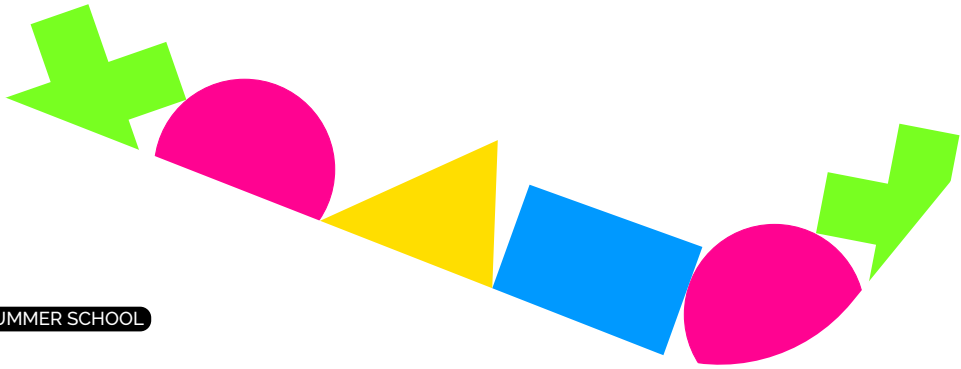


SUMMER SCHOOL

EX MIND

EXTENDED MIND FOR THE DESIGN OF THE HUMAN ENVIRONMENT
September 2ND/7TH 2024
Dd'A - Viale Pindaro, 65126 Pescara PE

This booklet describes and summarizes the work conducted by a research group of the ***University "G.d'Annunzio" of Chieti - Pescara*** *that involves professors and researchers from different fields (neuroscience, architecture, psychology and economy). The research group is so composed of:* *Prof. Lorenzo Pignatti, Prof.ssa Stefania Gruosso, Prof.ssa Luciana Mastrolonardo, PhD Alessandro Bortolotti, PhDc Andrea Di Cinzio, PhDc Giulia Candeloro, PhDc Alice Conti, PhDc Miriam D'Ignazio, togher with Prof. Javier Castellano Pulido (EAM)*

INTRODUCTION

The Department of Architecture of the University G. d'Annunzio, in collaboration with the Department of Neuroscience, Imaging and Clinical Sciences and the Department of Psychology, is organizing a Summer School titled "Extended Mind for the Design of the Human Environment". The task is very ambitious.

For many years the Department of Architecture has organized a series of **Summer School** addressing urban and architectural design issues with a relative traditional approach, relying on the experiences and expertise of architects, urban designers and planners. This year the Summer School aims at opening new directions and addressing new paradigms in **the design of the human environment** by addressing the emotional reactions that users have about spaces and buildings that we design. We try to enter into a field where behavior and emotions become relevant in experiencing the spaces where we live, work and recreate. We are thus addressing issues related to psychotherapy, psychogeography, neuroscience, behavioral sciences and economics, cognitive and social functions in order to introduce new paradigms to the design of the human environment.

In the Summer School we will address specific conditions in the city as we have always done in the previous years. We will be studying a series of sites in Pescara such as a public green corridor, an existing school, an archeological site and an industrial building that is now a cultural space. These are always the objective of our studies, but this time we will be looking at them with a different perspective. Our intention is to create interdisciplinary working groups where different experiences and backgrounds will come together in order to achieve the best results for the creation of livable spaces.
Our approach **will be different**. Normally we were always looking at traffic, functions and buildings within the city and try to put them in relationship and try to resolve possible conflicts. These will remain relevant issues to address, but now we intend to expand our observations and interests to a behavioral sphere.
There will be one moment when students will be doing space-explorations, interviews and documentation of all sorts of aspects (scale, geometry, materials but also smells, colors, light, textures, etc.) that will allow them to create a map of perceptions where they will be surveying and locating the major physical and emotional aspects of their explorations.
There will be a moment when students will create a sort of cosmogramme, as a graphic tool to gather their common visions and perceptions of the environment that start from the personal perceptions and will arrive to a common description of the complexity of the urban environment.
And, at the end, students will synthetize all this in a canvas that will contain a series of possible solutions, as a foundational tool for their design, guiding them in creating spaces that will aim to create behaviors and emotions.

This Summer School will also benefit of a diversified number of universities that will participate. By merging two **Blended Intensive Programs** (BIP) already active in the Department of Architecture together with the proposed **Erasmus Mundus Joint Master Design** (ERASMUS-EDU-2023-EMJM-DESIGN), we were able to put together **15 Universities** coming from **12 different countries** and approximately **180 students** that will work with enthusiasm in Pescara on these issues.

Lorenzo Pignatti

STARTING POINT

For centuries, the nature of the human mind and cognition has captivated philosophers. The **theoretical landscape** has undergone an extraordinary transformation:

- In ancient Greece, thinkers like **Plato** and **Aristotle** pondered the essence of the psyche or soul. Aristotle's De Anima treatise wrestled with defining the psyche's role in enabling perception, reasoning, and living movement.

- **Descartes**' 17th century "I think, therefore I am" marked a crucial dualism between the thinking mind (res cogitans) and the mechanistic material body (res extensa). This interactionist substance dualism became highly influential.

- The **1950s** ushered in the computational era, spawning ideas that the mind operated by manipulating internal symbolic representations, akin to digital computers.

- In the **1980s**, connectionist cognitive models were proposed that mirrored the brain's interconnected neural networks rather than serial digital processing. Researchers explored parallel distributed processing and neural network architectures.

- The **1990s** saw the emergence of embodied and enactive philosophies recognizing cognition as inextricably linked to an organism's lived body and environmental context (Varela, Thompson, Rosch). The embodied mind was seen as inherently situated in a biological, experiential, and cultural world.

- More recently, **Clark** and **Chalmer's** "extended mind" hypothesis and others have radically suggested that cognition intimately involves and may even extend into our skillfully utilized technologies, tools, and artifacts.

- The idea of **4E cognition** also gained ground, uniting the embodied, embedded, enacted, and extended approaches. This view embraces cognition as a process embodied in a living being, embedded in an environment it is inextricably part of, enacted by a whole system, and potentially extended to artifacts and technologies we interact with.

This progression reveals an ever-richer appreciation of cognition as irreducible to mere brain activity. Each phase expands the conceptual lens:

- *from the disembodied mental theater of mind/body dualism..*
- *to computational models overlooking bodily situatedness...*
- *to embodied approaches acknowledging minds as shaped by biological form...*
- *to extended perspectives embracing cognitive coupling with our surroundings and tools.*

Spatial experience is not created by brains alone, but emerges from the **dynamical interplay** of mind, body, and environment. The enactive insight unlocks a new frontier shaping spaces that resonate with how cognitive beings fluidly perceive and relate to their surroundings.

In designing human-centered spaces for the future, we have an opportunity to craft holistic cognitive experiences, uniting brain science with philosophy's long quest to locate the loci of mind within lived worlds. *Embodied, situated, sculpted* this is the shape of architecture to come.

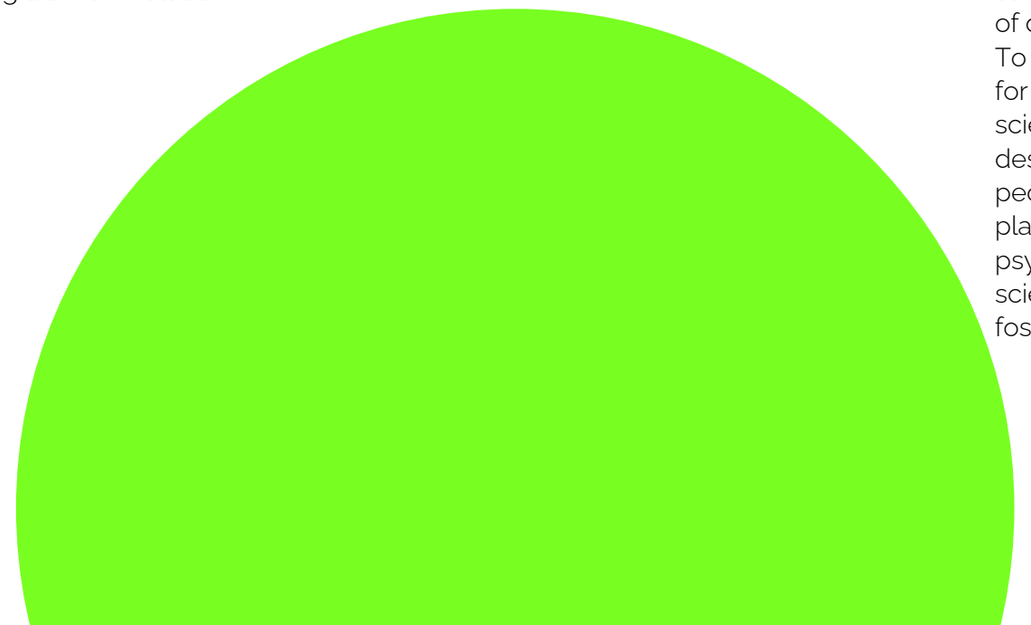
DECALOGUE

The architect plays a central role in territorial transformations, and the territory is the habitat of humans.

