# open air mind

**NEUROSCIENTIFIC STUDIES FOR THE OUTDOOR**

Stefano Calabrese

pratic

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This publication groups five neuroscientific research projects into a single volume, all commissioned to a group of academic scholars by Pratic and spearheaded by Prof. Stefano Calabrese from IULM University of Milan. These studies, performed between 2018 and 2024, explored in-depth Pratic's brand three-word tagline: *open air culture*.

The initial research phase focused on understanding the impact of light and dark alternation on lifestyle, design, and neurocognitive processes. *The Healthy Lighting* initiative adopted a multi-disciplinary approach, merging previously disparate data that had never been linked to each other and underscoring the significance of integrating natural environments with innovative materials and architectural elements to create truly comforting outdoor spaces.

*The Lively Colours* study unveiled how colour and coloured light influence human behaviour, often subconsciously or barely consciously, affecting circadian rhythm and promoting relaxation and sleep with hues like blue, associated with calm and introspection, or enhancing it and thus promoting alertness and cognitive function.

In the third study, *Design for Well-being*, the exploration centered on how shapes, volumes, and proportions influence the

human brain, according to neuro-cognitive and aesthetic predispositions ingrained in *Homo sapiens* since birth.

The fourth instalment, *Beauty&Brain*, identified architectural forms that resonate most with our aesthetic sensibilities. Meanwhile, the fifth, *My Dream House*, delved into the imaginative world of children aged 3 to 14, revealing their vision for future homes. The experimentation was invaluable as the dominant element in the drawings was the need to connect *indoor and outdoor spaces*, continually envisioning a new version of the "treehouse," an ancient archetype of human beings.

The insights gained through these five studies have equipped Pratic with a deeper understanding of cultural, aesthetic, and neuro-cognitive inclinations, guiding the development of sophisticated bioclimatic pergolas and signature awnings that combine functionality with aesthetic appeal, enriched by a profound and previously unattained understanding of human emotion and preferences. For us, this knowledge not only opens new avenues for design and creativity but also fuels our commitment to responsibly and collaboratively innovating outdoor spaces.

Edi Orioli
*CEO, Pratic S.p.A.*

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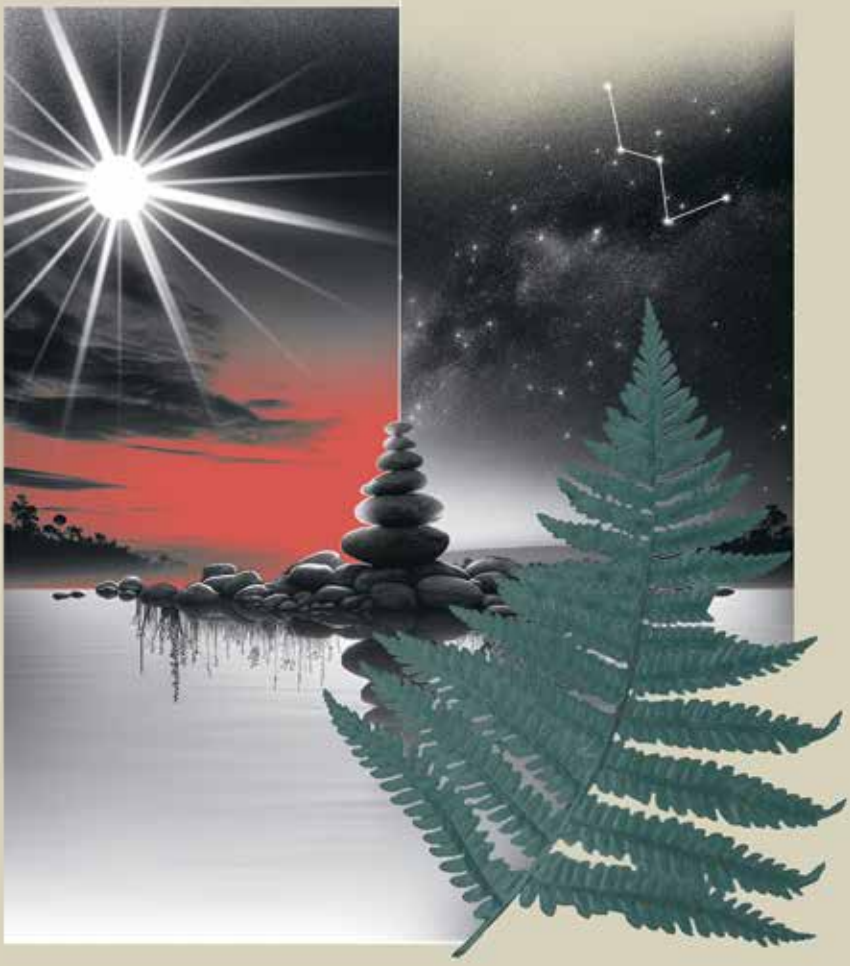
# Healthy Lighting



## TOWARDS A NEW CONCEPT OF OUTDOOR EXPERIENCE

Pratic has consistently been at the forefront of innovation in the outdoor industry. With a track record of significant technical and scientific advancements, often achieved subtly, the company has been pivotal in shaping the future of outdoor spaces. Through its patents and pioneering solutions, Pratic has not only met but also anticipated market needs, especially in the creation of Healing Gardens—spaces designed to nurture individual well-being.

Gone are the days, sixty years ago, when Pratic's offerings were solely viewed as tools for sun protection. Now, there's a veritable engagement with light and darkness.

Now, even a simple sunshading solution can embody a multifunctional meaning. In fact, the evolution from categorising fabric by strength now extends beyond durability to embrace colour, health benefits, and a balance of seemingly opposing elements like shade and transparency. Furthermore, the introduction of Pratic's bioclimatic pergolas has redefined outdoor design, merging architecture and aesthetics to blur the lines between inside and outside, ensuring year-round enjoyment of these spaces.

Pratic's bioclimatic pergolas embrace and take advantage of natural light through moving roof elements that adjust according to the sun's position. This is always done while main-

taining a connection with the natural world outside. As night falls, their artificial lighting, mimicking natural light's direction and frequency as much as possible, eases the transition to rest.

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**More than half-a-century of open-air culture.** Since 1960, Pratic has championed a philosophy of open-air living, continually reimagining its interaction with outdoor spaces. Innovation, quality, and sophisticated designs have propelled the company to become one of the foremost Italian entities in crafting pergolas and designer awnings. These elegant and innovative solutions revolutionise outdoor living, transforming outdoor spaces into stylish havens to be enjoyed year-round, regardless of the season.

#### THE CIRCADIAN RHYTHM: THE LIVING BEING'S CLOCK

A gear-driven machine. Straightforward, binary. Light and dark, sleep and wakefulness. This analogy illustrates the human body's operation, governed by a relatively uncomplicated system. The internal clock's "tick-tock" adheres to a precise rhythm, in tune with the surrounding environment and the sequence of daily tasks—from awakening to eating to sleeping. Over the course of evolution, humans, irrespective of their global position on the planet, have mastered the synchronization of their physiological rhythms with Earth's axial rotation. This process is known as the term "circadian rhythm". Simply put, the day-night cycle does more than transition from light to dark; it initiates a cascade of activities that automatically respond to external cues. While light is a critical environmental stimulus influencing the circadian rhythm—alongside other factors like traffic noise, street activity, and industrial sounds—it stands out for its profound effect on cerebral activity, body temperature, heart rate, and the establishment of biological rhythms. Devoid of these cues, humans might experience altered sleep-wake cycles, not confined to 24 hours but extending to 30-36

hours, comprising 20 hours awake and 16 asleep. The circadian rhythm is intimately linked to the human eye, serving not just as a visual tool but as a regulator of sleep-wake dynamics. The discovery of a third type of photoreceptor has revealed the eye's role in regulating our existence, highlighting the existence of photosensitive ganglion cells that respond to light, especially short-wavelength light that enhances melanopsin expression, a photopigment. This activation is triggered more easily by overhead light sources.

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**The circadian rhythm and its nobel recognition in 2017.** In 2017, the Nobel Prize in Medicine was bestowed upon American scientists Michael Rosbash, Jeffrey Hall, and Michael Young for their groundbreaking work on the circadian rhythm: an internal biological clock that exists in all living organisms, which resets roughly every 24.5 hours in harmony with Earth's rotation, managing our physiological functions. This discovery centered on isolating the *Period* gene, which is responsible for producing a protein known as Per. This protein builds up at night and diminishes during the day, following an approximately 24-hour cycle. It is believed that *Per,* after binding to the Tim protein — originating from the *Timeless* gene — inhibits the *Period* gene's activity upon reaching the cell nucleus. It was further revealed that the frequency of these alternations is regulated by a gene named *Double-time*, encoding the *Dbt* protein, which modulates the timing of *Per* protein accumulation, ensuring it aligns with the 24-hour cycle. Although the light-dark cycle is not the only factor influencing its regulation, it plays a pivotal role in the circadian rhythm's functionality.

### NEW TECHNOLOGIES AND THE CIRCADIAN RHYTHM: THE EXCESS OF ARTIFICIAL LIGHT

Artificial light, especially the blue spectrum emanating from LED-backlit devices like tablets, computers, e-readers, and modern televisions, disrupts sleep quality and circadian rhythms, leading to delayed onset of sleep. Research concurs that the changes in habits due to artificial light and electronic devices have varied effects depending on the light's wavelength.

Exposure to LED light, particularly intense at around 460 Nm, can boost cognitive performance and alertness yet simultaneously interfere with sleep, notably reducing REM sleep duration. The circadian clock is especially susceptible to artificial light during evening hours, risking misalignment and related issues. Research conducted by Cajochen and colleagues suggests a distinction between exposure to the "cold" light of an LED monitor and the "warm" light of a non-LED monitor, as the LED screen emits 3.32 times more blue light than its non-LED counterpart. Moreover, the human circadian clock appears to be highly sensitive to light wavelength, particularly to short-wavelength light around 460 Nm, which can act as a suppressor of melatonin release—consider that after two hours of exposure, a 60 percent reduction in melatonin production can be observed. This effect diminishes with increasing wavelengths, as seen with light around 550 Nm, which produces effects similar to those of light non-exposure.

It is the emitted light, not the monitors themselves, that affects the circadian rhythm. Scientific studies underscore how excessive use of artificial light impacts the human circadian rhythm and sleep, in contrast to natural light and outdoor living, which mitigate the cognitive and physiological consequences caused by cicardian rhythm disruption.

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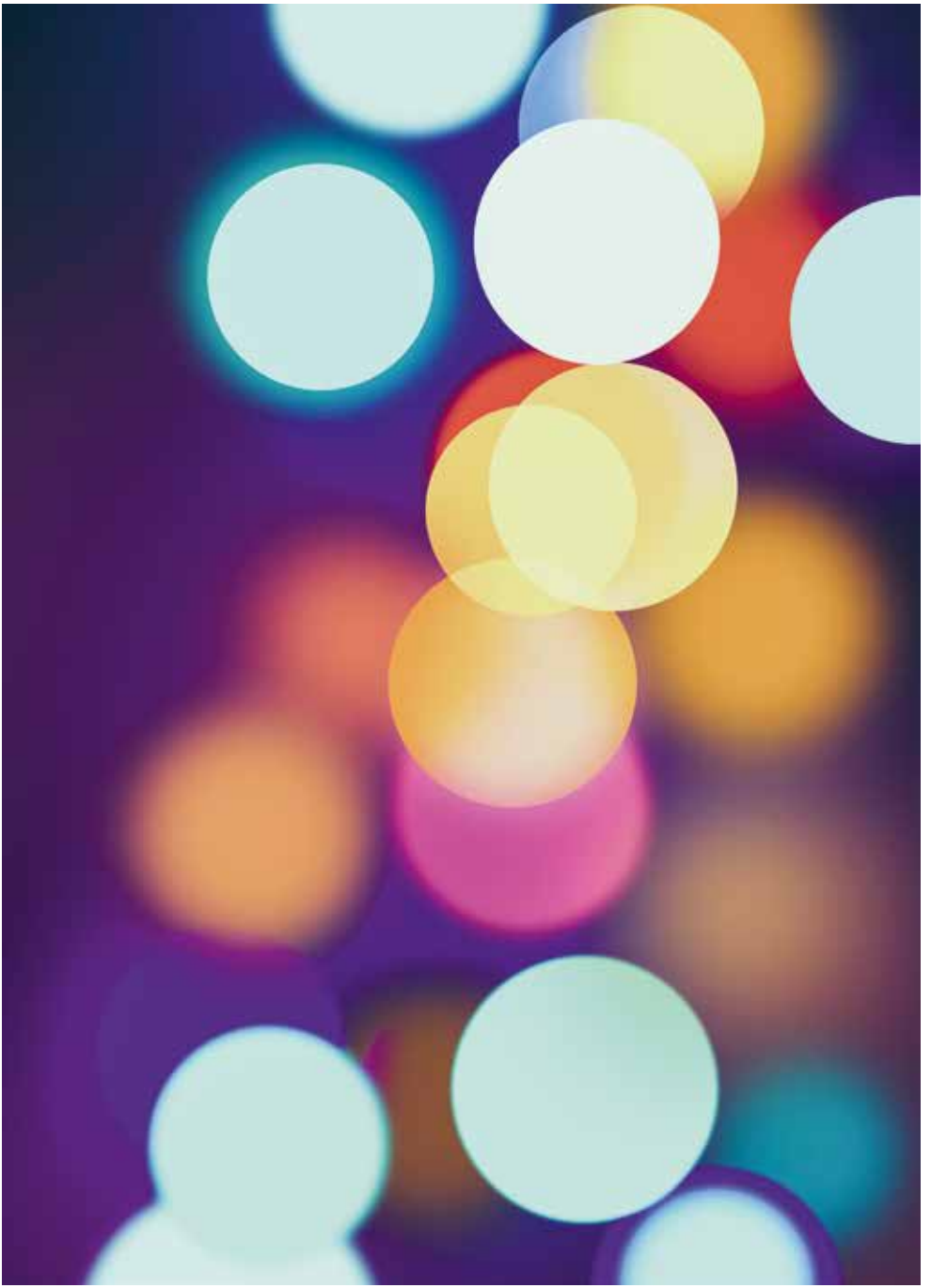
**Interacting with light.** Light has the power to highlight shapes and textures, either hiding or revealing them to the observer. Through the art of lighting design, we communicate, sculpt our environment, and shape the landscape that surrounds us. In the context of landscape design, the approach to lighting must account for the overall scenic impact, considering the interplay of light, shadow, vegetation, and architecture on our perception. An effective outdoor lighting design's primary goal is to make a space inviting, enhance its beauty, provoke a sense of pause, and offer a feeling of safety. In the realm of green space design, the chosen lighting techniques are intrinsically linked to the vegetation's role and the intended scenic outcome. Lighting from above simulates daylight, casting a play of reflections and shadows reminiscent of a bright, sunny embrace. Lateral lighting brings out textures, diminishing



