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→ Just an illusion? Between simulation, emulation, and hyper-realism

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# Phenomenology of space and virtual reality. An experimental course for students in architecture

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Abstract

The paper presents the theoretical assumptions and the way of conducting an experimental course on the Phenomenology of Space designed for architects and interior designers.

The course made use of virtual reality to allow students to directly experience the perceptive and cognitive effects induced by the forms of space, colour, the texture of materials, and light. Virtual reality was also the medium that made it possible to translate certain philosophical concepts related to the phenomenology of space into an experiential and applicative field close to the sensitivity and spatial culture of the designers.

The themes addressed gave rise to a progressive development that allowed students to develop an increasingly complex project and experiment with increasingly complex issues. The course began with the phenomenology of thresholds, and continued with the analysis of field and synesthesia, the phenomenology of atmospheres, and the analysis of orientation and mind maps. In each of these areas of research and experimentation, the common thread remained the relationship between the body and space. The article also presents the exercises proposed to the students and an overall assessment of the teaching experience.

Keywords Phenomenology Virtual reality Achitecture Philosophy Education

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## Presentation of the course

Virtual reality (VR) holds educational potential of great interest for all disciplines that deal with spatiality, and even more for those, like architecture, that have a privileged relationship with lived space, that is to say with the interaction between the body and its environment. I attempted to demonstrate this thesis through the conception and development of a course on Phenomenology of space that makes use of virtual reality to study the perceptual effects of architectural design.

The course began as a research project funded by an internal call for proposals in the Department of environments, construction, and design of the University of Applied Sciences and Arts of Southern Switzerland (SUPSI-DACD, Mendrisio, Switzerland) dedicated to digitization. From the outset, its implementation required the formation of a small interdisciplinary research team. It included, alongside myself, philosopher and professor of spatial theory Pietro Vitali (architect and professor of the degree course in interior architecture), Matteo Moriani (architect and assistant for the course developed by this project), and Marco Lurati (interaction designer and lecturer). In contrast to what often occurs, the collaboration between different areas of expertise in our case had a material character. The task of taking care of the content and educational aims of the course fell to me, as philosopher, while that of dealing with questions related to more strictly architectural aspects fell to the designers, who then guided the students in their design work. The interaction designer, finally, had the task not only of making the course possible through the development of the technology and the necessary programming, but also of teaching students how to carry out design in VR and the relevant programs (Twinmotion in particular). As is clear, no member of the working group could have proceeded without the aid of the others. The final goal was to create a course in phenomenology applied to architecture with the help of Oculus Quest 2 headsets. In other words, rather than just learning theories, the students would need to sharpen their

spatial sensibility by experimenting with these theories in a virtual environment. The challenge was thus double: on one hand to offer a course on applied philosophy, and on the other to introduce virtual reality into a theoretical course, making it the tool for the application of theory.

In addition to this, in an almost unconscious, seemingly instrumental way, the students would need to learn sophisticated programming languages, a skill that is also useful from a professional standpoint.

## Background

Virtual Reality has recently emerged in architecture and the arts as novel means for visualizing different design solutions and for building up the design model and its virtual environment.

Similar to these applications, VR is commonly used in architectural education in the design process, as it provides the designer with an image to create the spatial and topological relationships of a project. Although the use of VR for teaching purposes is not yet widespread in architecture faculties (in Europe at least), its pedagogical effectiveness has been clearly documented.[1] Several studies on the pedagogical function of VR in architectural studies have shown that the use of VR increases the awareness of designer during designing in terms of the structural properties and component assembly of a structural system,[2] helps students' way of thinking, critical thinking, and problem-solving activities,[3] creates the possibility to "feel like being in the place,"[4] strengthens the memory and awareness of the

1 F. Kharvari, L.E. Kaiser, "Impact of extended reality on architectural education and the design process," *Automation in Construction* 141 (2022): 1-19, https://doi.org/10.1016/j.autcon.2022.104393.

2 W.A. Abdelhameed, "Virtual reality in architectural design studios: a case of studying structure and construction," *Procedia Computer Science* 25 (2013): 220-230, https://doi.org/10.1016/j.procs.2013.11.027.