The skills required in this profession are numerous and constantly expanding; they go beyond structural stability, regulations, technology, context, composition, and impact, and must also encompass human health and extended cognition. It is therefore crucial that architects are aware of the biological and psychological implications of their work, as well as the impact of their actions on the environment and on both human and non-human beings, in order to create places that benefit human well-being.

Architects need to be open-minded and foster learning.

These ten points can open new doors to awareness, serving as a call to action and encouraging a shift in values.



Brings the BODY back to the center

Architecture is not just a visual art; it profoundly influences people's daily lives. Neuroscience has shown that the built environment can affect our mental state and health. For instance, well-designed spaces with good natural lighting and access to nature can reduce stress and improve mood. Environmental psychology suggests that the perception of spaces can also influence social behavior and the quality of interactions. Behavioral economics highlights how the layout of spaces can influence people's decisions and habits, such as choosing to walk or bike instead of driving.
To design cities which are truly good for people, we must turn towards science for knowledge about what designs benefit and what designs harm people. Only this way can we create places which enable both physical and psychological flourishing, relying on scientific evidence to create places that foster well-being.

Take RESPONSIBILITY for your work

Architects bear a significant responsibility in shaping the spaces we live in. Their design choices can positively or negatively affect residents' quality of life. Environmental psychology teaches us that well-designed public spaces can encourage social interaction and a sense of community. Conversely, poorly maintained or unsafe spaces can increase anxiety and isolation. Behavioral economics recognizes that architectural decisions based on trends or arbitrary criteria can lead to economic and social waste. Everyone who participates in designing architecture and cities needs to realize that every choice they make will have a positive or negative impact on people's wellbeing.
These choices shouldn't be based on fashion or arbitrary criteria.

Design BEAUTY for all

Buildings started to be judged as if they were art pieces in a gallery, instead of forms shaping our minds. Today, scientific research is confirming the relevance of classical principles of beauty, which were reliably used for millennia before we got rid of them in the name of modernity. We need to revise our stance towards beauty and make it one of the highest values of the built environment.
Architectural beauty should not be a quality accessible to all. Neuroscience has shown that aesthetics can influence emotions and well-being, with visually pleasing environments promoting feelings of happiness and tranquility. Psychology indicates that well-designed and welcoming spaces can enhance social inclusivity, making streets and public spaces safe and pleasant for a wide range of people, including children and the elderly. This principle is also reinforced by behavioral economics, which suggests that pleasant environments can encourage positive behaviors such as physical activity and social interaction.

Planning for PEOPLE

People need to feel connected to and have ownership of the places where they live. Environmental psychology emphasizes the importance of creating spaces that reflect local identities and allow residents to personalize and modify their environment. This sense of belonging can be strengthened through meaningful participation in the design process, where residents actively contribute to decisions. Neuroscience supports the idea that environments reflecting human characteristics, such as variety and imperfection, can make spaces more livable and enjoyable. In behavioral economics, participatory design is recognized for leading to more durable and accepted solutions, reducing conflicts, and improving collective well-being.

Think SUSTAINABLE

Current trends towards superficial sustainability certifications often overlook deeper issues of durability and long-term environmental impact. Environmental neuroscience highlights the importance of designing buildings that are not only energy-efficient but also long-lasting, reducing the need for frequent reconstructions and associated environmental impacts. Psychology suggests that buildings and spaces must be pleasant and functional to encourage their continuous use and maintenance. Behavioral economics discusses how sustainable design can influence user behaviors, promoting ecological habits and reducing consumption. To build truly sustainably, we need buildings to appeal to people so much that they will wish to keep them in their place for so long. Apart from only being sustainable on their own, they should also support sustainable values and behaviors on the part of their users.

Foster VIBRANT COMMUNITIES

Growing urbanization carries the risk of anonymity and social isolation. Social psychology tells us that well-designed public spaces can become meeting places and build social networks, which are crucial for well-being and social cohesion. Neuroscience shows that face-to-face interaction is vital for mental well-being, while behavioral economics highlights the importance of social capital for trust and cooperation among people and as a key element for community success. Architecture and urban design should facilitate the creation of spaces that encourage social interaction and a sense of belonging.

Usa data to shape BEHAVIORS

Architecture should be based on concrete facts rather than assumptions or fleeting trends. Neuroscience and psychology provide crucial data on how spaces influence our emotions and behavior. For example, certain types of layouts have been shown to improve concentration or promote socialization. Behavioral economics teaches that decisions based on objective data can prevent costly errors and enhance the efficiency and effectiveness of design solutions. Architects must embrace a scientific approach, staying open to new discoveries and willing to revise past assumptions and decisions to continually improve their work.

Ask always QUESTIONS

Knowledge and experience are continually evolving. Neuroscience teaches us that the human brain is plastic and constantly adapts to new information. Learning psychology emphasizes the importance of being receptive to new ideas for professional and personal growth. In behavioral economics, the concept of a "growth mindset" is crucial: being open to learning and adapting can lead to better and more innovative outcomes. For architects and urban planners, this means remaining curious and updated, continuously seeking new knowledge and approaches that can improve the quality of their projects and respond to the changing needs of society.

Design for SENSORY ENGAGEMENT

Neuroscience has shown that our senses significantly influence how we experience spaces. The built environment can be designed to engage all the senses—sight, sound, smell, touch, and even taste—to create more immersive and emotionally resonant experiences. For instance, incorporating natural elements like water features can provide soothing auditory stimuli, while textured materials can offer tactile richness. Environmental psychology suggests that multi-sensory environments can improve mood, reduce stress, and enhance cognitive function. By thoughtfully engaging the senses, architects can create spaces that are not only visually appealing but also holistically satisfying and conducive to well-being.

Foster EMOTIONAL RESILIENCE

The design of spaces can have a profound impact on emotional resilience. Neuroscience shows that environments that feel safe, comfortable, and controllable can reduce anxiety and promote emotional stability. This is particularly important in settings like healthcare facilities, where patients may feel vulnerable. Environmental psychology suggests that incorporating elements of nature, warm colors, and familiar materials can create environments that foster a sense of security and calm. Architects can enhance emotional resilience by designing spaces that provide comfort, reduce stress, and allow individuals to feel in control of their environment, contributing to better mental health outcomes.

1. BRINGS THE BODY BACK TO THE CENTER

2. TAKE RESPONSIBILITY FOR YOUR WORK

3. DESIGN BEAUTY FOR ALL

4. PLANNING FOR PEOPLE

5. THINK SUSTAINABLE

6. FOSTER VIBRANT COMMUNITIES

7. USA DATA TO SHAPE BEHAVIORS

8. ASK ALWAYS QUESTIONS

9. DESIGN FOR SENSORY ENGAGEMENT

10. FOSTER EMOTIONAL RESILIENCE

OPERATIONAL TOOLS

In the fields of architecture, design, and urban planning, understanding the intricate dynamics of **perception is paramount.**
Perception, the process through which we interpret sensory information, shapes how individuals experience and interact with spaces. This process is not merely about the conscious recognition of environmental elements but also involves **deep-seated unconscious influences** that affect emotions, behaviors, and overall well-being. The spaces we inhabit—whether buildings, public parks, or entire urban landscapes—are experienced through the lens of perception, which in turn is shaped by factors such as light, texture, color, and spatial arrangement.

For professionals tasked with designing and organizing spaces, understanding and manipulating perception is essential to creating environments that resonate on multiple levels, fostering both **functionality and emotional engagement**.

This chapter delves into the practical application of tools that enable professionals to design environments that resonate with users on both conscious and unconscious levels.

The importance of perception in design cannot be overstated, as it bridges the gap between the physical aspects of a space and the **psychological experiences** of its users. Conscious perception allows us to navigate and understand spaces, while unconscious perception subtly influences our emotions and behaviors. For instance, a well-lit, open space might consciously feel inviting, while the warmth of materials used might unconsciously evoke a sense of comfort.

These tools provide the means to operationalize this understanding, ensuring that spaces are not only functional but also psychologically and emotionally engaging.

The connection between perception and the tools discussed in this chapter is crucial. These tools offer professionals the ability to systematically analyze and implement design strategies that consider the full spectrum of human perception. They enable the creation of environments that are inclusive, accessible, and sensitive to the diverse ways people experience space. By using these tools, architects, designers, and urban planners can ensure that their projects resonate with a wide range of users, ultimately leading to more successful and meaningful spaces.

Understanding and utilizing these tools can lead to more **effective and meaningful design outcomes**.

- Mapping of perception
- Derive exercise: space exploration
- Cosmogram
- Canvas
- Representative image

MAPPING OF PERCEPTION

SCALE

Mapping of perceptions allows us to understand how people truly experience and feel about a space, which is crucial for creating environments that **resonate with human needs**. Is a sense-making process during which people map human-made and natural assets and express opinions, ideas, needs, and aspirations about a place, highlighting its critical aspects and potential.

Perceptions shape our emotional and psychological responses to a place, influencing how we behave and interact within it. By mapping these perceptions, we can capture a diverse range of opinions, feelings, and observations about a particular location, helping to identify areas that might be uncomfortable, unsafe, or underutilized, as well as opportunities for enhancing the space.

The mapping occurs during an on-site visit, where perceptions obtained through the five senses are recorded on a schematic map.