the dark zones at the vegetation's base. Upward lighting, which can cleverly conceal the light fixture, highlights the structure of the plants. Often, a tree can serve as a light source, especially a uniquely characteristic one, with lighting nestled within its foliage to forge intriguing interplays of light and dark. It is essential to recognize that the luminous staging of a garden also relies on its shadows. From a nearly radical perspective, outdoor lighting design can evolve into a "non-illumination" project, intentionally creating shadows and dark areas that, for instance, mimic the sun's movement throughout the day. Thus, the diurnal cycle is recreated during the night, crafting a seamless sensory experience.

#### COLORS AND THE PSYCHE: A GAME OF LIGHTS

Red instinctively alerts us to danger, while blue conjures tranquillity and serenity. The influence of colours on our physiological rhythms is tied to their wavelength frequencies.

Research from the 1990s by Baron and McCloughan, reinforced by more recent studies, indicates that coloured light impacts our mood at an unconscious level, provoking instant reactions to stimuli that are often linked to survival instincts. While these effects might be framed within the broader warm light/cold light dichotomy, they can provoke distinct responses in people independent of the light's spectral composition. Detailed studies on the brain's electrical activity have shown a link between increased light exposure and enhanced alertness, finding that red light can induce a state conducive to circadian relaxation and sleep, yet, paradoxically, it can also heighten alertness.

On the flip side, blue light bolsters circadian activity and readiness for both physical and mental endeavours, yet it tends to foster feelings of calm and introspection.

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**Chromatics.** Pratic's bioclimatic pergolas are not just visually stunning; they are the embodiment of avant-garde technology and innovation. Among these features are the integrated perimeter LEDs, which are adjustable in colour and

intensity. They are essential for experiencing the outdoor space not just during the day but also in the evening hours, recreating a pleasant and welcoming ambiance.

### LIGHT AND DARKNESS: ESSENTIALS FOR CIRCADIAN RHYTHM BALANCE

The alternation of darkness and light is a biological necessity. The human body requires specific conditions of exposure to light, as well as to darkness. A study in 2006 delved into whether workplace lighting impacts mood, revealing that it is not so much the increase in artificial light that influences mood but the presence or absence of windows in the workspace. This aspect is so significant that office areas should consist of at least 20 percent windows to meet employee satisfaction. This insight adds to our understanding of nighttime light's role in delaying melatonin production, thereby affecting the sleep-wake cycle. Melatonin production begins with darkness and peaks in the middle of the night, where light exposure can significantly disrupt the circadian rhythm. Sleep provides a unique opportunity for the visual system to immerse in darkness, a condition as critical as natural light for maintaining and synchronizing the circadian rhythm. Furthermore, factors like air travel, which leads to jet lag by suddenly changing time zones and possibly causing excessive light or darkness exposure, as well as the changing lengths of days and shifts between daylight saving and standard time, all influence the circadian rhythm and can lead to its desynchronization.

### VITAMIN D: ESSENTIAL FOR WELL-BEING

Getting enough vitamin D is good for the immune system, bones, and the regulation of the circadian rhythm. Contact with

the light source, with the due precautions, is crucial to obtain this biological resource, and a common light source is not enough; direct exposure to the sun is necessary since vitamin D is produced through the action of UV rays, particularly UVB rays, with a wavelength in the range of 290-315 Nm. Studies recommend daily exposure to natural sunlight, optimally during mid-morning or mid-afternoon in summer for 6 to 8 minutes and at noon in winter for 7 to 40 minutes, to facilitate adequate vitamin D synthesis.

This process is contingent on various factors, including the amount of sun exposure and the angle of the sun. The connection between vitamin D and sunlight is uniquely attributed to UVB rays, distinct from UVA rays, which are linked to sunburn and necessitate protective measures to guard against harmful effects. Beyond bone health, vitamin D is pivotal for immune function, aiding in managing conditions associated with inflammation and skin infections. Investigations also reveal that skin pigmentation influences the required duration of sun exposure to fulfill daily vitamin D needs. Individuals with darker skin need prolonged exposure than those with lighter skin, a fact supported by a study in the province of Udine.

Modern indoor-centric lifestyles contribute to widespread vitamin D deficiency, particularly among children and teens. One study of 93 children disclosed that merely 45.2 percent had sufficient vitamin D levels. Furthermore, the study underscores a greater deficiency risk among darker-skinned children, with a 75 percent vitamin D concentration deficit compared to 47 percent among their lighter-skinned counterparts.

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**Mood.** Open air culture is the driving force behind every Pratic innovation. The interaction with natural light from every angle, the continuous airflow, and the comfort of the spaces transform bioclimatic pergolas into true sanctuaries of well-being. Aluminum structures bring a fresh perspective to outdoor living, fostering a restored harmony between body and mind.

**Year-round.** A visionary project in sunshades ushers in a novel approach to sun protection. This is the essence of the T-Project, conceived by Pratic Concept, to fulfill the need for design-centric, highly functional solutions. This collection of awnings adapts seamlessly to any environment, instantly enlarging the living space. It provides the advantages of natural light while shielding from UVA rays.

#### LIGHT AS THE ESSENCE OF ARCHITECTURE

Capturing natural light and organising interiors so that it becomes the focal point of the spaces. Light is often deemed the essence of a space, going beyond its primary function of illumination to support the circadian rhythms of its inhabitants, enhance environments, shape spatial perceptions, and invoke distinct emotional reactions.

Closely tied to the notion of environmental wellness, light is a central element in design. It acts as a starting point that, with skills and creativity, needs to be measured and directed based on the needs and the desired effect. Perceived as a directional wave, it can be channeled horizontally, vertically, or diagonally. Horizontal lighting is achieved by working on the vertical plane of the space, with the windows playing a key role. Windows act as a boundary between the indoor, which shields us creating a safe space, and the outdoor, which is less controlled but where, at the same time, one wishes to remove unpredictable, dangerous, or simply unwelcome elements. Alternatively, it is also possible to arrange openings on the horizontal plane, for example on the roof, to allow access to one or more vertical light beams, which are much more effective in influencing the circadian rhythm. The vertical lighting approach is optimal for achieving *healthy lighting*, bringing the individual closer to the light conditions of the natural environment, as zenithal light encourages contemplation and creates an independent microcosm of emotions.

Diagonal light shows fascinating effects when applied in strategic points: due to the Earth's rotation, the sun's shift from east to west creates a constant dynamic of light beams entering the indoor space, illuminating different areas with variously shaped light bands and generating, through different highlighting techniques, various effects and outcomes.

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**Advanced design.** At the heart of every Pratic design is the principle of experiencing natural light in a way that is both pleasant and tailored to individual preferences. Consequently, each creation is thoughtfully designed to cultivate illuminated spaces that harness the advantages of a harmonious interplay between light and darkness. The adjustable blades allow modulating light intensity, crafting enchanting and dynamic atmospheres.

#### LIFE AS A PERGOLA

The evolution of the relationship between humans and light originates from the adaptation to the environment that has solidified over time. However, today, this relationship is challenged by the weakening distinction between day and night and the predominant preference for indoor spaces over outdoor ones. In the Western lifestyle, there is a preference for bunker-like offices and private homes with a substantial reduction, over the last century, in the time spent outdoors, leading to health problems associated with the lack of exposure to natural light. Even the "outdoor" space needs to be a "sheltered" and protected one. In its design, since ancient times, building engineering has been accompanied by architectural studies where targeted choices on openings and contact with air and light were strategic. Contemporary times, in the mid-20th century Western civilization, brought a wave of architectural innovations that were radically more in contrast with the concept of "enclosure" than ever before. Among the most remarkable examples of modern archi-

tecture and open spaces is undoubtedly the Farnworth House, built between 1950 and 1951 by Mies van der Rohe in the USA. The revolution of open space allowed for a maximum degree of internal light distribution, which massively filters through horizontal openings, provided by the glass walls overlooking the garden. Constructed of glass and steel, materials emblematic of the new "luminous" style, the building maintains both its exterior and interior walls in white: very bright, then, because they reflect all chromatic radiations.

This remarkable structure, pioneering in the ongoing process of the transition from indoor to outdoor living, promotes minimalism by using skillfully and effectively sunlight, capable of flooding the interior environment also thanks to the strategic absence of obstacles surrounding the house.

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**Comfort archetype.** The pergola's structure establishes an authentic haven for spending quality time. It not only excels in design but also innovates, reinterprets, and enhances the traditional shelter concept. Through advanced design, it ensures ideal lighting, ventilation, and temperature, with special attention paid to human needs.

# Lively Colours

## MILLIONS OF COLOURS: NATURE AND PERCEPTION

There are millions of colours in nature and just as many that our eyes can perceive—an astonishing amount, but one that makes up only a small portion of the entire electromagnetic spectrum. The sheer extent of this is even more remarkable when one thinks about how specialised the human eye and brain have become to make all this possible. Neuroscience discoveries have taught us that vision is an active process and that seeing and understanding cannot be truly separated. However, the most interesting aspect is that there are different areas of vision in the brain, not just one, as we had all initially thought. The three essential parts of a scene (colour, shape, and movement) are processed by different specialized areas, but not all simultaneously. First, we see the colour, then the shape, and, finally, the movement and position.

Colour perception may seem instantaneous to us, but in reality, it is the product of a complex process that has been stored in the human brain for millennia. Light is captured and split by three types of cells that can perceive the wavelengths of blue, green, and red. The brain then processes these, separating the information from the outside world and identifying details, movements, and colours.

Here, the signals are sorted by the visual cortex along two pathways: the first informs us about the shape and colour of the

observed object and the second about movement and position.

This breakthrough has put colour in the spotlight. Over the past decade, colours have not only been studied with interest by the scientific community but are also a major focus in the world of design, fashion, architecture, and aesthetic entertainment.

### BLUE, RED, BLACK, AND WHITE. DO UNIVERSAL COLOURS EXIST?

People have long tried to classify colours correctly and gain insight into their usefulness to different cultures throughout history. Johann Wolfgang von Goethe made an interesting point in his book *Farbenlehre* (*Theory of Colours*), published in 1810. Everyone tries to find a recognisable pattern or, even better, a universal rule that explains why one colour prevails over others in different situations.

Evolutionary theories attribute these personal inclinations to how society was structured in prehistoric times.

Other approaches, such as the Ecological Valence Theory (EVT), argues that our experiences primarily make us prefer one colour over another.

Some shades of color are associated with positive moods and success, while others are associated with negative feelings.

If we believe this explanation, it would mean that we prefer blue over brown because we associate blue with water and sky, both of which are essential to life; this would explain why most evidence points to it being at the top of the list of most popular colours.

Stephen Palmer and Karen Schloss have conducted research and found a model that explains about 80% of the variance in personal colour preference among people from the Western world; the work of these researchers shows that society and education play an essential role in colour preference.

Other linguistically oriented studies show that some colours are almost "universally" accepted at some level.

Brent Berlin and Paul Kay have shown in a comparison of 98 different language systems that colour semantics originated from basic colour terms: black, white, and red. We could argue that our environment and personal experiences influence colour preference, but at the same time there is a kind of primordial, unlearnt core of colours that gives us a clue as to why people prefer one colour over another. These colours are blue, red, black, and white.

However, we cannot talk about the structural, linguistic, and cultural aspects of the evolution of colours without examining how they have been reproduced over the ages.

Today, we have LED screens that can reproduce 16,000,000 shades of colour, but there was a time when people could only express complex concepts such as life, death, and the passage of time with three colours: black, white, and red. Three colours that are consistent with the findings of Berlin and Kay, which show that the naming and rendering of a colour is closely linked to and dependent on the context. This dependency has been termed the "Period-Eye" by art historian Michael Baxendal, suggesting that the ability to recognise colour and our attraction to it, indeed art itself, is innate and "activated" by the circumstances in which we find ourselves.

Neuro-art historian John Onions suggests that the tonal paintings of Titian and the linear style of Michelangelo have a dual nature.