3 F. Kharvari, L.E. Kaiser, "Impact of extended reality on architectural education and the design process."

4 T. Chandrasekera, K. Fernando, L. Puig, "Effect of degrees of freedom on the sense of presence generated by virtual reality (VR) head-mounted display systems: a case study on the use of VR in early design studios," *Journal of Educational Technology Systems* 47, no.4 (2019): 513-522.

spatial configuration,[5] augments "spatial abilities" in students,[6] trains the capacity to switch naturally from a planar representation of space to a 3D representation of the same space.[7] To cite a concrete experience, Johan Bettum, professor of architecture at the Städelschule, has used virtual reality in the master degree studio Architecture and Aesthetic Practice at Städelschule Architecture Class (Frankfurt) as a laboratory for spatial inquiries in relation to subjective experience, the construction of reality and the role of images in regimes of representation. These experiments consisted in designing immersive environments where architecture has been explored through the computerized representation of forms and spaces. According to the intentions of the course, this digitally produced realm of images supplemented and often supplanted the traditional role of drawing in the contemporary design process.[8] A second research experiment on the integration of VR in the curriculum at architecture schools, took place at the College of Architecture and Planning (CAP) of Ball State University. For three years in a row, the CAP created a design virtual environment for 2nd year students, making use of an HMD (Head Mounted Display). The CAP VR Environment aimed to support the actual architectural design process, therefore aiding the process of learning how to design, rather than limiting its use as a visualization tool. In the practical terms, the immersive simulation of an actual design project (the lobby of a small hotel) was intended to enable students to recreate the architectural characteristics of the space, eliciting an appraisal of their architectural spatial experience. According to the author, the ability to navigate through

5 A. Angulo, "Rediscovering virtual reality in the education of architectural design: the immersive simulation of spatial experience," *Ambiences. Environment Sensible, Architecture et Espace Urbain* 1 (2015): 1-23, https://doi.org/10.4000/ambiances.594.
6 T. Chandrasekera, S.Y. Yoon, "Adopting augmented reality in design communication: focusing on improving spatial abilities," *The International Journal of Architectonics, Spatial and Environmental Design* 9, no.1 (2015): 1-14, http://dx.doi.org/10.18848/2325-1662/CGP/v09i01/38384; M. Schnabel, T. Kvan, E. Kruijff, D. Donath, "The first virtual environment design studio," *19th eCAADe Conference Proceedings. Helsinki* (2001): 394-400.
7 J. Milovanovic, G. Moreau, D. Siret, F. Miguet, "Virtual and augmented reality in architectural design and education. An immersive multimodal platform to support architectural pedagogy," 17th International Conference, CAAD Futures 2017, Istanbul, Turkey.
8 J. Bettum, *Architecture, Futurability and the Untimely* (Bielefeld: transcript Verlag, 2022).

the simulated lobbies turned out to be key to capture the architectural spatial experience and perceive the aesthetic emotion and/or symbolic meaning embedded in the projects.[9]

A further type of studies attempted to demonstrate, through an experimental design that also involved students from a design class at the Milan Polytechnic, the possibility of recreating complex spatial qualities through VR, for example investigating how multisensoriality (scent in particular) affects the realism of the experience contributing to increase the users' sense of presence in the virtual environment.[10]

Although in some ways apparently akin to the case studies cited, it must be borne in mind that the course we experimented with differs first and foremost from them for the basic reason that it does not fall within the scope of architecture, but of philosophy applied to space (a philosophy with a phenomenological orientation). The aim of the pedagogical experiments conducted is therefore not related to design, but to the understanding of the body-space relationship, with a specific focus on the modalities of sensory perception. In other words, thanks to virtual reality, the students were able to experiment in various ways, according to a number of controlled possibilities, how the manipulation of certain variables (positions of openings, colors, scales, relationships between objects in space, artificial lights, sequences of spaces) impact the spatial experience on a perceptive and cognitive level. The aim was not to obtain a realistic representation of space, nor was it to learn about and visualize certain spaces and construction processes through VR. The aim was rather to verify with one's own (virtual) body the perceptual effects induced by

9 A. Angulo, "Rediscovering virtual reality in the education of architectural design: the immersive simulation of spatial experience."
10 M. Carulli, M. Bordegoni, U. Cugini, "Integrating scents simulation in virtual reality multisensory environment for industrial products evaluation," *Computer-Aided Design & Applications* 13, no. 3 (2016): 320-328, https://doi.org/10.1080/16864360.2015.1114390.

certain design choices, and to develop a method to derive generalizable knowledge from experience.

Although the aforementioned studies have provided the course with useful information and a set of important examples regarding the didactic use of VR in architecture, there is - to the best of my knowledge - no previous use of VR in phenomenology of space.