The dimensions of space influence our emotions and behavior. Studies conducted by Colin Ellard on urban psychology have highlighted how the **city environment affects brain function and human behavior**. Discussions often focus on the incidence of psychological and neurological disorders in cities and how urban design can mitigate the negative effects of urban life.

Design, from the scale of individual elements to the urban level, can indeed influence how people interact with the urban environment. For this reason, the design of both open and interior spaces must consider aspects such as:

Human proportions:
designing with attention to the dimensions and movements of people.

Harmony with the context:
ensuring that the scale of buildings is in harmony with surrounding structures and the urban environment, avoiding visual disharmony.

Creating focal points:
using variations in scale by incorporating large-scale elements that attract attention and serve as focal points within the space.

Balancing large and small spaces:
creating a varied experience by balancing large, open spaces with smaller, more intimate ones.

Using scale to guide movement:
designing architectural elements in a way that guides people's movement through space. Wider, taller corridors may invite movement, while smaller spaces may encourage people to pause and interact.

Integrating natural elements:
elements like greenery and water enhance psychological well-being and create a more welcoming environment.

Evaluating psychological impact:
considering the psychological impact of scale on users. Spaces that are too large can make individuals feel isolated, while spaces that are too small can cause anxiety. Finding a balance is crucial for mental well-being.

Promoting social interaction:
designing spaces that encourage social interaction through the thoughtful use of scale. Common areas like plazas and courtyards should be large enough to accommodate groups but contained enough to facilitate interaction.

Incorporating variable scale elements:
using elements of different scales to add dynamism to spaces. For instance, a monumental staircase can be balanced by smaller, more cozy spaces.

Evaluating and adapting:
continuously assessing the impact of scale during the design process through user feedback and field observations. Adjusting the design based on these inputs to enhance the overall experience.

GEOMETRY

The geometry of spaces influences aesthetic preferences and emotional well-being. Neuroscience shows a preference for curved shapes over angular ones, high ceilings that convey a sense of spaciousness, and the perception of enclosure, which can increase stress. Brain activation in response to curved spaces suggests that emotional processing is crucial in how we perceive architectural environments.

Contour
Studies have shown a preference for curved shapes over rectilinear and angular ones, with brain regions related to emotions being more active during the experience of these spaces.

Height
In indoor environments, people generally prefer higher ceilings, which provide a sense of spaciousness and the ability to visually explore a room. Neuroscientific studies show that high ceilings activate brain regions involved in visual-spatial exploration, indicating that people appreciate the cognitive freedom offered by large vertical spaces.

Sense of Enclosure
The perception of enclosure is studied in terms of visual and locomotor permeability and how this influences preferences for specific spaces. Enclosed spaces can increase stress levels, as demonstrated by the activation of brain regions related to threat perception.

MATERIALS

The choice of materials is essential for the psychological and perceptual well-being of users. Tactile, visual and acoustic materials directly influence comfort and safety.

Touch
The texture of materials can stimulate different tactile responses. Materials such as smooth wood, soft fabric or rough stone surfaces can evoke feelings of warmth, comfort or rusticity. Touch can influence comfort and a feeling of security through the use of soft surfaces that generally promote relaxation and calm.

Sight
The colour of materials has a direct impact on emotions and psychological states. For example, warm colours such as red and orange can stimulate and excite, while cool colours such as blue and green can calm and relax. The finish of materials (glossy vs. matte) can influence the perception of space. Glossy surfaces can make a space feel brighter and more open, while matt surfaces can give a feeling of intimacy and security.

Hearing
Materials have different acoustic properties. Soft materials such as carpets and fabrics absorb sound, reducing ambient noise, while hard surfaces such as glass and metal reflect sound, which can increase the noise level.

Natural materials
The use of natural materials such as wood, stone or greenery can improve psychological well-being. Neuroscientific studies suggest that exposure to natural materials can reduce stress and increase feelings of well-being, mimicking the effect of nature itself. Materials that evoke nature can stimulate a biophilic response, where humans' innate connection to nature promotes well-being and stress reduction.

ACOUSTIC

The acoustics of spaces have a significant impact on users' emotional and sensory perception.
Neuroscience shows how sound can profoundly influence the experience of an architectural environment. Sound repetition and the synchronization between sound and space can evoke specific emotions, while sound metaphors help connect architecture with auditory perceptions, creating more engaging and sensory-rich environments.

Sound Repetition
The repetition of sounds within a space can create emotional expectations, similar to how the repetition of architectural elements can influence visual perception. For example, the repetition of a tone can induce states of calm or anxiety depending on the context.

Sound-Space Synchronization
The acoustics of a space can be designed to synchronize with the architecture, creating an integrated multisensory experience. Spaces with good synchronization between visual and auditory perception tend to be perceived as more harmonious and comfortable.

Multisensory Interactions
Acoustic perception does not act in isolation but in combination with other senses. Architecture that considers acoustics in relation to visual and tactile aspects can create more complete and engaging sensory experiences, positively influencing the mood and well-being of occupants.

Designing Sound
The acoustic design of spaces can be optimized to evoke specific emotions and moods. For example, environments with soft acoustics and muted sounds can promote relaxation and concentration, while spaces with intense reverberation can stimulate energy and liveliness.

SMELL

Smell is a fundamental element in architectural design, as it contributes to creating sensory-engaging, functional, and memorable environments. Integrating smell into space design can significantly enhance user experience by influencing perception, emotions, memory, and human behavior.

Influence on Spatial Experience
Smell plays a crucial role in the perception of spaces, affecting comfort and well-being. Pleasant odors can make an environment more welcoming, while unpleasant odors can cause discomfort.

Emotional Connection and Memory
Scents have a strong link to emotions and memory, capable of evoking memories and triggering intense emotions. This makes spaces more memorable and can enhance user experience in contexts such as hotels, restaurants, and stores.

Behavior and Decision-Making
Scents influence people's behavior and decisions. A relaxing fragrance may encourage people to stay longer in an environment, while an unpleasant smell can drive them away quickly.

Identity and Branding
Scents can be used to strengthen brand identity. Many brands use specific fragrances to create distinctive atmospheres that customers associate with their brand.

Well-Being and Health
Smell can impact physical and mental well-being. Natural odors, like those from plants, can have calming effects and reduce stress, contributing to creating healthy and supportive environments for healing and learning.

Cultural and Social Considerations
Olfactory perceptions vary culturally and influence social interactions. Space design must account for different sensitivities to odors to create inclusive and respectful environments.

RHYTHM

Rhythm is perceived through the body and influenced by mirror neurons, which facilitate understanding and empathy. **Neuro-corporeal synchronization** creates a shared rhythm in social interactions. Experimental aesthetics demonstrate how art stimulates sensorimotor responses, involving the entire body-mind system. Rhythm modulates aesthetic and social experience, integrating mental states, physical experiences, and social behavior. Understanding the role of the body in perceiving and reacting to a space is thus crucial.

For instance, art elicits sensorimotor stimuli and reactions in observers. The perception of art is not merely a visual or cognitive process but involves the whole body-mind system in a form of sensorimotor resonance. Art, and more broadly specific forms or colors, can be perceived not only through the eyes but with the entire body. This engagement with the art piece enhances the sense of well-being among its viewers.

Rhythm is understood as a quality of perceived time through the body, modulating and influencing our aesthetic, social, and cognitive experiences. The rhythmic quality of an environment can affect how people interact with and experience that space, creating a more immersive and engaging environment. When rhythm is present, it **aligns physical movement and perception with the environment**, fostering a deeper connection and enhancing the overall experience.

The interaction between rhythm and the body highlights the importance of integrating these elements into design to enhance user experience. By considering how rhythm affects physical and emotional responses, designers can create spaces that are not only visually appealing but also resonant on a sensory level, promoting a more profound and satisfying interaction with the environment.

LIGHT

Natural light is essential for psychological well-being, regulating circadian rhythms, improving mood, and enhancing cognitive performance. Light can also affect spatial perception and evoke emotional responses.

Well-being Production
Light stimulates the production of serotonin and dopamine, improving mood and motivation.

Stress Reduction
Exposure to natural light lowers cortisol levels, contributing to greater relaxation.

Promotion of Social Interactions
Well-lit spaces encourage social interaction and foster a sense of community.

Principles of neuroscience can be applied to building design to enhance occupants' well-being, particularly through the concept of "neuroarchitecture," an interdisciplinary field that studies how physical environments impact the human brain. It has suggested the use of large windows and skylights to maximize natural light entry, as well as reflective materials to distribute light more evenly. Strategies for integrating natural light into buildings include:

- Using large and well-positioned windows to maximize natural light.

- Choosing materials that reflect light to better illuminate interior spaces.

- Creating dynamic lighting that changes throughout the day to mimic natural sunlight variations.

- Concentrating social and meeting spaces in the brighter areas to encourage interaction and well-being.

- Using artificial lights that mimic natural light and considering full-spectrum lamps.

COLOR

Color has a profound impact on perception, emotions, and behavior. The theory of color has evolved over time, influencing art and architecture. The mindful use of color can enhance mood, productivity, and well-being in built environments. Modern technologies enable real-time manipulation of colors, affecting environments in innovative ways.

Recent neuroscientific studies have begun to uncover the brain mechanisms involved in color perception and **emotional response**. For example, Zeki and Marini (1998) used functional magnetic resonance imaging (fMRI) to identify brain areas involved in color processing, providing new insights into the neural basis of color perception.