On the one hand, their style is a product of their personal experiences and subconscious. On the other hand, it is a (in this case conscious) appropriation of the environment in which these masters were immersed – the water of the Venetian lagoons in Titian's case and the dark ashlar work of Florentine stone in Michelangelo's.

What effect do colours have on the human mind? Can colours guide our decisions and influence our mood?

Here, too, nature provides valuable clues, starting with red.

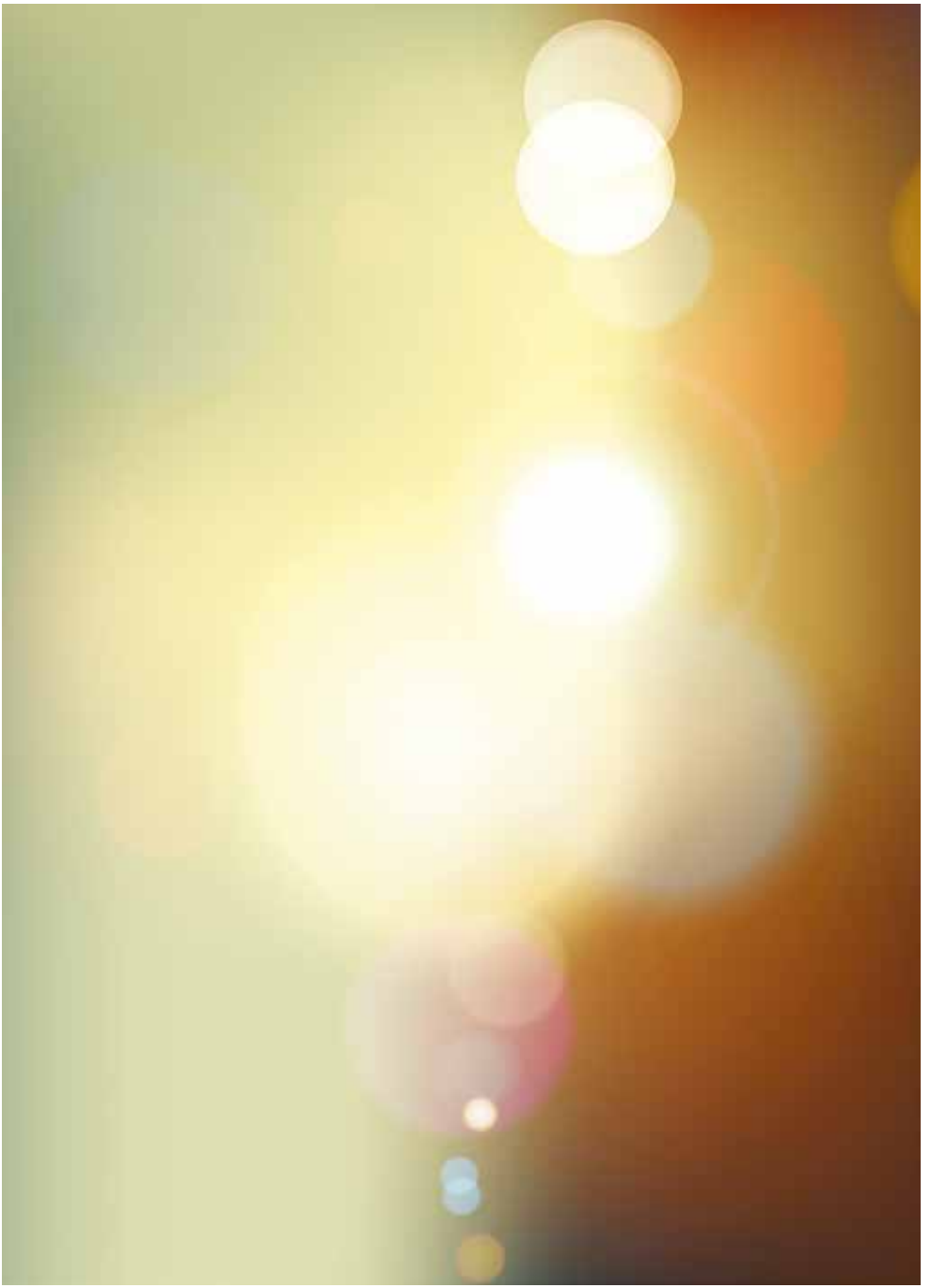
This colour tends to characterise the alpha male, and it is also generally known that a high concentration of testosterone causes reddening of the skin in humans. Therefore, red is best suited to conflict and dispute situations. In the sexual sphere, red plays an important role alongside black, which is the epitome of elegance.

At the other end of the scale, blue and green promote a mindset (especially when there is little at stake) compatible with the concentration and mental relaxation required to accomplish a difficult task.

These findings were confirmed by a meta-analysis that considered 166 research papers from the last 30 years and reconfirmed the difference between warm colours, which tend to be arousing and exciting, and colder colours, which are associated with satisfaction. Based on the numerous research projects in the marketing field, we can conclude that long-wavelength colours generate high levels of excitement and arousal; this state of mind peaks with the colour red and gradually decreases through orange, yellow, pink, etc., until it reaches the colour blue, which can relax the human mind.

From a psychological point of view, each colour can be associated with a certain attitude or characteristic of the human mind. Blue, for example, stands for competence, communication skills, and intelligence; brown stands for trustworthiness and reliability; black stands for power and elegance; violet stands for luxury and quality, while green is closely associated with experiences in nature.

The business world knows too well how colours influence our perception of what surrounds us. Studies based on the



responses of 450 participants on their perceptions of 100 brands from the Top Brand Report 2009 have shown that colours can trigger different reactions (red for excitement, blue for competence, and black for sophistication). It can even influence our buying habits.

#### COLOURS AND ARCHITECTURE: HARMONY OR CONTRAST?

If we take a closer look at interior and exterior architecture, we will notice that the typical colour scheme of artificial structures tends to create a series of stable visual and informative connections and convey the idea of solidity.

On the other hand, polychrome objects are often associated with dynamism, expressing the essence of nature and the passage of time. Two other categories further complicate this difference: background colours, which include all the matte, dark tones ideal for the background, and, opposite to that, foreground colours, a range of contrasting tones that scream for attention. Finding the right balance between background and foreground colours is one way to achieve a harmonious result, but it is not the only factor to consider.

Chromatic harmony results from a combination of hue, lightness, and saturation, the key elements that form the current international standard for defining and measuring hues. Therefore, designers must consider stable colour relationships that are in harmony with the overall structure and help to define spatial reference points so that people can easily identify with their homes and surroundings. For instance, recognizing one's neighbourhood or identifying with a particular place, such as one's home, should be easy.

As a counterpoint to this system, dynamic colour relationships can be created to help people adapt to their surroundings.

For example, painting a pergola that is attached to a house in the middle of a dull urban landscape green will help to make it stand out and create a perceptible discontinuity between the two colour schemes.

The result is a greater sense of well-being when we look at the space.

#### THE COLOUR OF A PERGOLA, BETWEEN RELAXATION AND FUN

Let's take a look at a real-life scenario.

If you design an outdoor area for relaxation or leisure and it is in neutral colours that exactly match those of the adjacent building, this will cause visual and psychological fatigue and prevent the mood change that is important when we move from a work environment to a leisure area.

This is counterproductive and runs counter to our original architectural goal. Conversely, a passageway that contrasts in colour with the main architecture, with its foreground colour matching the background colour of the building, creates a positive difference and a pleasant spatial discontinuity.

This promotes an effortless transition from the cold space of work to the warm space of leisure time.

Therefore, when we think about the colour scheme of a building and want to generate a relaxing pro-leisure effect as opposed to a grey or neutral work environment, we need to choose bright hues strikingly different from those of the main office structure.

We can find many practical examples of this in most home environments: Neutral colours and nuanced palettes with a camouflage effect are the most popular choice for large residential complexes in suburban areas, while bright hues and contrasting colours are typically used for prestigious design

items such as handbags, sports cars, and coveted furnishings.

When creating a passageway between an indoor space and an outdoor area used for residential or leisure purposes, a shift in function is unnecessary. This means we can disregard the colour relationships and focus on the interaction with the artificial and natural environment.

When the surrounding landscape is aesthetically stunning (such as a the scenery around a beach house), it makes sense to use a natural, neutral colour scheme or one that matches the surroundings, as this will ensure that the house harmonises with the beautiful view. It is no coincidence that many houses on the coast use sand-coloured shades.

On the other hand, if the surroundings are banal (e.g. industrial areas or places without vegetation), this lack of colour can be compensated using a richer palette and complex colour combination. This compensates for the change of seasons that brings with it natural colours (vegetation, sky, etc.) usually associated with open spaces that transition from indoor to outdoor (e.g. from a house balcony to a gazebo in a beach house).

#### A PLUNGE IN COLOURED LIGHT

Colours can also be influenced and reproduced by artificial lighting. In recent years, the field of artificial lighting has changed as society has moved from using incandescent bulbs to LED lamps. Although it may appear that LED lamps emit the same light as incandescent bulbs, the effect on the human psyche and how we perceive light is quite different. This is perhaps because different spectral compositions can trigger different eye receptors. Broadband light triggers three central sight photoreceptors (the ones that allow us to receive the image), while LED light mainly triggers one photoreceptor that enhances the

sense of immersion in the architectural experience. Therefore, each space should be designed based on the perceptual experience that the architect wants to convey to the users, and it must always be kept in mind that LED light enables immersion in the architecture, while incandescent bulbs generate a sense of separation between the viewer and the object being viewed. In practical terms, this means that if an outdoor structure is intended to create a sense of relaxation, it may be a good idea to use incandescent lights, possibly coloured ones with a long wavelength: if, on the other hand, the structure is meant for socialisation purposes, it would be advisable to use LED lighting with a short wavelength such as blue and violet.

Basically, the immersion factor should be considered depending on the type of structure we want to achieve. If we want people to feel involved and emotionally engaged, LED lights and colour tones with a short wavelength are what we are looking for. If, on the other hand, we want users to forget the routine, it is better to use incandescent lights with a red wavelength. If the outdoor area is bathed in natural light (e.g. a pergola by the sea or in the countryside), a subdued shade with a long wavelength in the yellow-red colour range will help it blend in better with its environment.

# Design for Well-being

## BILATERAL CREATURES

The human brain consists of a right and a left hemisphere, each tasked with different functions.

It is like a car with two separate engines, both to save energy and serve as a reserve if the other breaks down.

French neurologist Paul Broca first discovered the asymmetrical structure of the human brain in 1865, with the identification of the cerebral part of the brain, on the left, which processes verbal language. From that moment on, the various functions of the brain – thinking, emotions, motor skills, etc. – were identified as being the responsibility of the right or left hemisphere of the brain.

This phenomenon was already evident in the first hominids. Paleoarchaeological studies of early human artefacts confirm that our ancestors used the right hand since the Pleistocene, 1.4 million years ago.

Since then, the ratio has not changed: the overwhelming majority of the world's population is right-handed.

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**The left-handed and the right-handed.** Truly standing out in cave paintings of the Upper Palaeolithic (around 40,000 BC), such as those in the Chauvet Cave, are the "negatives" of handprints created by blowing red pigment through a tube around a hand resting on the wall. Seventy-seven percent of these negatives are of the left hand, probably because the right hand held the tool they used to spread the colour. In an experiment in which French university students were asked to imitate cave paintings, 77.1% of the handprints were

from the left hand, a proportion equivalent to the one of 10,000 years ago! Right-handed people dominate at least 93.1% of the world's population.

### WHAT IS NEW, WHAT IS ROUTINE

The consequences of the overwhelming dominance of the right hand can also be seen in the world of communication and design. For design, this means that objects are read by the brain according to the functional orientation of a right-handed person, meaning that everything from door handles to computer keyboards is designed for manual actions with the right hand and not the other way round. In the field of communication, advertising repeatedly shows products that can trigger an identification in right-handed people. When they see a cup of coffee with the spoon on the right side, they simulate the movements required to taste the coffee. From the brain's point of view, it is as if you were drinking it.

As of today, it seems that people are born left-handed or right-handed depending on their genes, but this is just a small consequence of the division of our brain into the right and left hemispheres. When experiencing something new, it is the right hemisphere that gets activated first: surprise, astonishment, and the experience of the unknown all start on the right side of the brain. Only when it becomes gradually more familiar the information moves to the left side of the brain, that encodes, purifies and serialises the information and transforms it into abstract concepts and categories. The right hemisphere processes new stimuli while routine ones are rooted in the left hemisphere.

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**The right and left hemispheres are already separate in several languages.** In Latin *cognosere/sapere*, in French *connâitre/savoir,* in German *kennen/wissen.* The process of "knowing" is based on an encounter with someone or something different, the "other". It is based on an experience and does

not provide stability. It derives from a holistic view and cannot be replaced by a list of its parts, all aspects of a way of seeing the world that is generally attributed to the right hemisphere. Knowledge, on the other hand, produces information or characteristics that give the impression of an inanimate, static, and unchanging object, and it is the only form that science allows. It has to do with the public domain – e.g. train timetables or the date of historical events –, it is certainly stable and does not change from person to person, but offers a partial reconstruction of the whole through the sum of salient and constitutive features, reserved for the left hemisphere of the brain.