## Theoretical framework

Phenomenology is undoubtedly the theoretical orientation most closely related to the intelligence of architects, who are accustomed to thinking about space "live," so to speak. Among the characteristic abilities of the architect are the capacity to consider the relationship between spaces and bodies, to imagine the atmosphere of environments and the way in which shape, color, and spatial scale influence our experience of them, and to organize solids and voids, exteriors and interiors, the visible and the invisible, light and shadow, volumes and matter, as though they were elements of an aesthetically expressed spatial language. It is precisely this sort of sensibility that the course sought to thematically develop, strengthening students' awareness of and ability to design perceptual (i.e., not only spatial) environments imbued with cognitive and emotional meanings. To best realize the desired encounter between philosophy and architecture in this pre-categorical level of spatial experience, I found it useful to refer to phenomenology broadly defined, broadly enough to include Gestalt psychology and some elements of behaviorist psychology. Before giving a synopsis of the thematic contents of the course, it will be necessary to evaluate the contribution that virtual reality can offer to the encounter between phenomenology and architecture, mediating between their languages. VR's potential consists in its particular qualities as an immersive medium, or more specifically in its

capacity to insert perception into an immaterial, interactive, and programmable *Umwelt*.

The first aspect is perhaps the most important. If there is a single quality that the spatial intelligence of the architect must necessarily develop during the course of study, it lies in the capacity to move from an understanding of space based on plans—made up of lines, symbols, numbers, and so on—to a subjective understanding, ideally placed in the space that those signs represent abstractly. The passage from an objective and external gaze (the one that reads the plan) to an internal, embodied one, capable of bringing the signs to life in a volumetric space and corporealizing them, is normally entrusted to the imagination. But given the complexity of this mental operation, it is always necessary to turn to a plurality of media: sketches, models, photographs of the models taken from the inside, rendering, etc.

None of these tools, however, is capable of physically including the subject, who thus continues to have a distanced and disembodied understanding of space. Given the importance of the role that the body plays in spatial experience, it is clear that the value of virtual reality lies in the possibility of transferring the subject inside of the space of representation, in such a way that allows them to have a direct, aesthetic, and even synesthetic experience. Thanks to VR, the architect can jump in and out of the representation: he or she can "enter the plan," making it into an immersive experience, and then exit, modify the design on the basis of this experience, and finally return to the virtual space to check the outcome of the operation. This movement in and out of the space of representation provides the intelligence of the architect with a new medium; this is not, however, virtual reality, but rather his or her own body as an "analogical" tool, one that provides an analog to embodied sensory experience. On the one hand, virtual space replicates the intentional structure that the world presents to us: space moves with me, shows itself and hides itself in relation to my gaze, and declares its secondary qualities (for example, showing itself to be narrow and oppressive,

or disorienting —all qualities that are related to a certain kind of subjective experience.). On the other hand, even if they are "embedded" in a virtual environment, the subjects still maintain an interior distance, a remainder of objectivity; they know that they are in a representation, just like at every moment they know that their own body is only an analogon of the sentient one, which allows them to have a mediated, self-observed experience, and to register its effects. If virtual space is a distant relative of the sketchpad, the body that explores virtual space is a distant relative of the pencil that draws in the sketchpad, or more precisely of the manual intelligence involved in that experience.

The risk of virtual reality causing the architect to lose an authentic relationship to space, or to "authentic space," is, when taken from this point of view, less serious than one might fear—and all the more so due to the fact that VR does not by any means claim to substitute itself for the traditional forms of mediation, translation, and representation of space, but rather to integrate them into its own capabilities. Furthermore, VR remediates within itself many media to which we have long been accustomed, from the drawing pad to the cinema; from this perspective, rather than eliminating all mediation, it entails a deep and layered media culture. This is also confirmed by the educational usage of VR, given that in order to adequately use it, the students will necessarily continue to move through the representational languages of different media (from manual design to CAD, as well as the photos and films that can be made within virtual reality). They can also share their visual experience externally, since what they see within the virtual environment can be simultaneously projected on a screen connected to a projector. This, if we consider it closely, is no small thing. Two separate and autonomous (although co-present) environments—two different parallel *Umwelten*—can be connected in real time. Making it possible to show the outside what one sees as one sees it, VR makes ocular experience shareable, albeit through two different media (on one hand the projected film and on the other the immersive reality.) The VR viewer transforms vision

into a full-fledged medium: it transmits, communicates to the outside, shows, and makes what it manifests public in real time. The virtual experience is, in effect, “replicant” by nature. In it, technological reproducibility has now caught up with the perceptual experience linked with one’s own body: today sight, tomorrow touch, and then who knows.