The use of color in architecture has a millennia-old history, reflecting not only aesthetic considerations but also **functional and symbolic** ones.
In the 1990s, studies on the psychophysiological effects of color in built environments provided guidelines for color use in hospitals, schools, and other public spaces. This led to the concept of "chromotherapy architecture," developed by Galen Minah (2001), which explores how colors can be used to promote well-being and healing in healthcare environments.

Contemporary research on color in psychology and architecture continues to expand, benefiting from new technologies and interdisciplinary approaches. Research on the effects of color in spaces involves issues such as sustainability and energy efficiency of buildings, considering aspects like **albedo and thermal comfort**, as well as the role of color in inclusive design and accessibility for individuals with visual disabilities or neurodivergences.

SOMATOSENSORY SYSTEM

The somatosensory system, which allows us to perceive touch, pressure, temperature, and pain through sensory fibers located in varying quantities throughout the body, is strongly influenced by the external environment. In architectural experience, the somatosensory system engages in several aspects:

Tactility and Materials
The tactile experience is fundamental for understanding and appreciating spaces. The choice of materials and surface textures can evoke emotional responses and create sensory connections with the built environment.

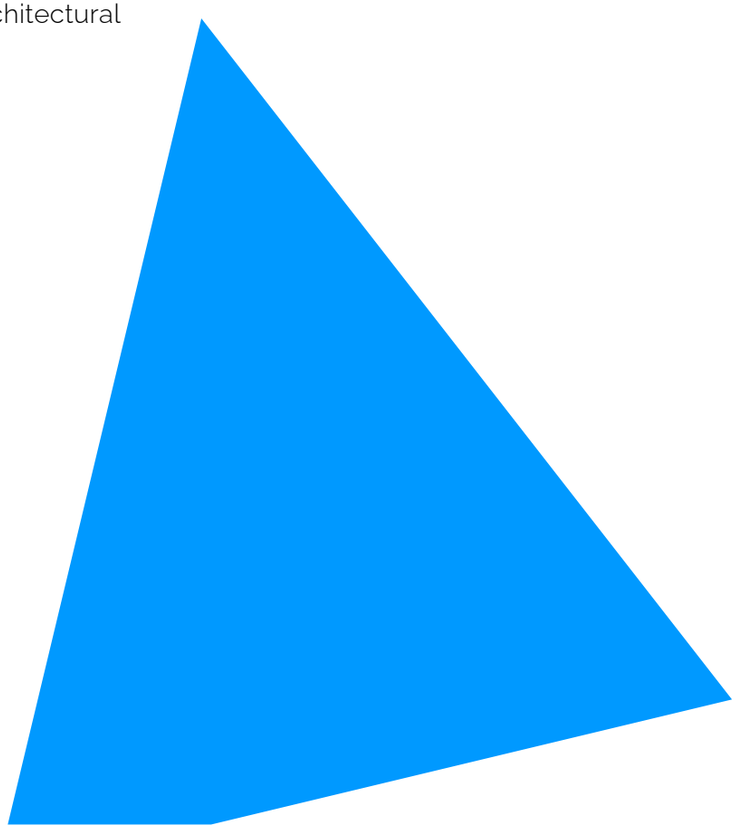
Proprioception and Spatial Navigation
Proprioception, or the ability to recognize the position and movement of one's body in space without visual aid, inevitably influences our ability to navigate and comprehend architectural spaces. Architects like Steven Holl have explored how variations in scale, form, and movement through space can stimulate proprioceptive awareness and enrich the architectural experience (Holl, 2006).

Thermal Comfort
Temperature perception is a key aspect of the somatosensory system and is crucial for comfort in built environments. Recent research on bioclimatic design and adaptive comfort has highlighted the importance of considering individual somatosensory responses in the design of climate control systems (de Dear & Brager, 1998).

Innovative Applications
Understanding the somatosensory system is leading to exciting innovations in architecture and design, such as interactive surfaces, multisensory design, and therapeutic environments.

PERCEPTION, PROPRIOCEPTION, INTEROCEPTION

Our experience of architectural spaces is deeply influenced by **complex sensory processes** that go beyond mere vision. This chapter explores the crucial role of perception, proprioception, and interoception in our interaction with the built environment, highlighting how these processes influence the psychology of space and inform innovative architectural practices.



Perception:
The Bridge Between Environment and Cognition

Perception is the process through which we interpret and give meaning to sensory stimuli from the environment. In architecture, perception plays a fundamental role in how we understand and interact with spaces. When we talk about perception, we refer to the processing—more or less conscious—of a sensation. Vision is the predominant sense in humans, which is why we will discuss visual perception and architecture.

Multisensory perception is an increasingly interesting topic for modern scholars/researchers who seek to discover how various sensations are integrated to create a complex experience. While architecture has traditionally focused on the visual aspect, there is growing awareness of the importance of multisensory perception. Pallasmaa (2005) emphasized how architectural experience involves all the senses, from the texture of surfaces to the acoustics of spaces. Malnar and Vodvarka (2004) proposed a "sensory design" approach that consciously integrates stimuli for all the senses into architectural design, creating richer and more engaging environments.

Proprioception:
The Sense of the Body in Space

Proprioception, the sense of the body's position and movement in space, is fundamental to our navigation and interaction with the built environment.

Proprioception and Architectural Scale: The perception of scale in architecture is intrinsically linked to proprioception. Architects like Le Corbusier explored this concept through the "Modulor," a system of proportions based on human body measurements (Cohen, 2014). Recent research has demonstrated how manipulating architectural scale can influence behavior and emotions. For example, Meyers-Levy and Zhu (2007) found that higher ceilings promote more abstract and creative thinking, while lower ceilings encourage concrete and detailed thought.

Proprioception and Movement: Le Corbusier's concept of "promenade architecturale" emphasizes the importance of movement through space for architectural experience. This

approach leverages proprioception to create dynamic and engaging spatial sequences (Samuel, 2010). Neuroscientists like Moshe Bar and Maital Neta (2006) have studied how the perception of curved vs. angular forms in architecture can influence emotional and behavioral responses, with implications for the design of spaces that promote well-being.

Interoception: The Internal Sense of Architecture

Interoception, the perception of the body's internal states, is emerging as a crucial factor in our experience of built environments.

Thermal Comfort and Interoception:

The perception of temperature, mediated in part by interoception, is fundamental to comfort in architectural spaces. The adaptive comfort model proposed by de Dear and Brager (1998) recognizes the active role of occupants in regulating their thermal comfort, highlighting the importance of interoception in the design of climate control systems.

Interoception and Well-being:

Recent studies have linked greater interoceptive awareness to improved psychological well-being (Critchley and Garfinkel, 2017). This has implications for the design of spaces that support practices like meditation and mindfulness, increasingly integrated into work and healthcare environments.

A deep understanding of perception, proprioception and interoception offers new perspectives for creating architecture that not only meets functional and aesthetic needs but also resonates deeply with our sensory and cognitive processes. This knowledge paves the way for more holistic and human-centered design, considering the architectural experience as a complex dialogue between body, mind, and the built environment. The challenge for the future will be to translate this knowledge into concrete design practices, creating spaces that we not only see and touch but also "feel" in a deeper and more meaningful way. The architecture of the future can thus aspire not only to host our activities but also to nurture our psychophysical well-being in increasingly sophisticated and personalized ways.

The integration of perception, proprioception, and interoception in architectural design is leading to innovative approaches. Emerging technologies allow for the creation of environments that respond in real-time to the physiological states of occupants. For example, the "ExoBuilding" project by Schnädelbach et al. (2012) explores how buildings can adapt to the respiratory rhythms of occupants, creating an interoceptive link between body and architecture.

DERIVE EXERCISE: SPACE EXPLORATION

Psychogeography is a field of study that examines the relationship between the physical environment and the emotional, behavioural and experiential responses of individuals. The concept of psychogeography first emerged in the 1950s within the Situationist movement, particularly through the work of Guy Debord and the Lettrist group.

Psychogeography focuses on the impact of the urban environment, including streets, buildings, and public spaces, on individuals' perceptions and emotional states. Those engaged in psychogeography frequently undertake "derives," or aimless perambulations through the city, with the objective of investigating the manner in which the urban context shapes their experiences and moods.

One of the primary objectives of psychogeography is to challenge the conventional, homogenised perception of the city and to identify novel approaches to engaging with urban environments. This often entails the discovery of previously unnoticed or disregarded elements within the urban fabric, in a practice that integrates the physical exploration of space with a critical and creative reflection on architectural design, urban planning, and human behaviour.

The exercise: "Derive"

The "derive" is a well-known psychogeographic technique that involves a spontaneous, aimless walk through an urban environment. The aim is to allow the environment itself to act as a guide, following the suggestions and impulses of the moment rather than a predetermined logic. During a derive, individuals may be drawn to specific details, atmospheres, or directions, thereby discovering new aspects of the urban space.

Derive Exercise: Space Exploration

Objective: This derive exercise is designed to explore urban space through a series of techniques that stimulate sensory perception and personal reflection on space.