#### EMOTIONAL EMOTIONS, RATIONAL EMOTIONS

Another important distinction between the two sides of the brain is emotions, which are controlled by the left hemisphere when they are positive and by the right hemisphere when they are negative or neutral. The left hemisphere controls approach-related thoughts and decides whether to approach something we like, while the right hemisphere controls whether we avoid something that frightens or worries us. However, there is more. The part of our brain that is used to recognise people is on the right side. When this part of the brain is damaged, the person has trouble recognising even familiar people (a disorder known as prosopagnosia). To understand how important lateralisation is for emotions, one can look at behavioural studies that indicate a right hemisphere prevalence when there is a visual preference for images of the left profile of a face, which are perceived as more expressive by the viewer. For 70% of people, there is a preference for showing the left side of the face to the camera or portraitist, from mediaeval Madonnas to Rembrandt portraits and the Mona Lisa to the selfie where the parts are not inverted by chance. When we take a selfie holding the mobile phone with the right hand and photographing the right side of the face, the image on the right will move to the left. Even technology takes neuroscientific certainties into account now.

**For pleasure, head left.** The first model of emotional lateralisation – that of the right hemisphere – was developed by the English neurologist John Hughlings Jackson around 1878, when he observed how patients with severe damage to the left hemisphere and speech difficulties were nevertheless able to express emotions through facial expressions or monosyllabic exclamations. In general, today's neuroimaging data show that left hemisphere activity systematically increases when viewing positive images, and right hemisphere activity increases with negative images. Interestingly, this model of emotional valence is also found in the emotional lateralisation of animals, with the exception of fish. In fact, all vertebrates categorise the positive to the left and the negative or neutral to the right.

### THE TRIUMPH OF THE LEFT HEMISPHERE

According to the neuroscientist McGilchrist, the entire development of Western civilisation up to today's predominance of abstract science and technology, in which the concrete clearly outweighs the spiritual, can be explained by the lateralisation of brain functions: the two hemispheres of the brain deal with the world in very different ways, and this has clear implications on human behaviour, social norms and creative processes. The left hemisphere, in which logic, analysis and language are controlled by focused attention, has prevailed over the right hemisphere, in which synthetic, imaginative and emotional processes are controlled by holistic attention. The two hemispheres are forced to work together, but one is always stronger than the other.

On the right side, reality is perceived in its entirety; on the left side, the representation of the same reality is catalogued and archived.

The crucial point is that each hemisphere perceives the outside world in a different way, so that our individual character and that of the socio-cultural environment depends on which hemisphere dominates.

**The three fundamental components of an emotion.** When we feel an emotion, three things happen: a physiological reaction to a stimulus (e.g. our heartbeat increases or we sweat), a behavioural reaction (e.g. we step closer to a person we love) and a sensory input (e.g. the subjective. experience of pleasure).

### DESIGN: THE NEURO-HISTORY OF A FRATRICIDAL STRUGGLE

Looking at the world of contemporary design – from architecture to interior design to objects – there is a persistent belief persists that the analytical and abstract left brain sets the tone in the creation and use of human artefacts and is obsessed with the useful, practical and functional. However, looking at the entire bi-hemispherical brain, it is possible to draw up a neuro-history of human design, in which everything- the production of objects, languages, social systems and aesthetic formats – is the result of an often-brutal competition between the right and left hemispheres of the brain, played out through shapes, colours and architectural positions.

The first cave drawings – those in the Chauvet Cave, around 35,000 years ago – are incredibly realistic and three-dimensional, with a balance between left and right brain use. But soon the images became more abstract and schematic, showing a stronger left hemisphere – like those in the Altamira Cave (18,000 years ago). If in the Renaissance a balance between right and left was achieved through functional but aesthetically pleasing forms, then the Protestant Reformation can be seen as the supremacy of words over images through an essential material life brought back in the Bauhaus minimalistic style of the twentieth century. Baroque and Art Nouveau represent the momentary rebellion of the right hemisphere of the brain against the left through the predominance of emotion, the merging of everything with everything and the organic promiscuity of forms.

The next industrial era in fact established a serial world that is functional and "comfortable" and subordinate to the functionality of the left hemisphere of the brain. The close link between the characteristics of the left brain and the defining aspect of Western modernity prove that technology tends to downplay the importance of the socio-environmental context or the physical and emotional dimension of life, which allows the right hemisphere of the brain to place the precise but fragmented intonations processed by the left hemisphere into a single framework.

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**Fight against the extremes of rationalism.** In the nineteenth and twentieth centuries, Art Nouveau and Liberty alongside the right side of the brain staged a rebellion against the left side. The organic lines, the phytomorphism (ornamentation in plant forms), the decorative traces on the façades of buildings as well as on objects that run through the entire surface without interruption or fragmentation, the essentially curvilinear orientation of the forms: everything amounted to a revenge against the classicist spirit of the left hemisphere.

### BIO-URBANISM & CO.: THE RETURN OF EMOTIONS

At this point, in order not to sink under the weight of the left hemisphere, contemporary design decided to change its pace in both the institutional and artefactual spheres; it sought a new balance between the two hemispheres of the brain. The rise of the right one is particularly evident in the new attention to context, environmental sustainability and organic urban planning.

Applied neuroscience is now a crucial factor in contemporary architecture, as architects are increasingly interested in designing buildings that promote the well-being of the people who live in them.

Recent experiments in neuroscience have made important discoveries. For example, the "panoramic" visual-spatial mecha-

nisms of the right hemisphere of the brain respond to horizontal stimuli and to certain coordinates of the environment, such as open or closed or curved or straight, and influence our sense of pleasure as well as our emotional judgement, from states of surprise to fear or avoidance. The right side of our brain also analyses how well we can see in a space: If a space is open and allows us to see far, we enjoy it a lot as we feel safe in our surroundings and can see what us is around without being seen. On the other hand, the focused and detail-oriented visual-motor mechanisms of the left hemisphere process vertical lines and reference points in the environment (landmarks). In doing so, they determine abstract and categorical spatial relationships such as the height of a space and motor comfort. A space appears beautiful and safe to us if we can approach it quickly or move away from it. These ancient mechanisms, which we inherited thousands of years ago, help our brain to react on autopilot.

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**Architecture and neuroscience.** Frederick Marks, founder of the Academy of Neuroscience for Architecture (ANFA), is convinced that the neurocognitive perspective must inform contemporary design about itself and that we can no longer ignore the enormous amount of experimentation in magnetic and functional resonance imaging (MRI) and electroencephalography (EEG) which show how our brain is activated when we look at or are in a building. What happens in our head when we process a space?

#### ABOVE ALL OTHERS: GEOMETRIC SPACES

These neurological findings inevitably pose a number of questions for professional designers, some of which are still unresolved. What types of environmental cues are most useful to help a person move around a space: vertical elements, horizontal elements, the perimeter of an enclosed space, the colour of the walls? What kind of environment allows individuals to

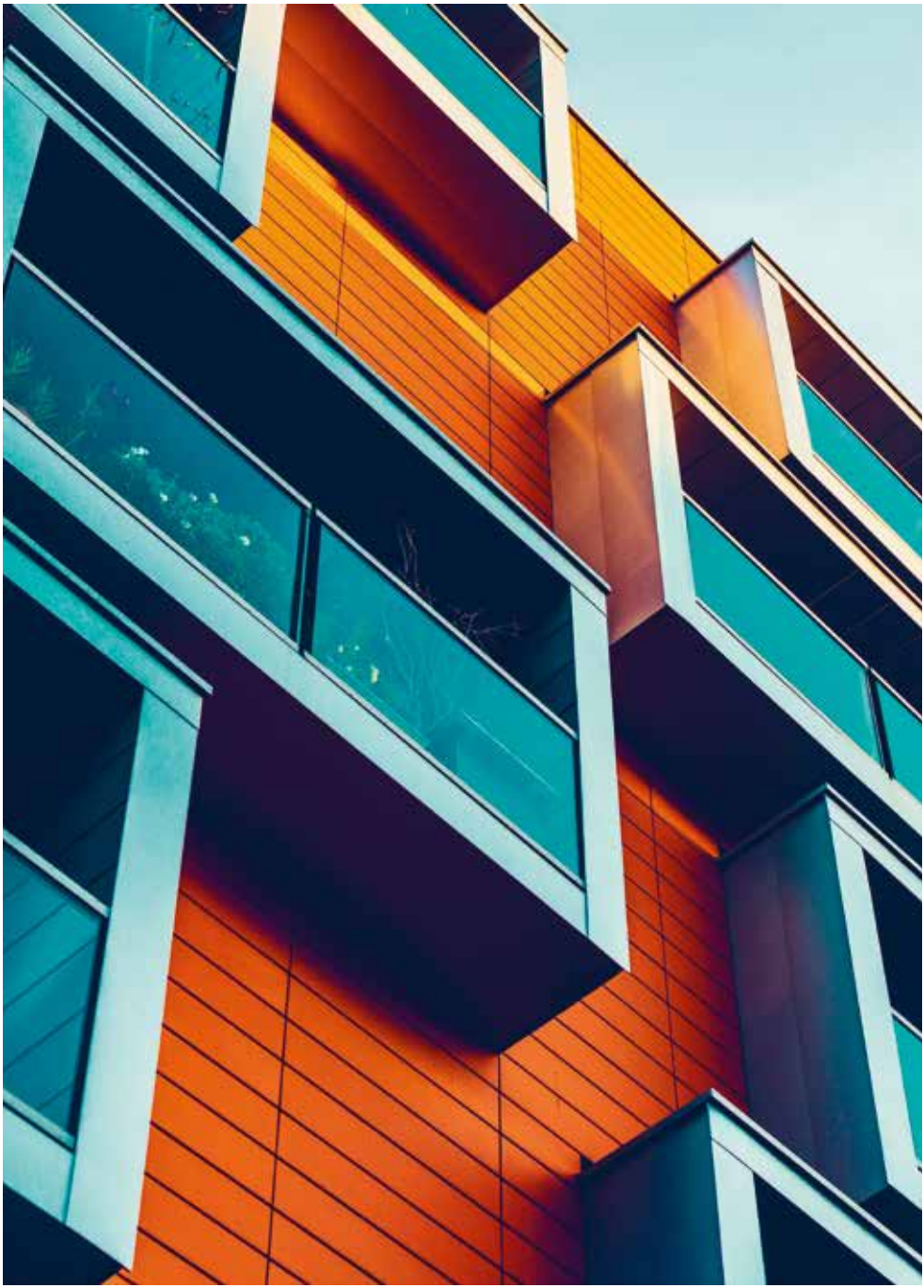
orientate themselves better? Architects and designers are investigating how combinations of height, openness, geometry, visualisation and greenery affect the neuronal state of the brain. This is a clone to support the best mental state of occupants in tall buildings and in highly urbanised contexts (i.e. in the context of any contemporary metropolis where architectural forms are scientifically based on the emotional responses of users).

Recent studies on the influence of environmental features on our evaluation of the aesthetics of a space and on our decision to avoid or approach a space show that we like environments with curved shapes and perceive them as more pleasant (liking). However, compared to spaces with straight lines, these spaces do not lead to a decision to approach them (wanting) proving that aesthetic judgement and behavioural decisions are managed by different brain mechanisms. Therefore, someone may like Art Nouveau, but he or she does not necessarily want to live there because the space does not have a calming effect.

Similarly, rooms that are more beautiful but don't inspire the desire to enter them are more likely to do so than rooms with lower ceilings which offer more protection: A recent test showed that 85% of people prefer bedrooms with low ceilings as they are perceived as protective.

Another crucial feature for human well-being is the geometry of the room. This is a fundamental aspect of pergola design: straight and symmetrical rooms are considered more efficient, functional and calming, while curved lines and asymmetrical rooms are more beautiful but less calming.

EEG data also show that brain activity is decisive in the first two seconds in which a space is perceived. Only after this initial exploration phase, which is controlled by the holistic processing of the right hemisphere, does the brain focus on certain elements that are recognised and processed by the left hemisphere. In short, the cerebral perception of the environment is built on a



"geometric module" that is reworked on the right side and reacts to the general shape of the environment. It is able to guide us in navigating space, independently of the non-geometric signals present in the environment and read by the left hemisphere.

#### GEOMETRIC MODULES IN PERGOLAS

We know from numerous animal experiments (rats, fish, insects) that brains are geometrically structured in a similar way to human brains and perceive the general shape of an environment and guide us in navigating this space. On an evolutionary level, this evidence can be explained by trees, for example.

Although they can change their colours or shapes from one season to another, the reciprocal spatial relationships of trees remain the same throughout the seasons (geometric signs) and allow animals to orient themselves correctly in the environment.

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**Natural light and green spaces: a recipe for well-being.** The theory of restoring attention (Basu, Duva ll, Kaplan 2019) suggests how contact with the natural elements has a positive effect on reducing stress and mental fatigue: hospital patients who have a window with a view of green spaces recover better and take fewer painkillers. This evidence illustrates the phenomenon of biophilia, whereby humans have an innate need to connect with nature – a connection that is primarily activated by visual perceptions, which provide around 83% of the information from the environment in which we live.

#### THE OUTDOORS: A MARRIAGE BETWEEN EMOTIONS AND REASON

Only outdoor architecture and open-air culture can bring together *liking* and *wanting*, what we perceive as beautiful and what we find most calming, functional and ergonomic. And why? A crucial aspect of how pleasant a space feels is how included or welcome we feel in it. Perceived inclusion is the degree of motor

and perceptual possibilities of a space, that is, how freely we can move and how easy it is to control the surrounding living space with our eyes.