The alienation of one’s own body, if we can call it such, may have slightly disturbing aspects for those who want to project it into dystopian future scenarios, but within the context of more modest educational ambitions, it holds enormous potential, given that it makes the lived experiences of others shareable and evaluable. As will by now be clear, the course was nothing like a normal design workshop, nor did it aspire to be. It was more like a virtual gymnasium where, through a series of guided experiments, the perceptual and psychological dimensions of space were exercised; a gymnasium that allowed for the easy modification of space and the experimental verification of its effects.

## Aims of the program

To be concise, the use of virtual reality in the architectural context can be summarized in four points. These, as we will see, were developed in the course through a series of exercises.

*1) VR allows for the modification of space at will, and for the verification of its effects on perceptual, emotional, and cognitive levels (depending on what one is interested in determining) in an immersive environment.*

For example, the height of a ceiling is, from one point of view, objective and mathematical, identical in any space. It is what it is, regardless of other spatial variables like color and depth. Within the perceptual dimension, however, things proceed very differently, since all of these variables intertwine and influence one another in a manner so clear that to define it as subjective would be misleading. The depth of space modifies the perception of

height in direct proportion to its increase. This can easily be experienced in virtual reality precisely because it only applies to a sentient body, which on paper does not exist. Experiments of this type can examine the relationship between color and spatial perception, the modification of an environment through light (or shadows) depending on the hour of the day or the season, the perception of one's center of balance in space, the relationship between different scales, the relationship between different volumes and shapes, synesthesia, and many other analogous situations.

VR offers the opportunity to examine all of these aspects not only through vision, but also from a practical point of view, that is to say, through the study of the behavior of the users that interact with the organization of a given space: how they move, what they understand, what they remember, and how they describe a certain environment. All of this provides a way to test design solutions (whether realistic or experimental), or to verify theories developed in the existing literature.

*2) VR allows for the implementation of phenomenological variations and the experiencing of their effects on different levels: aesthetic, psychological, ontological.*

The use of phenomenological variation within the context of the project meant the possibility of varying one or two special elements, altering in a controlled way their position, breadth, depth, and other characteristics. One can, for example, modify the perception and geometry of an entire environment by changing where the entryway is located, thus deforming the environment in relation to the observer's center. Depending on the breadth or depth of the entry, the experience of entering, and of the relationship between outside and inside, is modified. Depending where the two entries in a room are located—given that these establish between themselves, on a perceptual level, a reciprocal connection, a sort of invisible corridor—space will be "sliced" by that connection in different ways, redistributing

internal space and generating areas (compartments) of variable shapes and dimensions.

This method requires experimenting with a limited and controlled number of variations, and that the results be recorded from a perceptual and even ontological point of view. The dimensions of a window can be varied in such a way as to produce significant aesthetic discontinuities, but beyond a certain threshold of size the window changes in nature, becoming, for example, a glass door (if it alludes to the possibility of transit, taking on the potentiality of an opening-threshold), or a glass wall, where wall and window meet, each giving up one of its intrinsic potentialities (in the case of the wall, the possibility of visually separating spaces, and in the case of the window, that of connecting an inside to an outside atmosphere). The exercise of variation can take on many forms, all useful for testing a wide range of spatial effects with aesthetic, symbolic, or even ontological significance. To give a final example, which highlights the possibilities of VR, we might think of the effect of all of the possible variations applied to the height of a small room, from the minimum or even insufficient measurement to a generous one, say of 3 meters, up to a decidedly out of scale measurement of 10 or 20 meters. This modification allows for the discovery through intuitive evidence of the discontinuous relationship between stimulus and perception, or of the differential thresholds that punctuate the qualitative passage from one psychophysical condition to another (claustrophobic, comfortable, roomy, oppressive, etc.). The qualitative thresholds can also cause a change in the sense of space itself. For instance, a space in which the ceiling is too low will not be perceived as inhabitable. Habitability is a spatial quality that requires a certain minimum height, even if it is still a claustrophobic one. But if one exceeds this measurement greatly, one enters into a new context of meaning, for example that of an artistic installation, and space takes on a poetic significance that it did not have before. But this is not all. The exercise of phenomenological variation calls for the capacity to describe, or better, to verbalize lived experience, developing

an appropriate (specific), effective (figurative), and meaningful (persuasive) language. From perception to expression: a continuous two-way transit that helps students develop a degree of spatial awareness that they do not normally possess. Naturally, the exercise becomes progressively more complex depending on the number of variables one chooses to introduce. The preceding case, for example, could be made much more complex simply with the introduction of one further variable, such as materials (say, concrete or word) or the presence of a light source (for example, an opening onto a natural light source from above).