Instructions

Free Exploration

Begin the exercise by exploring the space around you without following any predetermined logic. Even though you are familiar with the area, let yourself be guided by your sensations, the details that catch your eye, and the impulses of the moment. Don't plan your route; move spontaneously, responding to the atmospheres and details that draw your attention.

Guided Exploration

After the free exploration, start exploring the space by following the 10 rules described below. Apply one rule at a time and in sequential order, allowing each to inspire you before moving on to the next:

- ***Turn only left***
  Move through the space by only making left turns. Discover where this limitation takes you.

- ***Circular movements only***
  Perceive the space by making only circular movements. How does this change your experience of the place?

- ***Search for sharp corners***
  Seek out sharp corners in the space. What do you find, and how do you feel in these places?

- ***Search for porous materials***
  Look for porous materials (like stone, wood, fabrics) and observe how they influence your perception of the space.

- ***Search for your favorite color***
  Identify your favorite color in the surrounding space and follow its path.

- ***Search for the brightest spot at noon***
  Try to identify the spot where, in your opinion, the most light arrives at noon. Pause there for a moment and reflect on your choice.

- ***Search for the least bright spot at 3:00 PM***
  Now, find the place you think receives the least light at 3:00 PM. What sensations emerge in this space?

- ***Let your sense of smell guide you***
  Follow your sense of smell to a place where the scent reminds you of something or is particularly pleasing to you.

- ***Search for the spot of greatest discomfort***
  Explore the space until you find the spot where you feel the least comfortable. Take note of your reactions and the reasons for this discomfort.

- ***Search for the spot of greatest comfort***
  Finally, search for the spot where you feel most comfortable. End your exploration in this space, reflecting on what makes it special for you.

Conclusion: After completing the journey, take some time to reflect on how each rule influenced your perception of the space and how you felt during each phase of the exploration. Share your experiences with the other participants.

PLEASE FILL OUT THE FORM EITHER WHILE YOU ARE DOING THE EXERCISE OR IMMEDIATELY AFTER COMPLETING IT

Remember that there is no right or wrong, and you will not be judged

COSMOGRAM

A cosmogram is a two-dimensional geometric figure that represents a cosmology, or an understanding of the universe. The practice of cosmography has a deep and widespread human history, as a means of inscribing and encoding memories by drawing connections between people and places through space and time. Cosmograms can position people in relation to a broader configuration of things, marked by a series of convergences and events between people and places [1].

John Tresch, an historian of science and technology and Associate Professor at the University of Pennsylvania, Philadelphia, defined the cosmogram as **"Inscriptions of the cosmos as a whole**" and as a neutral concept "It is just a general class of things that humans make: representations of the universe as a whole. And it has taken many, many different forms in history, and cross-culturally. All cultures have cosmograms". During the century the cosmogram was used to represent how the world works fitting together humans, all the divisions of nature, all the divisions within human society, and then the divinities around it or above it" [2].

Cosmograms are about how we compose and trace connections that we hold to be the world we live in (including ideals and parts not 'materialized' currently). They deal with our sense of how and with what we perceive our world works. For these reasons the cosmogram can be used as a tool capable of putting foreground aspects in certain aspects and downplays or hides others.

The success of this concept derives in fact from its versatility which finds ever greater diffusion in the most diverse disciplines, from the history of ideas, to urban planning, to ecology, to economics, to information technology and beyond, given its **ability to hold together given material and interpretation.**

[1] https://sonicacts.com/archive/interview-with-john-tresch-on-cosmograms

[2] https://cosmogramofharlem.weebly.com/what-is-a-cosmogram.html

The exercise

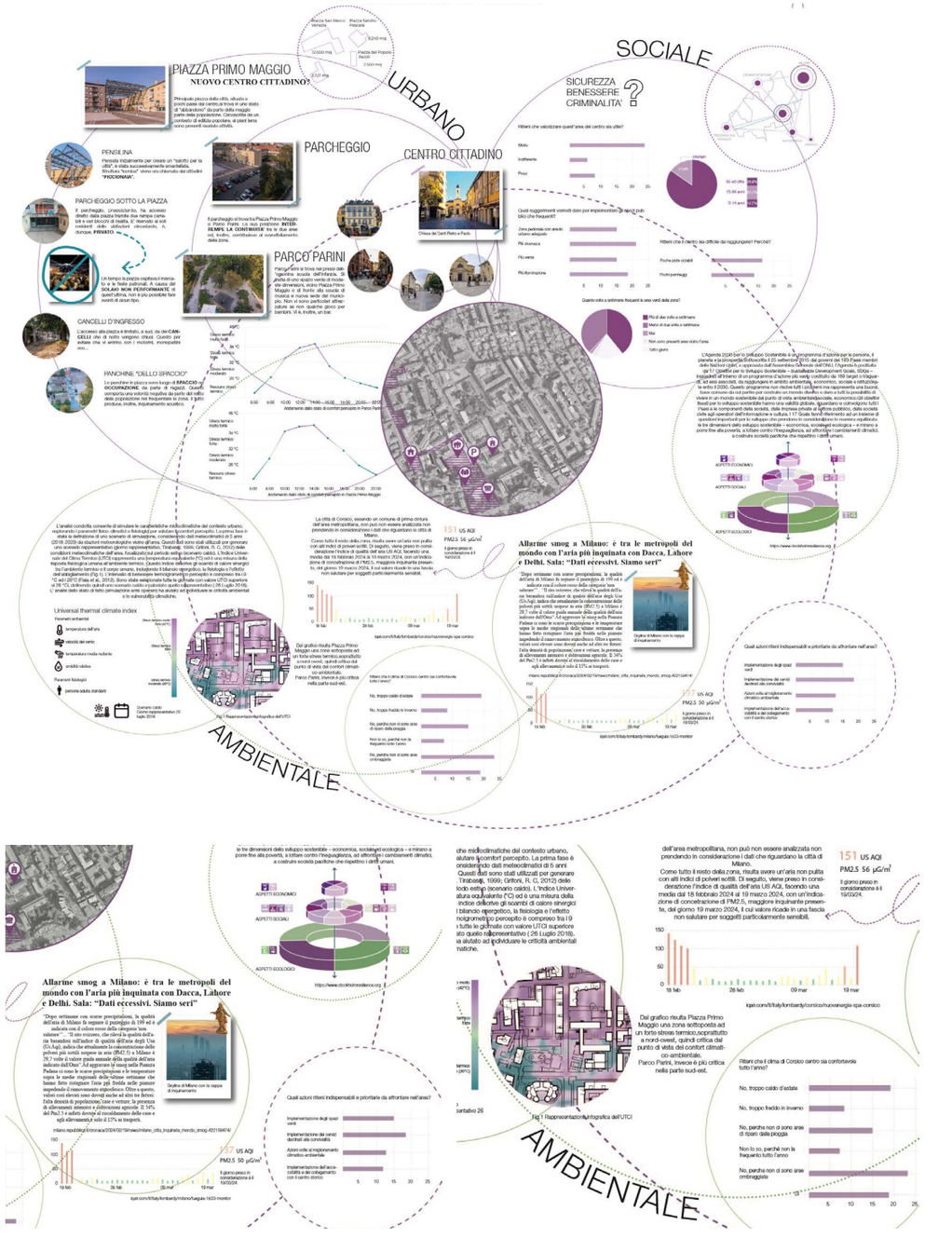
The cosmogram can begin with a basic frame until to become a really complex image. Close to the best known concept of the infographic the cosmogram is more than a table is a tool to gather our common visions and perceptions of the environment. This exercise consists to start from a personal perceptions to arrive to a common description of the complexity of the urban environment.

Objective

Starting from the John Tresch definition we will translate in graphic our perception of the environment and the external objects underlying priorities or ke elements. The cosmogram can contain categories that we use to analyze as infrastructure, building settlement, green until element or conditions but also elements that we conventionally do not represent such as the presence of spontaneous greenery, social conditions, urban atmosphere, small and not always visible details etc... The cosmogramme is an invitation to look at places with greater sensitivity, aware that our gaze will affect the well-being of the people who will experience it.

Instructions

The design phase of the site area is preceded by a brainstorming in which common emotions and perceptions are compared to be then graphically translated in Miro, an online shared whiteboard.
Miro is an online workspace focused on team collaboration through a platform that collects photos, documentation, survey results, videos and real-time data in a single shared collaborative workspace.
To have access to Miro just go online on *www.miro.com* and sign up if you are not yet then:
"Create a new board" then one of you will add the email address of the participant to the design team. In alternative there is the possibility to send a link to to invite others to participate. In the left bar you will find a series of tools for drawing shapes, lines and for inserting texts, its use is very intuitive. At the bottom right you will find the zoom. We are recommended to not use the templates that are in Miro but to creatively translate your emotions, perceptions and suggestions of the study area.



Exemple of Cosmogram applied in the architectural thesis work by G. Catena, G. Cassano, DdA

Example of Cosmogram edited by students of EPSAlicante

CANVAS

Nudging is the discipline of using behavioural science to facilitate or gently nudge people's decisions towards options that are more in line with their values, while respecting their freedom of choice.

Behavioral Insights Canvas for Architecture Students

This canvas is designed as a foundational tool for architecture students, guiding them in creating spaces that improve behaviors through Nudge techniques. The purpose of this canvas is to help students select complex or biased target behaviors and redesign spaces to effectively promote desired behaviors.