A pergola offers just that: opening and protection, spatial geometry and the ability to move freely from indoors to outdoors: pergolas adhere strictly to the Habitat and Prospect-refuge Theory, according to which the aesthetic pleasure generated by an environment lies in the fact that the space is perceived as satisfying and reassuring in relation to our primary needs. This, in turn, is the visual range that, in evolutionary terms, enables survival, i.e. allows the individual to see in the distance, hide, recognise threats and possibly decide to approach or not. Humans do not change, and architecture resembles them more and more.

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**The four guidelines.** 1. The shallowness of an environment is the aspect that produces the avoidance behaviour (*not wanting*); 2. The closedness of an environment is the characteristic that produces the most disagreeable judgement (*not liking*); 3. The openness of an environment is the characteristic that produces the most agreeable (*liking*) and the approach judgement (*wanting*); 4. The height of an environment is the characteristic that produces both the agreeable (*liking*) and the approach judgement (*wanting*).

#### NEURO-PERGOLAS, PRATICMIND

Given this evolutionary framework, it is clear that the brain prefers architectural spaces – such as those of pergolas – that favour protective inclusion, perspective vision and geometric arrangement. A more or less open or closed space with a ceiling that provides protective inclusion but not a great vantage point nevertheless evokes a sense of occlusion (a discomfort for the right hemisphere of the brain). In contrast, open-air architecture offers a great view and a protective enclosure, creating a

sense of well-being for both the left and right hemispheres of the brain.

They are also geometrically calming and provide a sense of solidity.

A pergola with a retractable roof is therefore the ideal solution for all–round well-being – it encloses but is visually open. Crucial to the shape of the pergola is that it can close outwards to protect from both the sun and the elements, promoting a harmonious transition between indoors and outdoors and balancing the lateralisation of the brain. On the one hand, the right hemisphere of the brain (holistic view of the landscape, geometric modularity, spatial orientation, tasting in terms of pleasure or *liking*), on the other hand, the left hemisphere of the brain (focal and close-up vision of the pergola, functional perception of the pergola, functional perception of a reassuring space, appreciation in the sense of approach or *wanting*).

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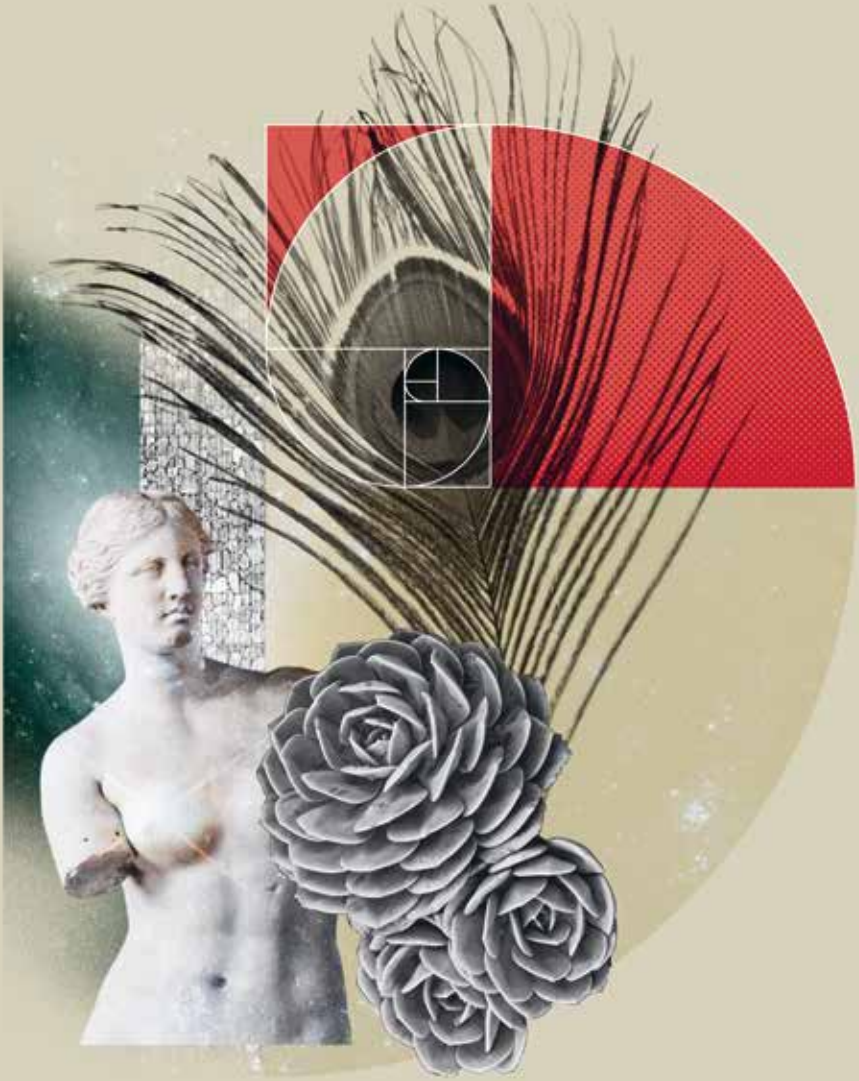
**Pratic: comfort and wellness.** The structure of the pergola creates a geometric space that is open to the outdoors but clearly defined and protective. It filters light, offering the protection of an indoor space while remaining firmly anchored to the outdoor world and the prototypical green culture: light, ventilation and temperature are now also available in Pratic's pergolas thanks to an advanced design centred on human needs.

# Beauty &Brain



## THE BEAUTY BOOM

Today, everyone seems to be interested in beauty, from neuroscientists to psychologists, from architects to stylists and bloggers: around 20,000 scientific articles on beauty have been published since 1970, 13,000 of them in the last decade alone. Why the beauty boom? With an ever-expanding beauty industry and a growing interest in self-expression on social media, the role that beauty plays in global society is now undisputed. While neuroscientists have recognised the biological basis of beauty, the idea of aesthetic excellence has been discussed for centuries without detailed reference to biology or human psychology.

For Greek classicism, the idea of beauty was a broad concept that also included the concept of "good" and could be applied to architecture, sculpture or the human body as well as to the laws of a city and politics in general. Beauty was synonymous with harmony, symmetry, order, proportion between parts, the appropriateness and suitability of things for their purpose.

In each case, beauty was a quality of the perceived objects, not a subjective reaction to them. Much has been achieved since then.

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**Beauty and good.** The Greek classicism defined the concept of beauty as indistinguishable from that of moral righteousness, summarised in the famous formula "Καλος και αγαθος" (beautiful and good), according to which aesthetic value is the paraphrase of a social value. Beauty, strength, honour and courage are the fundamental qualities of both the Homeric hero and sculptures such as

the Discobolus (455 BC), in which Myron represents both the physical torsion at the climax of the action and a carefree serenity etched on the athlete's face. For the ancient Greeks, then, beauty is a value that radiates in space and time and is capable of transfiguring those who are touched by it.

### I LIKE IT, I DON'T LIKE IT

Experimental psychology and neuroscience have shown that people attribute a positive aesthetic value to forms that are not too far removed from a "prototype" already stored in collective and individual memory. Aesthetic pleasure would therefore arise from the more or less partial correspondence of a natural or design object, a painting or a piece of music with an "average" model that already exists in our mental database: elements such as familiarity, the repetition of familiar gestures, the fulfilment of expectations in daily life according to a comfortable routine would provide each individual with those confirmations and certainties that are indistinguishable from the concept of pleasure, while the category of "ugly" would encompass anything strange, bizarre or unfamiliar.

Becoming familiar with something reinforces positive associations and creates mnemonic links that reduce uncertainty in aesthetic judgement.

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**The role of the hippocampus.** When it comes to beauty, the hippocampus shows increased activity: the hippocampus is an extensive archive, the part of the brain in which a visual comparison is made with data that has previously been collected, stored and categorised as correct and appealing. Why does this happen? Neuroscientists have recently discovered that subjects confronted with objects that are generally considered beautiful show increased activation of the visual areas in the lateral occipital cortex (LOC) and inferior temporal lobe (LTI), which respond less to the shape of the objects than to a greater regularity of the perceived morphological features.

## DARWIN AND BEAUTY

In the second half of the 19th century, the biologist and naturalist Charles Darwin offered a completely different explanation for beauty, linking it to sexual attraction: for the author of The Origin of Species, the "beautiful" individual is above all a promise of biological fitness and physical strength.

Beautymeans being healthy and efficient and guaranteeing the survival of the species because it can adapt to the environment. In this sense, beauty is a necessary male attribute for Darwin, while women merely react to the aesthetic signals of men and decipher their complex, seductive semiotics. Darwin and the neo-Darwinists give two different explanations for aesthetic perception.

The first theory states that beauty (e.g. the feathers of the mighty peacock) is a handicap, but precisely for this reason it is proof of a 'healthy and robust physical constitution": enduring such a handicap is in itself indirect proof of health and ensures the survival of the species. According to this theory, aesthetic taste, pleasure and beauty are linked to the notion of waste and uselessness, which explains the phenomenon of conspicuous expenditure in courtship, even by men (e.g. engagement rings).

According to the second theory, beauty is a direct indicator of a "healthy and robust physical constitution'. In women, for example, a certain waist-to-hip ratio or a face with particularly feminine and youthful features (the so-called babyishness of the face) indicate youth and therefore high fertility.

## NEURO-AESTHETICS

The idea of linking the concept of beauty to the biological roots of man began with Darwin, but it is only in the last thirty

years that neuroaesthetics has gained scientific dignity, in the certainty that no aesthetic theory can be verifiable and complete without a profound knowledge of the role of the brain. Is beauty a brain-based matter?

Indian neuroscientist Vilayanur S. Ramachandran has recently theorised that art and aesthetic activities in general entail certain enduring demands and that these demands respond to the functional properties of the brain. There are nine principles that our brain perceive as beautiful: (1) Grouping; (2) Apex shift; (3) Contrast (4); Isolation (5); Perceptual problem solving (6); Rejection of randomness; (7) Order; (8) Symmetry; and (9) Metaphor.

In this sense, beauty is a tool to see things better, to draw our attention to them and to remember them better: something essential. Let's take an example: the rhymes of a poem are traditionally used as a means of beauty because they give the words a rhythm that everyday language does not have, and we get used to expecting elements of identity (the rhymes). With what consequence? When we perceive something orderly, symmetrical or rhythmic, our system of expectations is confirmed. But we know that when something confirms our system of expectation, the confirmation sets dopamine into circulation / dopamine envelops us with its neurochemical warmth and we experience a strong feeling of pleasure / pleasure makes what we perceive beautiful. A closed and infallible cycle.

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**Beauty from the point of view… of rats.** Numerous tests on animal behaviour, particularly rats and pigeons, have shown that by rewarding correct responses with food, animals tend to prefer the strongest and most conspicuous stimulus (neuroscientists use the term "salient"), and even when this relevant input is presented together with other stimuli where the same property appears to be less pronounced, the animals respond more intensely to the strong and salient input. in this context, a very curious behaviour has been observed in rats: a rat was presented with two visual elements, one square and one rectangular; each time it approached the first, nothing happened, while it was rewarded

with food when it approached the second. After a dozen trials, the rat learnt that choosing the rectangle led to food. Nothing new so far: it is the same mechanism as Pavlov's dogs. What makes this test particularly interesting is the next step: the rat was presented with the same rectangular object and another object that was no longer square, but even more rectangular (larger and with better contours). One might have expected the rat to continue to go towards the object that it had learned would give it cheese, but instead it went towards the second one, because it recognised the salient feature of the first object and saw it reinforced in the second, triggering an even greater finalist interest: once it had learned that "rectangular" meant "I get food", the more pronounced the rectangularity, the better.

#### THE PRIVILEGED TERRITORY OF BEAUTY: THE FACE

Does beauty coincide with a particularly strong stimulus, i.e. with what neuroscientists call "perceptual salience"? Ramachandran argues that some artistic movements have implemented these principles, such as Cubism: Pablo Picasso or Henry Moore, in their respective fields of painting and sculpture, have managed to deeply connect their work with the "figurative principles" of our neuro-perceptual grammar, as abstract art consists of "ultra-stimuli" that excite the neurons in the visual areas with particular intensity.

But what do these scientific findings have to do with beauty? It all began in 1820 with the discovery of the Venus de Milo, an outstanding example of a highly realistic statue embodying human aesthetic perfection, in which a striking facial asymmetry causes the central line of the face to be slightly off-centre.

The observation of this anomaly led the anatomist Christoph Hasse to conduct the first empirical study on the lateralisation of the human face and the elements that make it "beautiful" in 1886. When comparing photographs of the face of Venus with those of several real people, Hasse discovered that similar asym-

metries occur almost everywhere: In particular, Venus' left eye is closer to her nose than the right.

The anatomist hypothesised that the wider left side of the forehead is the result of a larger left hemisphere of the brain, which is larger because it controls right-handedness, which is almost dominant in the world population.

Based on these findings, the psychiatrist Julius Hallervorden developed the mirror technique for facial asymmetries in 1902, which is still used today: An impression is made of each photographed face and the image is then cut in half and mirrored.

In this way, two new and different faces are obtained: one consisting only of the left half of the face, which is also doubled on the right side, and another consisting only of the right half of the face, which is also doubled on the left side. The left face is the more expressive one, because the area where emotions are decoded in relation to faces is located in the right hemisphere and therefore everything is recognised on the left side. And not only that. We now know that facial asymmetries are a common feature of the world population, with 74% of asymmetries occurring in the lower part of the face and only 5% in the upper part.