*3) VR allows for the firsthand study of relationships between form and meaning.*

Here, I turn to the field of Gestalt psychology, and more particularly to the possibility of simulating and studying phenomena of orientation and mental maps (at the base of which lie the tools of the psychology of shapes). To once again in this case offer some examples, one might think of virtual space as a site in which to experiment with different strategies for functionally dividing up space, for grouping families of objects on the basis of the principles of "figural unification," for generating rhythms, for anticipating the sense of space (directions and meanings), and for inducing motor responses. Within this field of experimentation also lies the possibility of giving symbolic significance to a certain element of the environment (for example, the main entrance, the most important painting, the state room, etc.) as well as that of articulating in various modes the relationship between voids and solids, distances, or objects with different shapes and sizes.

*4) VR allows for experimentation with the constitutive factors of atmospheres.*

This fourth point is the result of the interaction between all of the preceding spatial components and their relative interactions, and thus cannot but appear last. Experimentation with the constitutive factors of the atmosphere becomes explicit when attention is shifted to the

holistic aspects of the environment, the emotional impact that the space has on us, and the moment of encounter with an atmosphere and the way it can be an object of design. The usefulness of virtual reality in respect to the phenomenological analysis of atmospheres is clear: precisely because an atmosphere is in itself an immersive and synesthetic phenomenon, it can only be observed through bodily presence. One is always *inside* an atmosphere, to the point that the very presence of a certain atmospheric connotation defines, when perceived, the confines of an interior (the interior of a work of architecture, of a certain city or neighborhood, or of a particular culture, etc.). VR thus shows itself to be extremely effective as a tool for the analysis of the psychological aspects of atmosphere, facilitating an applied atmospherology. The various aspects that comprise the atmosphere of a place, that is to say its social and emotional characteristics, can become the object of critical analysis and can be used for the revision of designs. Within this field of experimentation there is also the possibility of observing space from any desired perspective and of moving, even if in a limited way, in a manner that unites visual and synesthetic experience.

In addition, VR offers the possibility of introducing natural sounds, background noises (for example, chatter, whose intensity depends on the number of people that we decide to put into the space), sounds of footsteps (which change depending on the surface being tread upon), and music (which can be diffused into space from a preselected source). It is not yet possible, however, to introduce tactile experiences, while olfactory ones are difficult to manage and a bit artificial.

## Structure of the course and workflow

The course took place during the first semester of the 2022 academic year, and was divided into 12 lessons, each lasting an entire day.

Excluding the first introductory lesson and the last one, dedicated to the presentation of final exercises,

five units were offered to the students, each one comprising two lessons. Each unit dealt with a different theme, but always built on the themes discussed in the preceding units. The course thus followed a gradual development through units. The typical organization of the units followed this order: a theoretical lecture (Matteo Vegetti); presentation of the exercise; discussion; presentation of programing tools and the use of Twinmotion for the given exercise (Marco Lurati); design work by students under the guidance of the course assistant (the architect Matteo Moriani, with the invaluable volunteer contribution of the interior architect Victoria Pham). Each unit was concluded the afternoon of the second lesson with a group review of the exercises. Since these were carried out by students in pairs, the presentations took place as follows: one student explained the design choices and the outcomes of the experimentation, while the other, from within the virtual space, showed the spaces in question (thanks to a projector connected to the Oculus, or rather to the computer supporting it). Each pair of students worked on a space of a different scale (2.5x2.5; 5x5; 10x10; 20x20; 2.5x5; 5x10; 10x20). In this manner, the phenomenologically significant issue of scale was indirectly present throughout the course, presenting numerous opportunities for reflection. Given that the same exact exercise presented difficulties of different types depending on the scale, each group of students necessarily had to offer a different design solution. The differences between scales were of course also evident in the exercises based on variations.

In what follows I offer a descriptive brief of the subjects dealt with in each unit and in the corresponding exercises. The latter held a fundamental importance in the overall economy of the course, given that they connected theory with practice and formed an educational pathway that began from a few basic elements and then became progressively richer and more complex.

"I ask a young student: how would you make a door? With what dimensions? Where would you place it? In which corner of the room would you have it open? Do you understand that these different solutions are the are the very basis of architecture? Depending on the way that one enters into an apartment, on where doors are located in the walls, you feel very different sensations, and the wall that you that you drill likewise takes on very different characteristics. You then feel that this is architecture."[11]

The first introductory lesson of the course dealt with the relationship between body and space, bringing to light some of the fundamental issues in Merleau-Ponty and Heidegger's phenomenological approaches.[12] Through the definition of these concepts and the relationship between them (space as correlate of the activity of a living body, as environment, as site, as a felt, perceived, lived space, invested with meanings), the course established a theoretical basis sufficient for understanding its aims.

