight function.
COMPLEXITY	The morphology of nature exhibits a vast range of organic and geometric shapes, scales, colors, modularizations, and textures, making it crucial to understand this complexity and identify recurring patterns for natural mimicry, whose complexity distinguishes it from human projects that tend to simplify and make visually legible.
ORGANIC SHAPES	Organic shapes are found in living organisms, possessing curved and irregular lines, often more complex than linear geometric shapes.
GEOMETRIC SHAPES	Traditional geometric shapes are found in natural structures, both at microscopic and macroscopic scales, including rectangles, triangles, hexagons, pentagons, diamonds, as well as spheres, ellipsoids, cones, cylinders, and polyhedra in the natural three-dimensional environment.
FRACTALS	Hemenway (2010, cited in SOARES, 2021) explains that fractal geometry, introduced by Benoît Mandelbrot in 1975, describes a set of irregular shapes that do not follow Euclidean geometry, characterized by self-similarity, infinite complexity, and fractional dimensions.
SPIRALS	Growth patterns in nature are described as curves that move in relation to a central point (pole), constantly varying their distances.

4. Artificial intelligence as a mimetic tool

Currently, in the computational realm, a variety of tools are emerging in the form of creative image creation through artificial intelligence, with new approaches constantly being developed for different purposes. Essentially, these tools have the ability to generate realistic images from textual descriptions, using only a few keywords as input. In this process, algorithms are employed to translate textual descriptions into visual representations, resulting in high-quality and visually impactful images.

Among the various artificial intelligence tools, the use of Midjourney was preferred for the experiment in this article due to its recognized graphical quality, the ability to create an image from a previous image, and the option to create a new image by blending two other images using the **/blend** option.

4.1. Midjourney

Midjourney is a generative artificial intelligence service developed by the MidJourney Inc. research laboratory, which allows the generation of unique images from textual descriptions and/or through interaction with other reference images. As described on its own website.

> Midjourney is an independent research lab exploring new mediums of thought and expanding the imaginative powers of the human species. We are a small self-funded team focused on design, human infrastructure, and AI. (MIDJOURNEY, 2024).

4.1.1. Basic parameters used

Throughout the experiment, some parameters were used for generating the desired alternatives:

/imagine Basic command to activate the **/prompt:** which generates images through textual description *(See Figure 1)*.
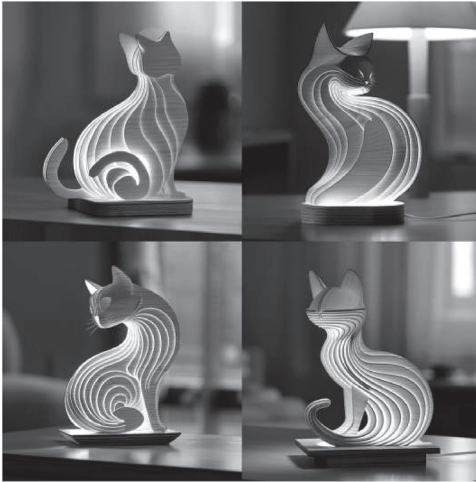
Figure 1.
Example of an image created using the / **imagine prompt:** a modern desk luminaire with a shape inspired by a cat.

Each command entered in the **/prompt** generates 4 images that can be reprocessed using the commands **V1 V2 V3 V4 or U1 U2 U3 U4.** The commands **V1 V2 V3 V4** creates a variation of the selected image, where the letter V stands for "vary": **V1** corresponds to the variation of image 1 in the upper-left corner, **V2** to image 2 in the upper-right corner, **V3** to image 3 in the lower-left corner, and **V4** to image 4 in the lower-right corner.

The commands **U1 U2 U3 U4** increases the resolution of the selected image according to the mentioned positioning. The /blend command allows you to quickly load 2 to 5 images and then analyze the concepts and aesthetics of each image, blending them into a new image. Lastly, the -- command removes something unwanted. Midjourney has many more commands; however, these initially met the specificities of this research.