Nudge theory is crucial for understanding how environmental cues can influence human behavior. By thoughtfully designing spaces, we can guide individuals towards making better choices naturally and effortlessly. This approach is particularly important in promoting sustainable and desirable behaviors in everyday environments.

How to Use the Behavioral Canvas

Identify the Target Behavior:
Caring for Space

Students begin by clearly defining the target behavior they want to change: This involves answering key questions:

- ***WHO*** *IS EXHIBITING THE BEHAVIOR?*
- ***WHERE*** *DOES THIS BEHAVIOR OCCUR?*
- ***WHEN*** *DOES IT HAPPEN?*
- ***WHAT*** *SPECIFICALLY IS THE PERSON DOING?*

Understanding what precedes and follows the target behavior is crucial. Students should consider the expected consequences and any ingrained habits associated with the behavior.

Understand Behavioural Factors

To design effective spaces, students need to investigate into the aspects of behavior:

- *ARE THE* ***CONSEQUENCES*** *OF DECISIONS UNDERSTOOD?*
- *IS THERE A* ***LACK OF DATA*** *FOR UNDERSTANDING?*
- *ARE PEOPLE* ***CORRECTLY INFORMED****?*
- *ARE THEY* ***AWARE*** *OF THE FALLIBILITY OF THEIR JUDGMENTS?*
- *ARE THERE ANY* ***DISTRACTORS*** *OR DRIFTING PHENOMENA?*
- *WHAT* ***MEANING*** *IS ATTRIBUTED TO THE DECISION?*

Designing to Overcome Barriers:

Students then focus on how to dismantle barriers:

- *HOW CAN SPACES BE DESIGNED TO* ***REDUCE*** *OR ELIMINATE THESE BARRIERS?*
- *HOW CAN THE DESIGN REMOVE OBSTACLES THAT HINDER UNDERSTANDING AND RATIONAL* ***DECISION-MAKING****?*
- *HOW CAN THE SPACE BE DESIGNED TO SUPPORT THE* ***GOAL BEHAVIOR****?*

PLEASE DOWNLOAD HERE THE LAYOUT, FROM OUR WEBSITE exmindproject.com IT'S A GUIDE TO FILL IN FOR YOUR CANVAS EXERCISE

Enjoy the process!

Practical application example: *ENCOURAGING RECYCLING*

Consider a scenario where individuals struggle with recycling.
The goal for students is to design a ***communal kitchen area*** (or some other space) in an office that addresses this challenge and promotes sustainable behavior. The ***struggle with recycling*** is the target behavior they aim to change through thoughtful space design and Nudge techniques.

To achieve this, students should:

Design the Space with Nudges
Place clearly labeled, color-coded recycling bins in easily accessible locations. This makes it simple and intuitive for individuals to correctly sort their waste, reducing the effort and confusion associated with recycling.

Use Visual Cues and Educational Materials
Incorporate visual cues and educational posters to inform and remind individuals about the importance of recycling and the correct methods to do so. This helps increase awareness and knowledge, making recycling a more mindful and intentional act.

Make Recycling the Most Convenient Option
Ensure that recycling bins are the most convenient and obvious choice. Position them strategically so that disposing of recyclables is easier than throwing them in the trash. This way, the design of the space naturally nudges individuals towards making more sustainable choices.

By applying the principles outlined in the Behavioral Architecture Canvas, architecture students can systematically approach the challenge of improving behaviors through thoughtful space design. This canvas encourages students to think critically about the impact of space on behavior and use architectural design as a tool for positive change. The ultimate goal is to create environments that not only address immediate behavioral challenges but also promote long-term, sustainable habits.

BEHAVIORAL ARCHITECTURE CANVAS

TARGET Behavior: _____

GOAL Behavior: _____

Who? Where? When? What does he/she do? _____

Who? Where? When? What do we want him/her to do? _____

- What precedes tthe target behavior?
- What immediately follows the target behavior? What are the consequences the person imagines or expects?
- Are there ingrained habits?
- How costly are the different response options?

How do i dismantle behavioral barriers related to a specific space support the goal behavior?

- Are there any noticeable biases? Are the consequences of the decisions understood?
- Is there a lack of data for understanding?
- Are ther behaviors rational?

How do i design the space in a way that removes cognite barriers?

- Are people correctly informed?
- Are people aware of the fallibility of their judgments?
- Are there any disractors? Drifting phenomena?
- Wha meaning is attribueted to the decision?

How do i facilitate awarness and support the goal behavio through design?

REPRESENTATIVE IMAGE

Exercise

1. Normally, in this kind of workshops, each team delivers a proposal with images that represents a concept for the transformation of given place (at least in the public space). For this exercise, we propose to select one image from bird view (the same for all the teams) to represent the general proposal for the public space and its transformation from the image of the current state. It is possible (and desiderable) to select another real image of the current state from the point of view of a person that would be used to represent the proposal but it should be decided together so that it will be used by at least 4 teams.

2. In the development of the project, every team should consider the information that they can get using their senses and intuition, their feelings of the place. It is also important that every team draw some draft maps, at least of the public space, (there is no need to be precise, they could only use their senses) containing personal analysis of variables as intensity of sound (and kind of noise), lighting and shadows, wind direction and intensity, smells, colors, hard or soft surfaces, humidity, temperature... and everything the team considered relevant, before and after the intervention.

Objective

1. Selecting 1 or 2 images from each team (belonging to the diversity of BIP selected places) will be useful in a research activity to compare the different proposed transformations from the neuro architectural point of view.

2. The second objective is to demonstrate how the intuition and the trained senses of the architect students are always key elements in this topic.
The analysis will be made by a team of researchers linked to ExMind once the workshop finished.

Instructions

Each design team will decide 1 or 2 point of views (images of the current state) as explained, with the supervision of an invited researcher from Malaga University conducting this research (Prof. Javier Castellano) and the opinion of the tutors that want to help in this activity.

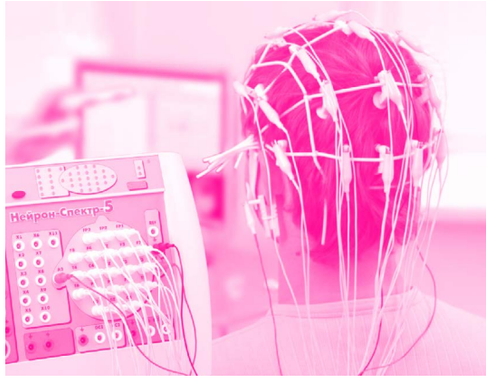
MEASUREMENT TOOLS

Physiological, environmental, and behavioral measurement tools are revolutionizing the way we understand the interaction between humans and architectural spaces. These techniques allow for the collection of detailed data that helps evaluate how differaent environments influence not only behavior but also the emotional and physiological states of individuals. The integration of these various measurements provides a comprehensive and detailed picture of the interactions between people and the built environment, offering valuable data for the design of more functional, comfortable, and stimulating spaces.

NEURO and PHYSIOLOGICAL MEASUREMENTS	ENVIRONMENTAL MEASUREMENTS	BEHAVIORAL MEASUREMENTS
EEG _ Electroencephalography		
fMRI _ Functional Magnetic Resonance Imaging		Eye Tracking
EMG _ Electromyography	Air Quality Measurements	Movement Monitoring or Dwell Time Tracking
MEG _ Magnetoencephalography	Binaural Head	Facial Expression Analysis
GRS _ Galvanic Skin Response	Lux Meter	VR _ Virtual Reality
ECG _ Electrocardiography	Thermo-Hygrometer	AR _ Augmented Reality
Oximeter	Anemometer	Questionnaires and Surveys

NEURO and PHYSIOLOGICAL MEASUREMENTS

EEG
Electroencephalography



This is a useful technique for measuring and visualizing the brain's electrical activity, allowing us to understand cerebral reactions to different architectural spaces.

For instance, some studies using EEG have observed differences in arousal levels (i.e., physiological excitement or activation) of people in environments illuminated with lights of different color temperatures, specifically 5000 K (cooler, white light) and 3000 K (warmer, yellow light) (Noguchi, Sakaguchi, 1999).

Other EEG measurements of arousal have been conducted, for example, to observe the level of excitement and/or physiological activation of people in red-colored spaces (Kuller, Mikellides, Janssens, 2009).

Küller,R.;Mikellides,B.;Janssens,J., ***Color, arousal, and performance. A comparison of three experiments.*** ColorRes.Appl.2009, 34, 141–152. [CrossRef]
Noguchi,H.; Sakaguchi,T., ***Effect of illuminance and color temperature on lowering of physiological activity*** .Appl.Hum.Sci. 1999, 18, 117–123. [CrossRef]

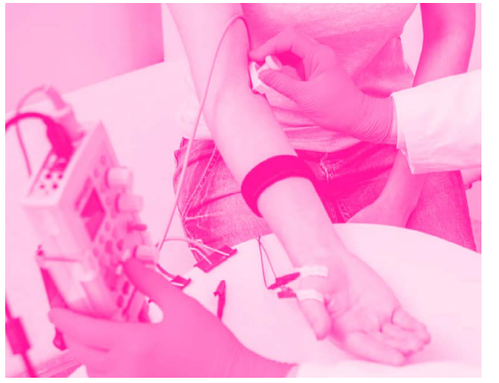
fMRI
Functional Magnetic Resonance Imaging

This technique allows for the visualization of brain activity and the identification of which areas of the brain are active in response to various architectural stimuli.