Then, a first approach to virtual reality, and a first intuitive test of the ideas learned, was carried out through the use of the Gravity Sketch program, which offers its users the possibility of creating space through the movements of their hands, and to choose from a vast repertoire of creative resources (lines, shapes, surfaces, colors, materials, transparencies, etc.). Each pair of students randomly selected an aesthetic/perceptual theme (unknown to the others) to give form to. Once a pair of students created theirs in VR, the rest of the class was invited to visit it and provide a brief description of it. Based on the comments received, it was easy to tell if the students had succeeded

11 Le Corbusier, *Precisions on the Present State of Architecture and City Planning* (1930) (Cambridge MA: The MIT Press, 2015).
12 M. Heidegger, M. *Corpo e spazio* (1964), trans. F. Bolino (Genova: Il Melangolo, 2000); M. Merleau-Ponty, *Phenomenology of Perception* (1945), trans. D. Landes (Abingdon-New York: Routledge, 2012).

in conveying the theme that they were tasked with interpreting spatially.

In a small way, this first contact with virtual reality reproduced the characteristic transposition of theoretical themes into an "applied" dimension that would characterize the course as a whole. Most importantly, Gravity Sketch is an effective tool for becoming familiar with VR, and more particularly with the possible functions offered by the Oculus.

## UNIT 1 - Phenomenology of thresholds

The first unit was dedicated to the theme of thresholds, or rather to the diverse configurations of the divide between interior and exterior that make the experience of space as a place possible (the possibility of "entering" or accessing that only the crossing of a threshold allows). Experimenting with the different thresholds that comprise space and mastering their rhetorical significance means knowing how to articulate space like a complex text, full of caesuras, connections, leaps, transitions, and transformations. Each threshold represents a critical point in space because it is called upon not only to manage the different practical and symbolic functions of the environment, but also the relationship between seemingly irreconcilable opposites: interior and exterior, public and private, the familiar and the foreign, the inside and the outside. The phenomenology of thresholds thus aimed to show through numerous examples how the threshold could be designed and conceived of in different ways depending on goals and intentions (aesthetic, symbolic, practical).

The lesson took its impetus from an anthropological reflection on the significance of the threshold/door, [13]to then move towards more philosophical[14] and phenomenological[15] questions. Here, as elsewhere, Ching's im-

13 J. Rykwert, *The Idea of a Town* (Cambridge MA: The MIT Press, 1988).
14 G. Simmel, "Bridge and door," *Theory, Culture & Society* 11 (1994): 5-10.
15 P. V. Meiss, *De la forme au lieu* (Lausanne: Presses polytechinques et universitaires, 1986); A. Moles, E. Rohmer, *Psychologie de l'espace* (Paris: Casterman, 1998).

ages and insightful observations were very useful in accompanying the discussion.[16]

The lesson was also the occasion to thematize the threshold between "front" and "back," between "stage" and "backstage," or rather between the public and private dimension, through a series of different frames. Here, I use the language of Erving Goffman to allude to the importance of the frame in defining, on the basis of its specific material or formal qualities, the type of situated social situation that one wishes to obtain: the degree of visibility, of separation, of privacy (or of porosity, contamination, or transparency) that one wants to establish between the respective domains of "front" and "back" in order to strengthen or weaken the public valence of the place and the relationships that take place there.[17]

## Expected outcomes:

- Understanding the symbolic value of the entering a space and the way in which the threshold manages the relationship between interior and exterior.
- Experimenting with the perceptual effects generated by the different positioning of a door-opening in the same identical space.
- Experimenting with the connection that is created between two door-openings within the same space, and the modification of spatial relationships that this connection brings about.
- Understanding the significance of the center as what organizes space and its distortions.
- Understanding the language of the window-opening through different typologies.
- Experimenting with the concept of "frame."
- Analyzing the way in which an object (in this case, a work of art) reacts to space based on its position, size, relationship to light, and to its own "aura."