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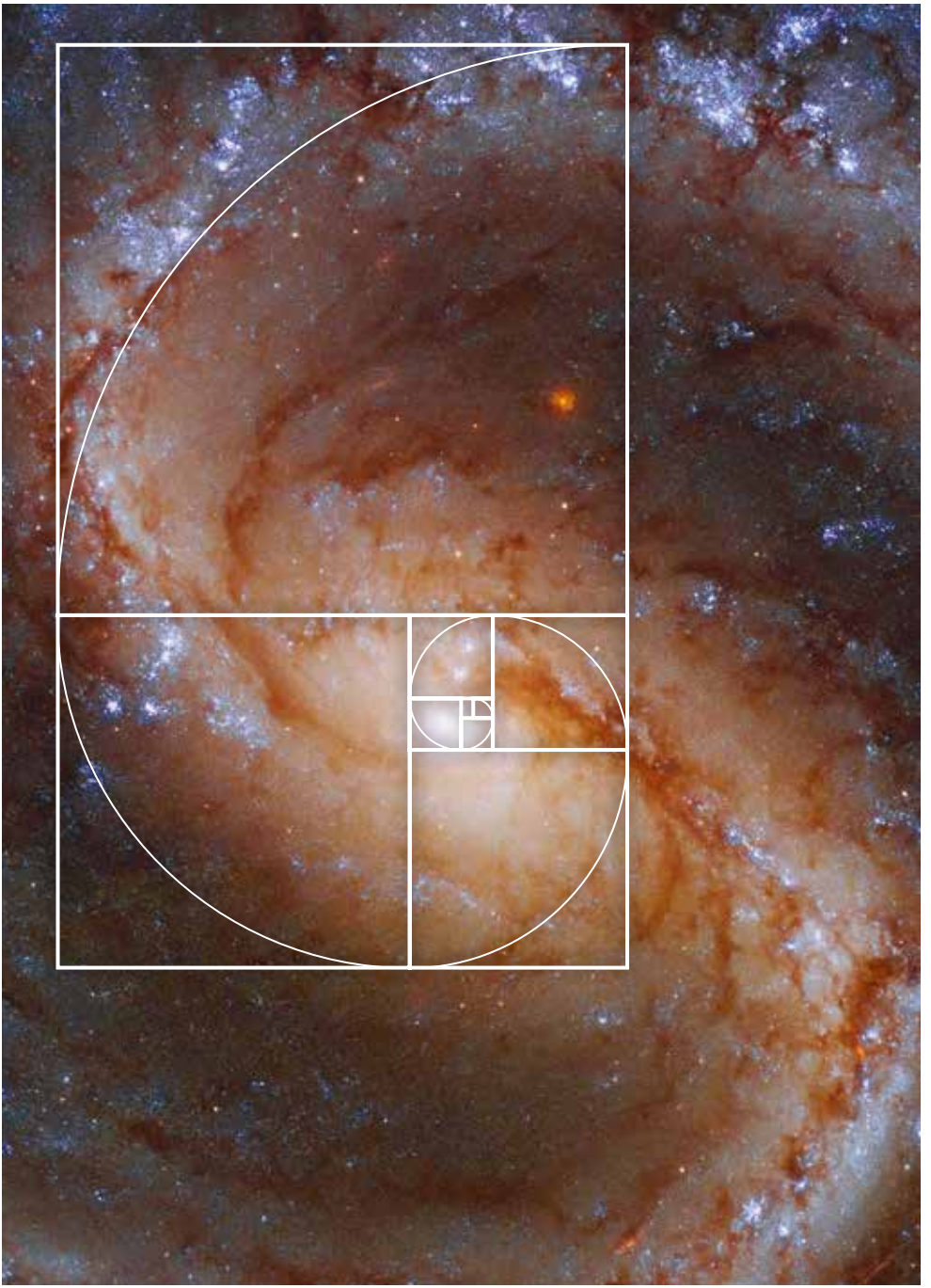
**Beauty and emotions.** Men and women (but the latter more than the former) tend to show the left side of the face, which is explained by the right hemispheric specialisation for processing facial emotions. A tachistoscopic test (i.e. fast and timed reading of words) revealed a clear advantage of the left visual field in emotion recognition, indicating a greater right-hemispheric sensitivity to emotions, from which it follows that the left side of the face expresses emotions more intensely than the right side. A person who wishes to express a stronger emotion may therefore unconsciously choose to do so in a way that allows more emotional information to be processed, i.e. by showing the more expressive side, the left one, decoded by the right hemisphere, which is responsible for emotional processing. Further confirmation of this hypothesis comes from behavioural research: when people are asked to pose in an emotional and a non-emotional (formal) context, in the first case they show the left side of their face to the camera, while in the second case they unconsciously expose the right side.



That beauty coincides with a higher emotional coefficient is demonstrated by the famous canon of ideal beauty, the so-called Golden Ratio, a geometric and figurative application to many natural forms of the Golden Number, i.e. an irrational number that never ends and is approximately equal to 1.6180339887. Please note that the golden ratio is not the result of a mathematical calculation performed by human beings, but a natural phenomenon that is constantly observed in the reality of the environment and that humans has always tried to imitate as a standard of perfection.

The first to theorise about the Golden Ratio was the Greek mathematician Euclid around 323 B.C. But the intuition of its presence is documented in the earliest visual representations of humans, so we can assume that the Golden Ratio was first recorded and then stored by the human brain as a combination of proportions that characterises things that are pleasing and beautiful: unlike many other aesthetic parameters, the Golden Ratio is not subject to change due to changing environmental conditions, as it is spread all over the world and is not altered by a specific context. It is reasonable to believe that the formation of neural connections, which never atrophy and are therefore genetically acquired, enables the learning and reproduction of proportions that evoke satisfying sensations. Thus, symmetry (correspondence between dimensions) and eurythmy (harmony between volumes) form the canon of aesthetic expression of the Greek-Roman period, together with a golden mechanism based, however, on irregularity, i.e. on a slight deviation from the mathematical average that characterises everything that is considered beautiful.

It is as if exaggerated symmetry gives an impression of death, while small visual disturbances convey the feeling of pulsating life.

Significantly, even in the contemporary design of living spaces, the Golden Ratio is also extremely effective in the design when it comes to creating small interior spaces such as terraces, courtyards or pergolas.

Such environments serve many purposes – as they can be adapted to different situations related to work, family and public life – but it is precisely the Golden Ratio that makes it possible to optimise the relationship between the covered spaces (inside) and the outdoor landscape (outside), as in this spatial organisation the living/working space extends outdoors while maintaining the need for privacy and usability.

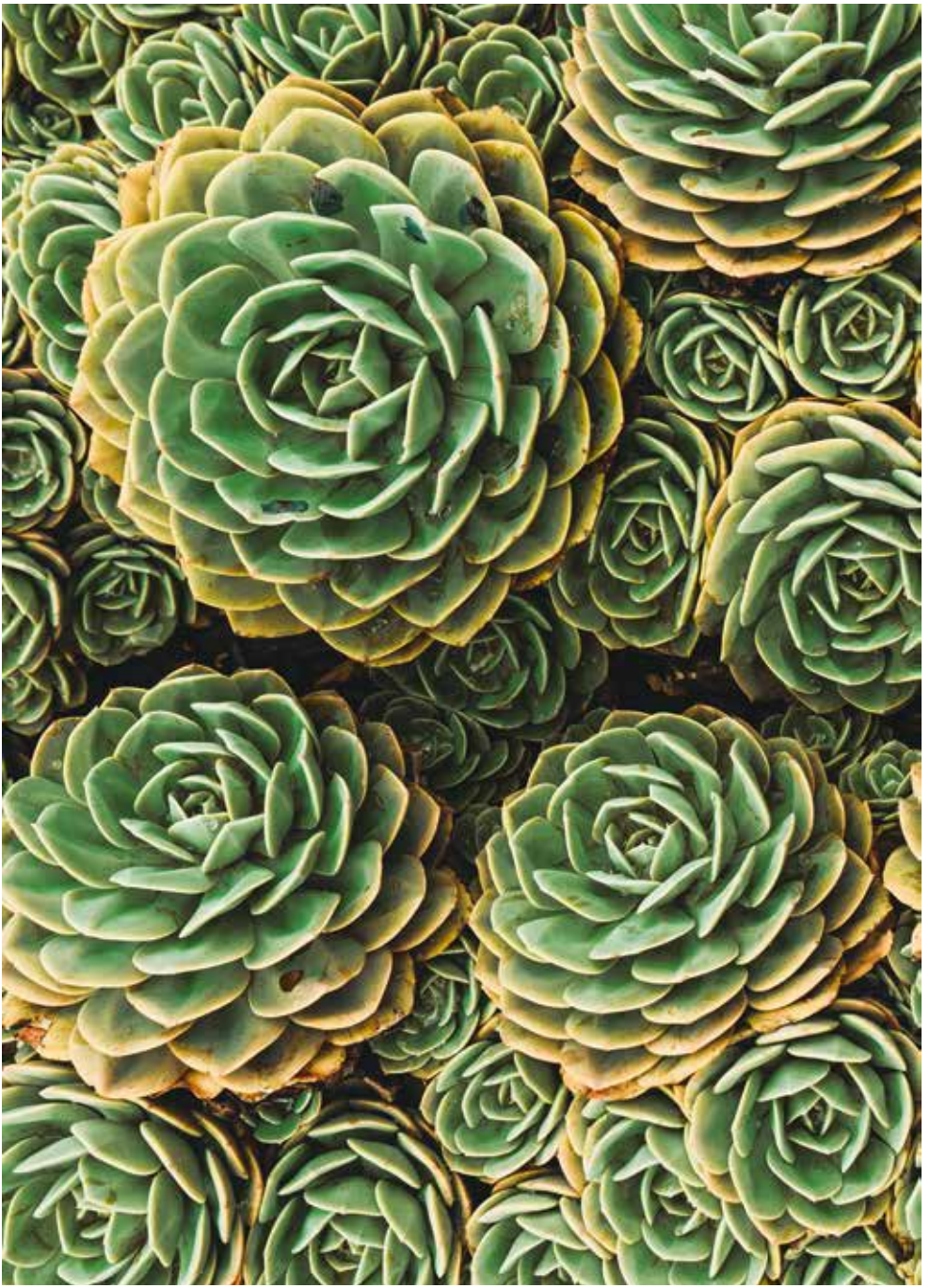
### ARCHITECTURE AND BEAUTY

Beauty is an integral aspect of the way people respond to reality, and the world of design is an excellent incubator for aesthetic devices. One of the greatest challenges in architecture and consumer product design today is to create buildings in which aesthetic qualities such as beauty or elegance go hand in hand with functional qualities such as accessibility, stability and practicality. The aesthetic qualities of architecture, such as ceiling height, openness to the outside and the curvature of the interior, have an impact on people's emotions, cognitive functions, decisions and behaviour. Today, the beauty of buildings and design products is seen as a specific indicator of "quality", as in the case of good and beautiful (Καλος και αγαθος) in Greek Classicism. However, this was not always the case. While for Vitruvius beauty (*venustas*) was one of the three fundamental dimensions of architectural design, alongside stability (*firmitas*) and functionality (*utilitas*), the 20th century has seen a significant reduction in the aesthetic dimension of the man-made environment: modern building science has focused

more on improving utilitarian measures such as fire safety, construction costs and ergonomic use of space. Advances in material design and construction technology have led to the construction of buildings that are taller and stronger than ever before, so that the minimalist and reductionist form derived from this philosophy embodied a new aesthetic ideal: architectural beauty was understood as a negligible element of functionalist design and *venustas* was absorbed – in Vitruvius' sense – by *utilitas*. It is only in recent decades that interest in the aesthetic experience of architectural artefacts has increased, at least since neuroscience revealed the impact of this factor on our mood, our cognitive activities, our behaviour and even our mental health.

### "ORGANISED COMPLEXITY" IS ALWAYS BEAUTIFUL

While the entire twentieth century was dedicated to a general aesthetic simplification, Christopher Alexander, an Austrian architect living in the USA, recognised complexity as the only way to achieve beauty in architecture. The shortcomings and deficiencies of much of the contemporary world, in Alexander's view, are due to oversimplification, an underestimation of interrelationships, an incorrect consideration of the relationships between parts and the whole, and an overvaluation of function over pleasure. Beauty, on the other hand, requires so-called organised complexity, which involves non-linear and non-random interactions between different variables, dynamic developments and emergent properties. The organised complexity of architecture conveys an innate intelligence distributed through a territorial network, redundant information, deep knowledge of variables such as local geography, weather patterns, diverse cultural needs and economic



calculation in the use of local materials. Take, for example, a disposable object like an elegant roadside bench that you can only sit on: It does not transcend this narrow boundary. On the contrary, a low and wide wall could function in several sub-areas, e.g. to protect a tulip bed, allow elderly people to sit in the sun, encourage a child to (pretend to) walk over a dangerous edge or mark a boundary for neighbourhood gangs.

#### THE ROLE OF EMOTIONS AND THE SOCIAL CONTEXT

Recent studies have found that the interiors of curved buildings are perceived as more beautiful and pleasant than those of rectilinear buildings, as the beauty ratings of curved spaces correlate with increased activation of the ACC (the anterior cingulate cortex, the centre of our aesthetic "sixth sense"), which is directly linked to dopamine production and feelings of pleasure. An oppressive environment, on the other hand, leads to a strong release of stress hormones, which can even have a negative impact on health. From this, one could conclude that a clever interpretation of interior design that aims to create a sense of beauty positively influences psychological functioning, learning, social behaviour and emotional well-being.