The use of fMRI in the architectural field has, for example, demonstrated how buildings designed by architects, such as the Pantheon, the Salk Institute, the Chapel of Ronchamp, the Alhambra, and the Cathedral of Chartres, can induce a state of contemplation compared to generic buildings (Bermudez et al. 2017).

J. Bermudez, David Krizaj, D. L. Lipschitz, C. Elliott Bueler, J. Rogowska, D. Y. -Todd, Yoshio Nakamura, ***Externally-induced meditative states: an exploratory fMRI study of architects' responses to contemplative architecture***, Frontiers of Architectural Research, Volume 6, Issue 2, 2017, Pages 123-136

EMG
Electromyography



This technique measures muscle activity, which is useful for assessing physical tension and stress in response to environments. Additionally,

EMG has been used in studies for the recognition of facial expressions (Calvo, Nummenmaa, 2016), which can be helpful in understanding the states and emotions individuals experience when interacting with architecture.

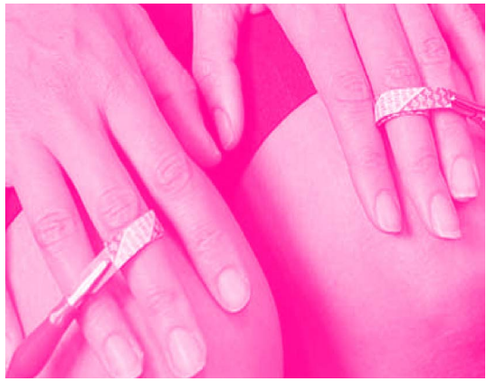
Calvo,M.G.;Nummenmaa,L. ***Perceptual and affective mechanisms in facial expression recognition: An integrative review***. Cogn.Emot. 2016, 30, 1081–1106. [CrossRef]

MEG
Magnetoencephalography

This neuroimaging technique measures the magnetic fields generated by neuronal electrical activity in the brain, allowing us to visualize real-time changes in the magnetic fields produced by neuronal activity.

This can offer interesting, yet unexplored, insights in the field of architecture, such as studying how different spatial configurations influence brain activity or monitoring brain reactions to various environments to assess levels of stress or well-being.

GSR
Galvanic Skin Response



Measuring the galvanic skin response allows for the detection of stress or arousal levels.

In a study on the perception of urban and architectural environments, it was shown that GSR signals are higher in historic city centers compared to areas with modern urban fabric (Erkan, 2024).

This suggests that historic environments may evoke stronger emotional responses, potentially due to their rich cultural significance and intricate design elements, highlighting the importance of preserving and thoughtfully integrating such areas within modern urban planning.

Erkan, I. ***Sense of Urban and Architectural Environment***. Architecture and Engineering. Volume 9 Issue 2, 2024

ECG
Electrocardiography

Monitoring heart rate can be useful for measuring emotional state and stress levels in relation to built environments.

Exposure to different environmental factors, such as noise, subjective social stress, or thermal loads, has a significant influence on heart rate variability (Schnell et al. 2013).

Additionally, it has been demonstrated through heart rate measurements that resting in environments with a window offering a view of nature is more restorative than resting in environments without an external view (Engell et al. 2020).

I.Schnell, O.Potchter, Y.Epstein, Y.aakov, H.Hermesh, Shmuel Brenner, E.irosh, ***The effects of exposure to environmental factors on Heart Rate Variability: An ecological perspective***, Environmental Pollution, Volume 183, 2013, Pages 7-13, https://doi.org/10.1016/j.envpol.2013.02.005.
T.Engell, H.W. Lorås, H.Sigmundsson, ***Window view of nature after brief exercise improves choice reaction time and heart rate restoration***, New Ideas in Psychology, Volume 58, 2020, 100781.

Oximeter

This device measures blood oxygen saturation, which can help gauge levels of stress or relaxation.

Data collected from oximeters can contribute to developing design guidelines for creating environments that support respiratory health.

For example, these guidelines might include the integration of natural ventilation, the use of indoor plants, and the selection of materials that do not emit toxic substances.

ENVIRONMENTAL MEASUREMENTS

Air Quality

This involves monitoring levels of CO_2, particulate matter, and other pollutants to understand the impact of the environment on health and behavior.

For instance, the choice of natural materials and the organization of spaces can significantly influence indoor air quality.

Poor air quality can lead to various health issues, including respiratory problems and decreased cognitive function, emphasizing the need for architects to prioritize ventilation, material selection, and spatial layout in their designs.

Incorporating biophilic elements and sustainable practices can further enhance indoor air quality, contributing to healthier and more productive environments.

Binaural Head Noise Level

By measuring noise levels, it is possible to understand how acoustic pollution affects comfort and behavior.

A study suggests that responses to environmental stress from noise have a direct impact on physical well-being and an indirect impact on emotional well-being (Cantuaria et al. 2023).

Manuella Lech Cantuaria, Jørgen Brandt, Victoria Blanes-Vidal, ***Exposure to multiple environmental stressors, emotional and physical well-being, and self-rated health: An analysis of relationships using latent variable structural equation modelling***, Environmental Research, Volume 227, 2023, 115770.

Lux Meter

This device is used to assess the intensity and quality of natural and artificial light.

Proper lighting in a space is crucial for ensuring visual comfort, safety, and productivity.

Natural light, when available, is preferable because it has positive effects on health and well-being, influencing mood and circadian rhythm (von Gall, 2022).

von Gall, Charlotte. 2022. ***The Effects of Light and the Circadian System on Rhythmic Brain Function*** International Journal of Molecular Sciences 23, no. 5: 2778.

Thermo-Hygrometer

This device measures environmental conditions to analyze their impact on comfort and behavior.

An environment that is too humid or too dry, or with inadequate temperatures, can negatively affect well-being, causing discomfort and even health issues.

For example, some studies have demonstrated the relationship between environmental conditions and their effects on blood pressure (Wang et al., 2017).

Anemometer

This device measures environmental conditions to analyze wind speed.

Wind speed can influence occupant comfort, structural safety, and the energy efficiency of buildings.

A study conducted in 2020 analyzed how window design affects comfort and energy efficiency by managing wind speed (Esfahankalateh et al., 2020).

Wang Q, Li C, Guo Y, Barnett AG, Tong S, Phung D, Chu C, Dear K, Wang X, Huang C. ***Environmental ambient temperature and blood pressure in adults: A systematic review and meta-analysis***. Sci Total Environ. 2017 Jan 1;575:276-286.

Atefeh Tamaskani Esfahankalateh, Mohammad Farrokhzad, Ommid Saberi, Amirhosein Ghaffarianhoseini, ***Achieving wind comfort through window design in residential buildings in cold climates, a case study in Tabriz city***, International Journal of Low-Carbon Technologies, Volume 16, Issue 2, May 2021, Pages 502–517

BEHAVIORAL MEASUREMENTS

Eye Tracking

This technique monitors eye movements to understand where people look and for how long.

Some studies conducted with eye tracking have shown that people tend to ignore blank facades (Hollander et al. 2020; Krupina et al. 2017) and focus longer on elements of higher architectural quality (de la Fuente Suárez, 2020).

Hollander, Justin B., Ann Sussman, Alex Purdy Levering, and Cara Foster-Karim. 2020a. ***Using Eye-Tracking to Understand Human Responses to Traditional Neighborhood Designs.*** Planning Practice & Research 35 (5): 485–509.

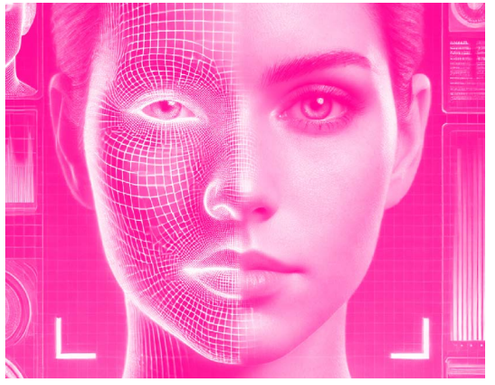
Krupina, A.A., V.V. Besplaov, E.Y. Kovaleva, and E.A. Bondarenko. 2017. ***Eye Tracking in Urban Visual Environment. Construction of Unique Buildings and Structures*** 52:47–53.

De la Fuente Suárez, Luis Alfonso. 2020. ***Subjective Experience and Visual Attention to a Historic Building: A Real-World Eye-Tracking Study***. Frontiers of Architectural Research, September, S2095263520300558.

Movement Monitoring or Dwell Time Tracking

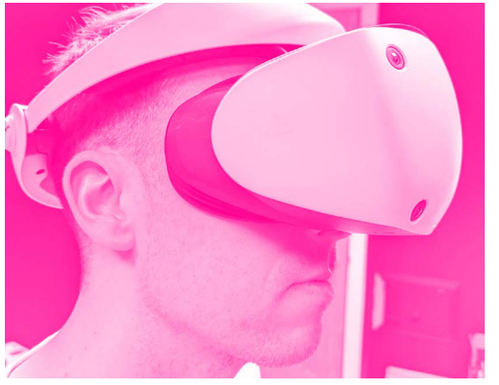
Tracking people's movements through motion sensors or tracking systems is useful for analyzing the paths and behaviors individuals exhibit in a space. This allows for the detection of relationships between spatial visibility, individual motivations, and knowledge of the spaces (Stanitsa et al. 2023).