16 F.D.K. Ching, *Architecture: Form, Space, and Order* (Hoboken: John Wiley & Sons, 2015).
17 E. Goffman, *Behavior in Public Places* (New York: Free Press, 1966); and *Interaction Ritual* (New York: Pantheon, 1982)

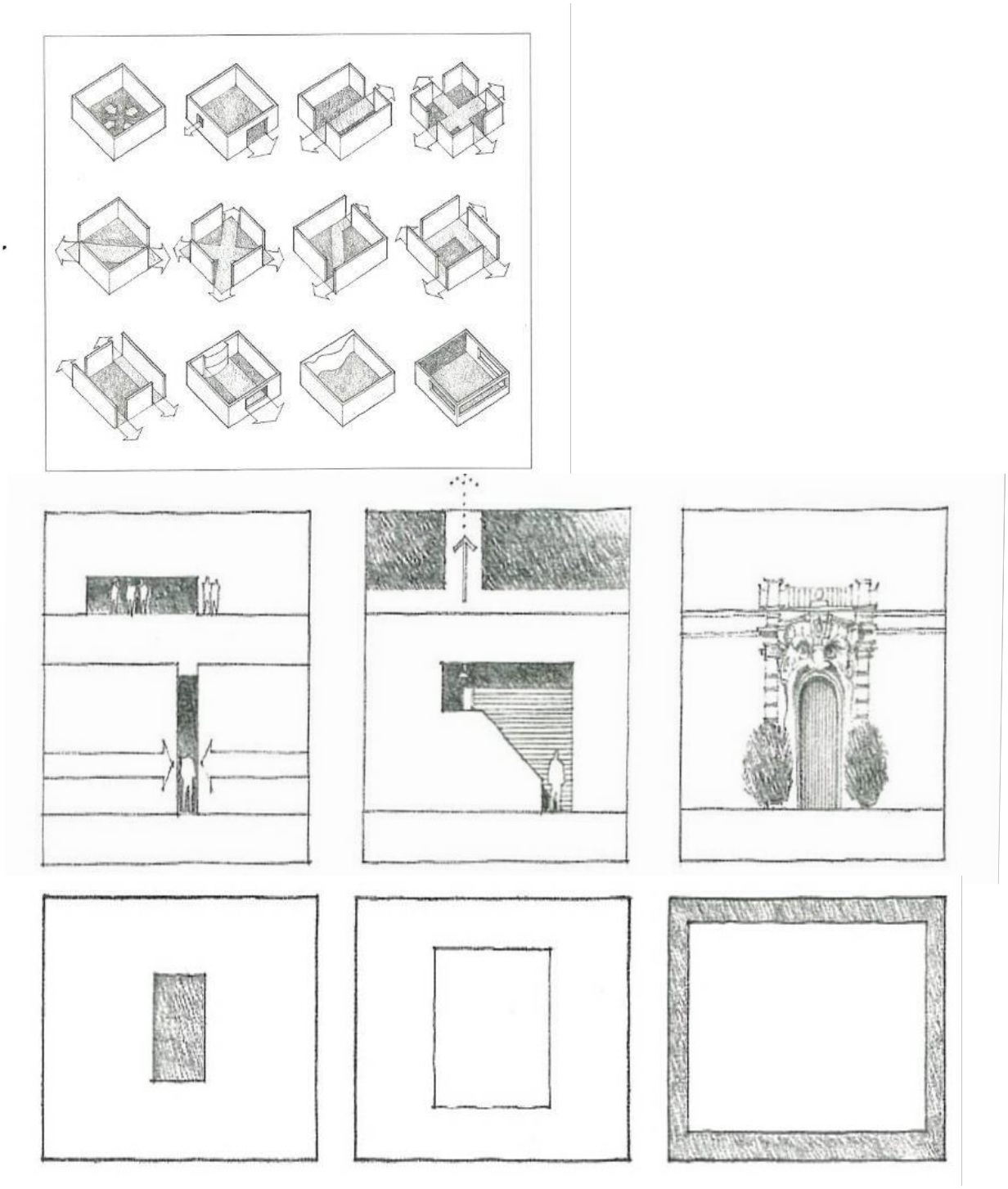


Fig. 1. Beyond a certain limit, an opening ceases to be an enclosed area and becomes a dominating element: a transparent plane bordered by a frame. From F.D.K. Ching, *Architecture: Form, Space, and Order* (Hoboken: Wiley, 2015).