4.2. Considerations on the use of Artificial Intelligence in design projects

In summary, artificial intelligence has proven to be a powerful tool for driving innovation and progress across various areas of society. However, its responsible implementation requires ongoing reflections on the ethical, social, and economic challenges it raises, ensuring that its benefits are distributed equitably and sustainably over time. It is important to note that in no way could Artificial Intelligence, in the ways used in this experiment, completely replace the comprehensive design process, as aspects such as functionality, ergonomics, structure, and materials are not responsibly addressed by this technology. However, in creative terms, there is an interesting possibility of generating alternatives, somewhat akin to a visual brainstorming session.

5. Applications

The experiment aims to generate concepts of artifacts based on elements of nature (natural mimesis) through three distinct approaches:

1. Using the inspiration of a specific element of nature.
2. Incorporating natural patterns without being linked to a specific element.
3. Creating a methodological synthesis based on the morphological box method.

All these approaches will be evaluated through textual descriptions and also using images, whether they are unique references or combined ones.

5.1. Natural mimesis with a specific element

Natural mimesis generated from the influence of a single species of fauna, flora, or a specific non-living natural element, i.e., without elaborate procedures and without blends with other elements of different origins.

**Example 1:** Chair inspired by a sea turtle.
Example 2: Lamp inspired by a banana fruit.

5.1.1. Specific element: Water Lily plant *(See Figures 2 y 3)*

Figure 2 (left). Lamp Inspired by Water Lily plant (Source: Midjourney **/prompt:** desk luminaire inspired by the Water Lily plant). **Figure 3 (right).** Lamp Inspired by Water Lily plant (Source: Midjourney. **V4** - One of the variations of the previous image).

5.1.2. Specific Element: Armadillo *(See Figures 4 y 5)*
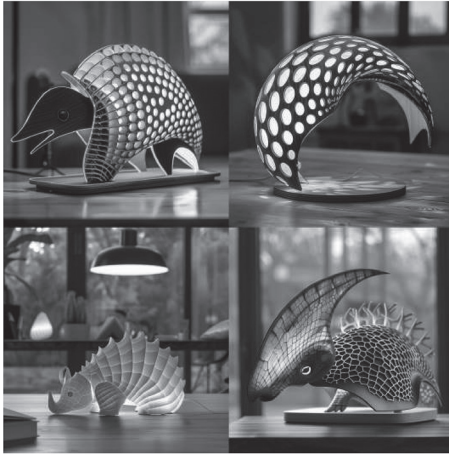
4   5

Figure 4. Lamp Inspired by armadillo (Source: Midjourney **/prompt:** desk luminarie inspired in armadillo).
Figure 5. Lamp Inspired by armadillo (Source: Midjourney. **V1** - One of the variations of the previous image).
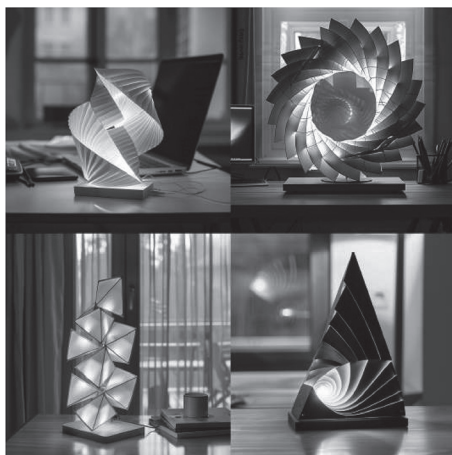
5.1.3. Mimesis Based on Nature's Morphological Patterns *(See Figures 6, 7, 8 y 9)*

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Figure 6. Chair with fractal structure (Source: Midjourney /**prompt:** chair with fractal structure). **Figure 7.** Chair inspired by fractal structure (Source: Midjourney **V3** - One of the variations from the previous image). **Figure 8.** Lamp inspired by patterns in nature (geometric shapes, triangular module, scale, and Fibonacci spiral) (Source: Midjourney /**prompt:** a desk luminaire from a triangular geometric module that repeats from radial symmetry in a spiral fibonacci in which the modules gradually increase in scale in perspective view). **Figure 9.** Lamp inspired by nature patterns (geometric shapes, triangular module, scale, and Fibonacci spiral) (Source: Midjourney **V3** - One of the variations of the previous image).