The structural elements of traditional architecture include a variety of open and semi-open spaces (central courtyard, veranda, pergola, balcony, winter garden, etc.) that meet the needs of the residents of an urban complex for social interaction, privacy and other values. These are precisely the needs that contemporary architecture has almost forgotten.

### THE PRINCIPLE OF MAXIMUM EFFECT WITH MINIMUM EFFORT

It is well known that humans like to invest a minimum of effort, resources and cognitive abilities in order to achieve the greatest possible effect, be it in terms of survival, reproduction, learning or understanding. Similarly, a visual model is appealing to the eye when seemingly simple design features reveal a high level of information, as in caricatures or Impressionist paintings. If we apply this principle to the field of design, we can look at the Dominus Winery in Silicon Valley, for example, designed by Swiss architects Herzog & de Meuron with the intention of adapting the building to the Californian landscape with its rocky hills.

The result is a huge, cage-like pergola covered with stones from the surrounding area.

This simple solution produces a number of effects: The adaptation is immediate, the construction is economical and solid, the thick walls ensure a cool and constant temperature inside without preventing the sun's rays from penetrating through the walls and creating a charming game of light. A result of high aesthetic quality.

### THE PRINCIPLE OF UNITY IN VARIETY

The world around us is overloaded with information and we cannot simply select the first source that comes our way. It is therefore useful to establish relationships in order to understand what belongs to a whole and what does not, to distinguish order from chaos or unity from diversity. The last process in particular represents a very old aesthetic principle, already theorised by the Greeks and whose evolutionary and neurophysiological basis has only recently been discovered by Ramachandran, because we tend to see things that are close to each other or seem to be

adjacent "as if" they belonged to the same whole. This perceptual tendency to group and relate things that are spatially close but separate plays a crucial role in human life because it allows us to recognise significant objects or groups – e.g. a dangerous predator such as a tiger partially hiding behind a tree – and gives us the comfortable feeling of being in control of the situation. Like grouping, other unifying mechanisms discovered by Gestalt psychologists perform the same function, such as symmetry and cohesiveness, which can produce satisfying sensations of "beauty", as when listening to a piece of music, where pleasure is generated by the organisation of regularity through rhythm, harmony and tone sequences.

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**The formal laws of beauty.** Other aesthetic formats discovered by Ramachandran can be explained by the same adaptive function, namely the need to perceive something clearly in very different contexts. Let's look at some examples: when something is very striking (fluorescent colours or very strong features), the brain tends to see it immediately and neglects the rest (principle of "peak shifting"); when something is isolated from other objects, like in an art gallery where a statue has an empty space around it, the brain immediately focuses on it and concentrates; when something is in stark contrast to what surrounds it – like a red flower on a white background – the brain tends to believe that only this flower exists and nothing else.

#### THE PRINCIPLE OF "MOST ADVANCED, YET ACCEPTABLE"

As we have seen, one of the most established aesthetic theories is the theory of prototype preference, according to which we favour the most typical examples of a class of elements, i.e. those that are most familiar to us. At the same time, people are attracted to novelty, strangeness and originality, but this second preference also proves to be adaptive, especially for children, as novelty attracts attention and thus promotes learning. Since the two characteristics of typicality and novelty seem to be incom-

patible, a number of studies have investigated their joint effects on aesthetic preferences and found a great deal of empirical evidence in favour of the MAYA principle (*Most Advanced, Yet Acceptable*). The acronym is an invention of the famous American designer Raymond Loewy, who also created the Coca-Cola brand, and means the following: it is always preferable to incorporate an element of novelty into a design while preserving its typicality, as we tend to favour elements with an optimal combination of both aspects.

A good example of MAYA in the musical field is the remixing of covers and evergreens, such as blending the familiarity of an old melody with its rhythmic readaptation; but similar blends of familiarity and originality in a coherent and cross-cultural way can also be found in olfactory and gustatory perception (as in a traditional Milanese risotto with an added oriental spice).

#### THE PRINCIPLE OF OPTIMAL MATCHING

This last principle concerns the relationship between the different sensory channels and their cognitive effects, because we live in an environment where everything is perceived with the five senses, e.g. when we drive a car and see the dashboard, smell the leather interior, hear the ticking of the indicators and touch the steering wheel. If associating a subject with a sensory aspect is a non-aesthetic attribution process, judging whether these associations are congruent is clearly an aesthetic process, as our brain activates a reward system when the subjects match, while it is not activated when they are not compatible. This kind of reaction is reminiscent of the formulation of the father of modern architecture Louis Sullivan, according to whom "form follows function" or again "sound/feel/smell follow function", where "function" is not to be understood as something useful,

but as an experiential phenomenon such as pleasure or consolidation of one's identity. Similar experiences are nowadays crucial for the purchasing decisions of individuals with regard to the primary utility function, which is why attempts are being made to make the sensory messages congruent with the overall experience.

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**The effects of the cultural context.** The four principles of architectural beauty outlined so far explain the aesthetic taste of the individual, although there may be differences depending on how a culture interprets the universal mechanisms of the mind: aesthetic responses, like cognitive processes, result from the interaction between individuals and their environment. Of course, it is possible to find examples in real life of objects perceived as aesthetic that do not follow any of the principles described here, and indeed some cultural manifestations may even reflect the exact opposite of what a certain principle would require: very luxurious ornaments and jewellery that we encounter in churches around the world, for example, can be seen as contradicting the principle of "maximum effect with minimum effort", but however ubiquitous such manifestations may be, they do not undermine the universal validity of these principles, which are rooted in the millennia-old life of *Homo sapiens*.

# My Dream House

## PHILOSOPHY OF HOME LIVING

To establish a residence, to exist, to own a house: The Latin verb *habitare* encompasses a range of nuanced meanings leading to the fulfillment of an intimate process of connecting with reality, shaping individual identity, and taking on the role of property owners. Therefore, the noun derived from it – *habitus* – means that which encloses us, an inner state, a collection of repeated actions (specifically, a "habit"). To stay, manifest, find one's identity, and establish a personal connection are the core meanings embodied by the home concept. Rather than simply referring to a piece of real estate, the idea of "home" represents the privileged space of memories and individual identity. According to the French philosopher Gaston Bachelard, everything that defines us publicly would be showcased in the living room, while our deepest and most intimate desires would reside in the basement (the subconscious of the home), and the memories of our childhood would be stored in the attic like veritable personal journals wrapped in the dust of time. In essence, homes fulfill the complex and essential role of a protective shell that can hold and safeguard our lives from disappearing into oblivion.

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**Home – house.** A dwelling symbolizes the personal appropriation through which individuals endeavor to meet the deep-seated need to exist and find self-recognition. The English language has fully embraced this distinction with two words that express the concept of "a dwelling" from different perspec-

tives: In English, the term "home" means a place where we reside in the world to establish our own identity (my place, mi casa, summoning a sense of familiarity and comfort. On the other hand, "house" refers to an impersonal dwelling structure, a building, or a real estate unit (someone else's house, tu casa).

#### OUR HOMES ARE OUR BODIES

Our bodies are not simply located in space; they inhabit it becoming organically intertwined with our life experiences. This is why each real estate property is assigned a distinct purpose and semantic label, reflecting the activities we carry out within it, or rather, the significance these activities hold for the body that resides there. For instance, the kitchen – derived from the Latin word *coquere* which encompasses cooking using fire – serves as the designated space for fulfilling our fundamental needs of sustenance and hydration. As the heart of the home and an ancestral place for *Homo sapiens*, the kitchen used to be a purely functional area in the 19th and 20th centuries, separated from other living spaces and often concealed from view. However, in modern times, it has evolved into a room for gathering and socializing, holding a sense of stylish prestige and frequently integrated into the living area through innovative open space layouts.

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**An unprecedented interior designer: Edgar A. Poe.** Only now do we truly appreciate the insights of the American writer Edgar A. Poe (1809-1849), renowned for his mastery of horror tales. In his remarkable and forward-thinking work, *Philosophy of Furniture*, Poe theorized something that has only recently been fully comprehended. This realization comes after a long period in the 18th and 19th centuries when interior spaces were fragmented into functional and ergonomic classifications. Poe proposed that a dwelling should be designed based on the emotions evoked by the furniture within it. By revisiting not only his "theoretical" text as an impromptu interior designer but also his tale Ligeia, it is possible to grasp how furniture becomes a theatrical backdrop for Poe. In this immersive space, one can experience specific emotions and uncover the value of shadows untouched by light. Dark glass, selectively illuminating only

the gilded details, creates an atmosphere where habitability gives way to an "opiate dream" of sorts. In this dusky mist, the solidity of objects dissolves.

### THE EVOLUTIONARY CYCLE OF THE HOME

Beginning with our primordial refuge in the womb, as psychologist Donald W. Winnicott described, the concept of dwelling gradually unfolds through a process of tactile and visual exploration. It evolves into a motor capacity that enables us to acquire knowledge about our environment's fundamental objects. We learn, for example, that a sofa provides a place to rest and is associated with a pleasant experience or that a bed allows us to sleep during the night. A significant shift occurs around the age of twelve, marking the beginning of a progressive detachment from infantile perceptual patterns and the onset of autonomous behavioral exploration. During this time, certain architectural spaces become separate from the rest of the rooms and "off-limits" as the adolescents leave their distinctive identity "imprints" upon them. Consider, for instance, the significance of the bedroom, a space representing freedom and where the concept of privacy first emerges. The previous strong desire to feel held and protected within the family group is gradually replaced by the need for exploratory experiences in new spaces and the ability to engage in intimate actions.

In adulthood, the domestic environment finally solidifies as an authentic nurturing ground for our identity. According to Carl Gustav Jung, this stage of life assigns an important symbolic value to the image of the house, intertwining the longing for the protective "shell" of childhood with an individual strategy. During this phase, our dwelling transforms into an intricate web of relationships, aspirations, and future directions. It becomes a personalized home that perfectly aligns with our true selves.

**The game of hide-and-seek.** In early childhood, we grasp the crucial topological distinction between inside and outside, the ability to differentiate an enclosed, protected, and familiar space with its own rules from the vast, unknown, and potentially dangerous realm outside. The concepts of being inside (being accepted) and being outside (being excluded) serve as metaphors for this fundamental distinction, shedding light on the global and enduring appeal of the game of hide-and-seek. In childhood, it ignites a desire to enter or exit from large boxes, closets, or treehouses—places that inherently provide a feeling of protection and seclusion.

**The *Prospect-refuge Theory*.** The *Prospect-refuge Theory*, proposed by the geographer Jay Appleton in 1975, aligns with the psychological mechanisms that shape our perception of space. According to this theory, individuals, influenced by their ancestral memory, consciously select living environments based on two key factors: the ability to observe their surroundings (prospect) while remaining unseen (refuge). Throughout evolution, our species is thought to have developed specific inclinations towards a vast and unhindered visual outlook on the environment. At the same time, there exists a simultaneous desire to discreetly observe the surrounding setting without being detected in return. This is why individuals prefer placing themselves on the outskirts of a room rather than the central area. They have a fondness for spaces with ceilings and coverings, as opposed to entirely open areas, and they instinctively gravitate towards locations that allow them to observe the surroundings from an elevated perspective. The design of pergolas and outdoor spaces in modern times caters to these primal needs by creating a geometric setting open to the environment yet well-defined and protective. It effectively filters light, providing a sense of shelter equivalent to that of an indoor environment, all while remaining connected to the outdoors and the inherent symbolism of nature.

#### CONVEX LINES MAKE US HAPPY

According to the latest findings in environmental psychology, both natural surroundings and constructed environments can shape our emotions and behaviors. It is intriguing to note that individuals, as a result of their experiences in specific locations, gradually develop distinct psychological associations, leading them to perceive specific settings as either pleasant

or unpleasant. When we reconstruct a place mentally, such as our home, and delve into its meaning, our reliance on memory becomes crucial. Specifically, we draw upon the stored patterns in our autobiographical reservoir, which assist us in envisioning potential micro-scenes that could unfold within that particular space. This intricate process entails a gradual cognitive comparison between our current perceptions and past experiences and locations we have previously visited. It is not a coincidence that the ability to comprehend space from an allocentric perspective, where we can view it through someone else's eyes and maintain an "objective" representation, tends to develop around the age of eight. Before this milestone, our vision remains egocentric, whereby objects and surroundings appear different depending on the position from which we observe them.

Nevertheless, the brain functions autonomously and presents us with its own interpretations, particularly regarding the outlines and silhouettes of objects. According to a recent exploratory study by psychologists, individuals have an inherent inclination towards materials with rounded and convex contours, triggering a positive response. This inclination can be traced back to the evolutionary history of *Homo sapiens*. On the one hand, our perception of convex shapes aligns with the morphological principles observed in living cells. On the other hand, the amygdala, responsible for the emotional processing of events, tends to perceive broken, angular, and concave lines as signals of danger or hostility.