Facial Expression Analysis



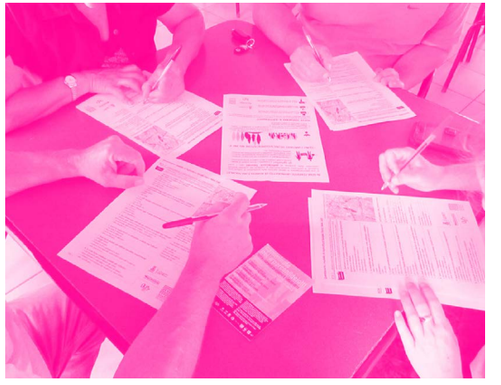
Software is used to recognize and analyze facial expressions to determine emotions. During the design phase, it may be possible to monitor users' emotional reactions to models or simulated environments to better understand which spatial configurations promote comfort, satisfaction, or reduce stress.

Virtual Reality (VR)



Creates immersive simulations of architectural environments to observe reactions and behavior in controlled scenarios. Augmented Reality (AR), on the other hand, overlays digital elements onto the real world to study how people interact with modified spaces.

Questionnaires and Surveys



These tools collect self-reported data on perceptions, emotions, and preferences related to architectural spaces.

For example, questionnaires like the Perceived Restorativeness Scale (PRS) assess how environments contribute to individuals' psychological recovery (Hartig et al. 2003).

Others, such as the Urban Design Quality Assessment Tool (UDQAT), evaluate the quality of urban design based on variables like visual attractiveness, the functionality of public spaces, perceived safety, and inclusivity (Carmona et al., 2008).

Avgousta Stanitsa, Stephen H Hallett, Simon Jude, ***Investigating pedestrian behaviour in urban environments: A Wi-Fi tracking and machine learning approach, Multimodal Transportation***, Volume 2, Issue 1, 2023, 100049.

Hartig, T., Evans, G. W., Jamner, L. D., Davis, D. S., & Garling, T. (2003). ***Tracking restoration in natural and urban field settings***. Journal of Environmental Psychology, 23(2), 109-123.
Carmona, M., De Magalhães, C., & Hammond, L. (2008). ***Public Space: The Management Dimension***. Routledge.

PROGRAMME

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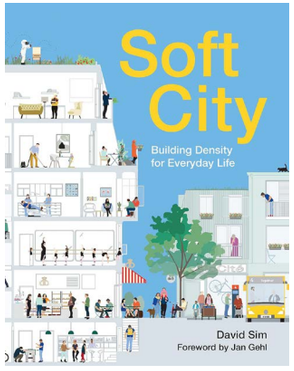

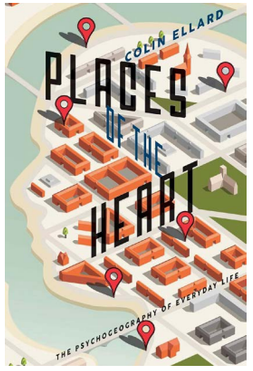

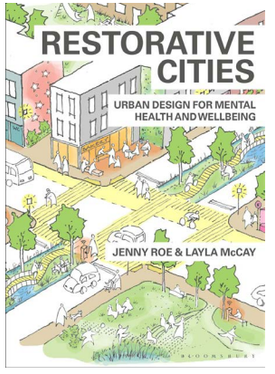

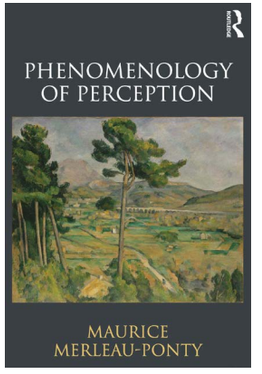

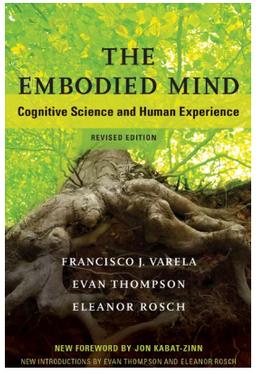

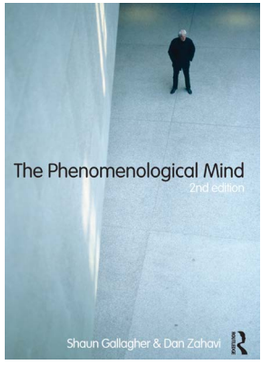

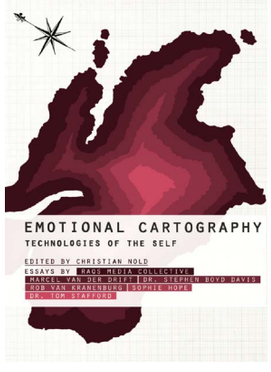

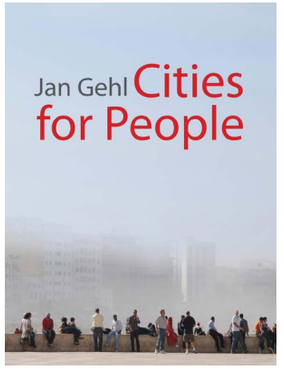

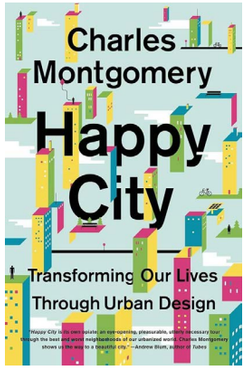

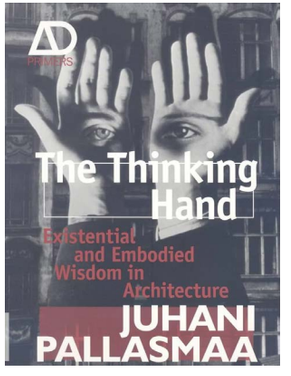

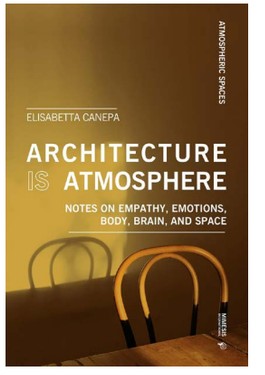

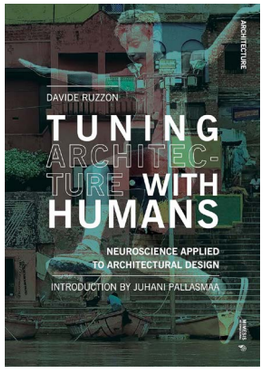

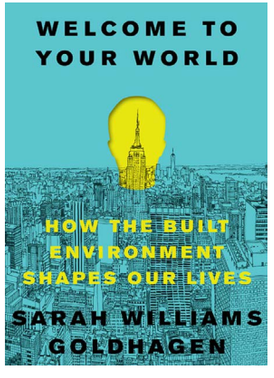

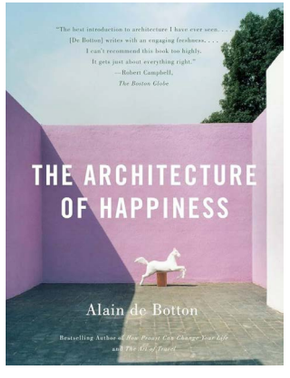

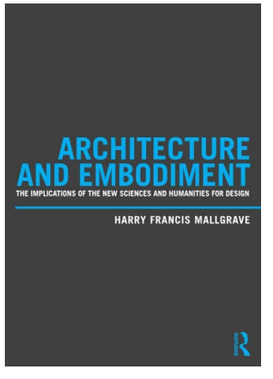

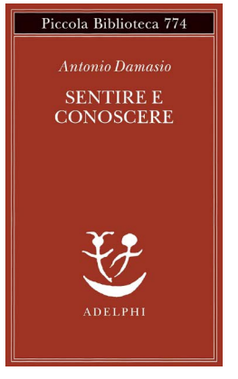

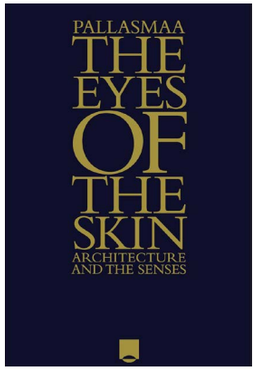

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WE ARE PLEASED TO ANNOUNCE A **SPECIAL AGREEMENT** BETWEEN OUR SUMMER SCHOOL AND DIFFERENT ACTIVITIES NEAR THE UNIVERSITY.

THIS AGREEMENT OFFERING EXCLUSIVE PRICING FOR OUR PARTICIPANTS.

THIS AGREEMENT IS VALID THROUGHOUT THE DURATION OF THE SUMMER SCHOOL **FROM 2ND TO 7TH OF SEPTEMBER** AND IS AVAILABLE TO ALL PARTICIPANTS.

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