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**The neuro-cognitive role of boundaries.** Boundaries are crucial to understanding residential space, and they encompass various elements such as walls, doors, color areas, and more, delineating and defining different spaces. Without this segmentation, there would be a lack of meaning and emotional context that distinguishes a "home" from a mere "house." We often adopt specific rules to establish a sense of order and permanence within domestic functional areas. For instance, a particular person always occupies the right side of the table, or a specific individual consistently sleeps on the left side of

the bed. These rules stem from recognizing that the implicit spatial segmentation of living areas plays a fundamental role in shaping our perceptual and cognitive processes. It provides us with a sense of predictability in our own behaviors and the behaviors of others. However, Alzheimer's disease disrupts this segmental understanding of spaces, making them indistinguishable for those affected.

#### GREEN!

The role of the green dimension is equally undeniable, as environments with pristine natural features are perceived as more pleasant by their inhabitants. In 1984, the world's most authoritative scientific journal, Science, published the first research providing empirical evidence of the beneficial relationship between nature exposure and human health improvements. In the same year, American sociobiologist Edward O. Wilson put forth the concept of "biophilia," which refers to our innate tendency to focus on living beings and anything that reminds us of them. This activates a mechanism of emotional connection. Wilson believed that biophilic thought is deeply rooted in the ancestral memory of *Homo sapiens* and is the result of adaptations over millennia to ensure survival.

Since then, numerous studies have aimed to investigate the correlation between exposure to natural environments, often referred to as "green settings," and the enhancement of psychophysical well-being. Research in the early 21st century has demonstrated that residential areas surrounded by greenery are less likely to exhibit antisocial behaviors. Moreover, children with attention disorders have significantly reduced behavioral symptoms when exposed to these environments.

Nature offers a valuable opportunity for prosocial interactions as its restorative qualities enable individuals to replenish and preserve their psychological well-being. This hypothesis is

reinforced by the principles of the *Attention Restoration Theory* developed by American psychologists Rachel and Stephen Kaplan. According to their theory, stressors can result in cognitive overload, effectively alleviated only by natural elements. Consequently, incorporating micro-gardens on balconies, planting trees and hedges in parking lots, and creating gardens in the inner courtyards of residential buildings are crucial strategies that align with our perceptual system's functionality and promote well-being.

#### HOW CHILDREN INTERPRET SPACE

Being able to locate oneself and objects in space and mentally map and graphically replicate living spaces are all adaptive behaviors that develop gradually throughout one's life. Even at three months old, infants show signs of remembering the position of familiar objects. By age five, children can orient themselves in a setting by using prominent and emotionally distinctive features called landmarks. Through the study of children's drawings, Swiss educator Jean Piaget and American psychologist Rhoda Kellogg were pioneers in demonstrating the developmental stages of spatial understanding during early childhood. They identified three successive stages in this process. In the first stage, which lasts until age three, children are primarily guided by the concepts of "proximity" and "separation" without considering Euclidean geometric relationships. As children reach the age of seven, they enter the stage of intellectual realism (they begin to understand that what they see is influenced by what they already know). This allows them to consider projective relationships between objects. During their primary school years, children expand their mental maps to include not only what they observe but also what should logically be placed within specific

locations. In the phase of visual realism between the ages of eight and nine, children start considering aspects such as perspective, proportions, and measurements. This enables them to grasp the geometric relationships between spatial elements.

Following the egocentric phase, where the representation of space is influenced by the individual's role and position (hence why children initially draw frontal perspectives only, as they are in front of something), the allocentric phase emerges. Around the age of nine, children start considering the "unchangeable" characteristics of the environment regardless of their own position. It is during this phase that *viewer-independent* encoding develops.

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**Drawing serves as an endoscope.** It is essential to acknowledge that during early childhood, we perceive reality and process our desires primarily through visual cues. It is only later that we gradually connect acquired concepts with verbal labels. While images remain pristine, innate, and unaffected by cultural influences, words become "civilized" and subject to the "distortions" of the surrounding environment. This fundamental distinction is why children's drawings, as both neurobiologists and psychologists affirmed, hold a unique truthfulness and convey an ancestral narrative. Recognizing this, the scientific community has recently embraced children's drawings as a powerful tool for revealing their perceived reality. Moreover, drawing is recognized as supporting and enhancing cognitive development. In essence, drawings act as a "magnetic resonance" that allows us to delve into children's minds.

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**The two theories on children's drawing.** According to Henri Luquet, drawing is intricately connected to neuro-cognitive development. It requires children to retrieve sequences of actions and images from their memory and graphically reproduce them based on their similarity to reality. During the phase of intellectual realism that emerges around the age of seven, children tend to replicate elements of reality not solely based on what they visually perceive but by considering things as they are. It is not by chance that at this age, these "young architects" choose to depict the interior of their homes as if the facade were transparent, allowing them to showcase all the constituent elements. On the other hand, according to a psychodynamic perspective, a child who engages in drawing is playing with representations from the mind. The genesis of figurative drawing is not primarily driven by the intention to

represent but rather by a latent cognitive organization that leads children from the age of four to reflect on the movements an object can make rather than its defining characteristics for representation. In essence, a drawn home is not such because of the presence of two windows, a roof, and a door, but rather by the actions that can be performed as seen through a theatrical perspective.

#### DIHEDRAL STRATEGY, CYCLIC STRATEGY

It is remarkable to observe the abundant recurrence of certain elements in children's drawings as if all children had followed a single drawing school. However, this is actually a pre-existing neurocognitive style in the brain. Symmetry plays a significant role in this context, as it involves creating figures by arranging an object's elements correctly with respect to planes, points, and lines. Throughout most of their school years, children rely on a dihedral strategy, which involves mentally simulating a figure by dividing it into two equal parts using a dividing line and replicating the same graphical information on both sides. Only from around the ages of eight to ten do children become capable of selecting a central starting point and reconstructing an object through repeated spatial movements (cyclic strategy). This is why, at the age of six, children often place two symmetrically positioned windows in the central part of a house using an imaginary straight line, while it is only at the age of nine that they begin to consider a single rounded window located in the middle of the roof or attic.

Equally noteworthy is the persistent search during childhood for a physical boundary that distinguishes the external and internal dimensions. When attributing the semantic label "home" to an architectural element, children introduce specific features like doors or windows that allow them to perceive the indoor environment as entirely separate from the outdoor space. They require distinct boundaries to safeguard the concept of

"home" and perceive something as a "shelter." Simultaneously, children experience a cognitive need to define and attribute meaning to space. However, they consider spatial strategies helpful in establishing a meaningful relationship between the home and the natural world. Their interest in the green world and their innate biophilia drive them to develop vital connections between indoor and outdoor environments.

#### AESTHETICS ACCORDING TO CHILDREN AS MINI-ARCHITECTS

Based on an experiment carried out between October 2022 and February 2023 in the provinces of Parma and Reggio Emilia, involving children aged 3 to 14, it has been observed that the architectural preferences of the young generation, which will shape future lifestyles and aesthetic tastes, gravitate towards homes that cater to their personal ambitions, potentially influenced by the rise of remote work due to the Covid pandemic. Simultaneously, they seek homes that fulfill their desire for entertainment, going as far as incorporating gyms and swimming pools within the indoor environment. However, the prominence of natural elements stands out in this future scenario. Large plants are strategically placed near main entrances or along perimeter walls while climbing flowers adorn the entire facade. Consequently, we can say that the dwellings of tomorrow, to be considered genuine homes by today's children, must allow residents to fulfill their individual aspirations. These homes should include dedicated spaces for recreation, separate from the main living areas, and integrate biophilic elements to reduce the accumulated stress from the outside world.

While the future homes are thought out by children with a clear functional division of the areas in question, the intended functions are changing, too. The most innovative dwellings

incorporate areas specifically designed to cater to secondary needs related to pleasure and socializing, thus increasing the overall wellness level. From pools to gyms, these features enhance the residents' well-being. Moreover, there appears to be a growing inclination to fully embrace the presence of pets in the home, almost on an equal footing with human inhabitants. For example, a child envisioned a bathroom with two separate showers, one for her and another for the pets.

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**No distinction between indoor and outdoor.** Most future homes envisioned incorporated architectural strategies to maintain a reciprocal relationship between the indoor and outdoor spaces. Recent studies in developmental psychology demonstrate an inseparable connection between positive emotions and elements of the natural world. Green areas such as courtyards, gardens, parks, and natural landscapes capture children's attention and elicit pleasant emotional responses. These responses, in turn, are associated with improved cognitive performance and prosocial tendencies. Noteworthy is that many children across different schools and age groups have drawn slides that directly connect the first floor of a dwelling with the garden, for example. This creates a genuine link between indoor and outdoor spaces, making them almost interchangeable. Another architectural strategy, driven by considerations related to biophilia, involves designing large windows that allow the inhabitants to continuously benefit from natural light and maintain direct visual contact with nature. In children's drawings, nature is often represented by trees depicted on both sides of the facade.

#### OPEN-AIR CULTURE: A HOME IN THE GARDEN

Gardens had a significant presence in children's literature in the eighteenth and nineteenth centuries, serving various purposes: a place for recreation, *otium*, play, and aesthetic enjoyment. The pleasure of being in a natural setting is an integral part of the developmental repertoire. Since their first years of life, children demonstrate a preference for green environments over urban ones, seeing nature as a space that combines play-

fulness and social interaction. In the imaginative world of children, indoor and outdoor spaces merge to form the architectural concept known as the "home in the garden." It is an open yet sheltered space, surrounded by lush greenery, simultaneously connected to the outside world, and dedicated to privacy and contemplation. It becomes a sanctuary for relaxation and a means of escape from the rigid conventions of the adult world.

In the realm of the outdoors, everyday reality seems to dissipate, allowing for the suspension of physical laws. A house in the garden can be depicted as hanging from a tree, defying gravity, or featuring floating stairs and swings without apparent support.

It embodies a fantastical dwelling where temporal boundaries fade away and spatial dimensions become purely symbolic. Even the occupants of this house must navigate spatial obstacles, with the staircase playing a symbolic role as a vital structural element that leads to the dreamlike realm, in contrast to ordinary residential spaces accessed through a door.

The homes in the garden, as envisioned by children, are structures that do not necessarily cater to primary needs, such as eating and sleeping. Instead, they address socio-psychological needs. Spaces dedicated to relaxation and pleasure, such as living rooms and play areas, are integral to their designs. These imaginative houses, depicted in nineteenth-century children's literature, foreshadow the innovative contemporary pergolas used to create versatile and enjoyable outdoor environments.

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**The treehouse.** For children, a treehouse means creating a secluded space that contrasts sharply with the familiar environment of their home. Climbing trees allows them to transcend the laws of the "ground" and imagine extraordinary events, similar to the protagonist in Italo Calvino's "The Baron in the Trees". Children's considerations in building treehouses are intriguing from a perceptual and cognitive perspective. The rules of architectural balance are entirely disregarded, as the house appears on the brink of falling at any moment. However, children rely on "containment" to perceive the structure as integral to the natural element. Thus, treehouses seem to reflect the spatial

preferences of *Homo sapiens*, as the openness and height of a built environment significantly influence the sense of pleasantness (*liking*) and attraction (*wanting*).

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**Loft & open air living.** In addition to treehouses, children envision small-scale built environments in the garden to establish privileged and immersive connections with the natural surroundings. In this scenario, feelings of restoration and pleasure are closely intertwined with a sense of belonging to the green world. For instance, a six-year-old girl designed a "loft" featuring two spacious balconies or pergolas with rounded shapes on either side of the structure. These balconies were encased in large glass windows, allowing for a beneficial connection with the surrounding nature. The loft serves as a retreat, enabling one to detach from social life while simultaneously observing it from a privileged perspective immersed in lush greenery.

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**Tents and huts.** Tents hold a deep, ancestral meaning for children, evoking ancient civilizations. These structures are perceived as intimate spaces providing mental and psychological restoration opportunities. From an architectural standpoint, they are semi-closed design that serves as a "transitional object" seamlessly connecting the realms of the outdoors and indoors. For instance, a six-year-old girl created and positioned a tent in the heart of a flower-filled garden. The tent was carefully divided into multiple themed areas, expanding across two levels. A large orange slide was incorporated to access the outdoor section, serving as a playful link between the indoor play area and the lush green lawn. This design effectively erased the boundaries between indoor and outdoor spaces.

## CONCLUSION

Since ancient times, *Homo sapiens* have recognized the primal need for shelter, embarking on a quest to find a suitable place where they could find refuge and a sense of identity. Fear and desire, the simultaneous urge to protect oneself and assert dominance over the surrounding habitat, have been central to the human experience throughout history. Children have inherited and, in a way, preserved in their memories a yearning for a more livable environment that fosters personal well-being

and safety. The remarkable results of the research carried out by Pratic, involving children from the provinces of Parma and Reggio Emilia in envisioning and drawing the homes and design objects of the future, demonstrate the clarity with which childhood, relatively unburdened by the historical and environmental influences of adults, intuitively grasps what will contribute to our happiness in the present and the future. These include slides that better connect them with the surrounding gardens, dedicated spaces for pets, dwellings designed exclusively for children, treehouses, and even ceilings with transparent surfaces that allow for stargazing. Additionally, they envision anthropomorphic or animal-shaped buildings that closely resemble living beings, design objects that remind them of fruits, and many other imaginative concepts. As depicted in the children's drawings, environmental sustainability is always associated with biophilia —a deep love and connection to life—where materials harmonizing with nature, light, and well-being are essential. When children sketch the homes of the future, they not only envision the future itself but also tap into the realm of the "anterior future": what humanity has always dreamed of before could become a reality, and perhaps even ideas that have never materialized could do so. Instead of merely a house within nature, the children envision the home-nature.

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