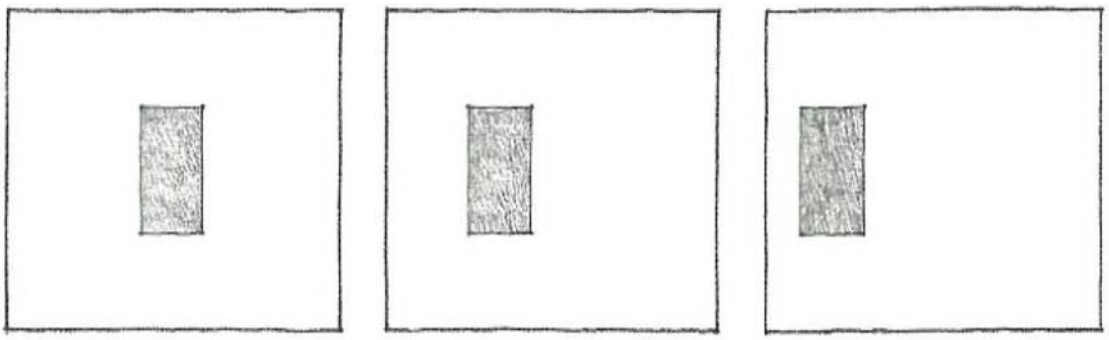


Fig. 2. An opening situated on the plane of a wall will appear to be a luminous form against a contrasting background. If it is centered on the plane, the opening will appear stable and will visually organize the surface around it. If it is decentered, it will create a level of visual tension with the sides of the plane towards which it has been moved. From F.D.K. Ching, *Architecture: Form, Space, and Order*.

## Exercise

Each pair of students works on a space of different scale, with a square or rectangular base (2.5x2.5; 5x5; 10x10; 20x20; 2.5x5; 5x10; 10x20).

A) Create three spaces with equal dimensions. In one of these spaces, place a door-opening in three different positions, and note how the space changes perceptually, writing a description of it from within the virtual space.

B) For each of the three spaces, create two door-openings placed in different ways (but on the same wall). Describe the result: how is space modified? Where is the center?

C) Place a rug of shape, dimension, and material of your choice in each space.

D) Place a window-opening in each space. The openings must be central, zenithal, and angular (size and shape are up to you).

E) Modify the dimensions and shape of the window-openings, increasing their width or height freely. Describe the result.

F) Place into one single space a combination of four of the entry-doors or windows created earlier (4 total: this could be 2 doors and 2 windows or 3 doors and 1 window, etc.) Describe the result.

G) Connect in a sequence four of the spaces created earlier. Give these environments a hierarchy and connect them with a path that joins the entrance and the exit. Design the main entrance into the space from a rhetorical standpoint. Try to convey the hierarchy between different environments through the use of different kinds of thresholds. The thresholds must anticipate the sense of the space being entered, and must convey the relationship between the spaces that they connect (you can use frames, stairs, boxes, ramps, partitions, false ceilings, different thicknesses for the walls, and the form and dimensions of the thresholds can be modified. In this phase, the

threshold can become a volume). You may not, however, use any elements of décor.

H) Place a sculpture in one of the environments in such a way as to enhance the latter.

I) Design a threshold/separation (a frame) that creates a private space within one of the rooms that you have already made.

J) Make a 30-second VR film of these environments and describe the created space (2000 words). The description should be written subjectively ("I advance and see on my right…;" "the light from the window is illuminating the threshold that I am about to cross…")

K) Take 3 photos of the interior that illustrate the design choices (that is, representative views of the interior space generated through experimental solutions.)

## UNIT 2 - The power of the field

"By emphasizing the generated field in addition to the architectural object, one raises once more the problem of space, but in different terms by giving the concept a different value. In traditional criticism space is a homogeneous structure, a kind of counterform to the mural envelope, indifferent to the lighting conditions and to its position in relation to the buildings, whereas the notion of field stresses the continuous variability of what surrounds the architectural structures."[18]

The second unit, which clarified some of the theoretical elements already present in the first, analyzed the principles of field theory, or better, an ensemble of theories based on the shared presupposition that a space occupied by volumes does not coincide with their physical

18 P.P. Portoghesi, cited in R. Arnheim, *The Dynamics of Architectural Form* (1977) (Berkeley: University of California Press, 2009).

space, but extends beyond it, without however being independent of the originating form.[19]

The field thus coincides not with the borders within which everything is enclosed, but with a certain arrangement of forces and vectors acting in space. Space thus becomes an active and reactive environment: a field of psycho/physical forces. Every volume present in the field, by virtue of its mass and its shape(s), changes the field's appearance. The field generated through design deeply affects our perceptual schemas through the play of forces that act within it. But within the concept of field, the concept of center, already encountered in the previous unit, plays a fundamental role. While geometrically a center is simply a point, perceptually it extends as far as the conditions of stability that it is based on will permit. Of course, the center may or may not be indicated. In architecture, it can be indicated (or suggested) by a ceiling lamp, a mobile, a decoration, or a mosaic. Or, it can be an empty space at the center of two diagonals or of the geometry dictated by the positions of the thresholds. Normally, however, there are multiple centers at work in each field, each of which attempts to prevail over the others. The lesson thus brought attention to the problem of the interaction between fields of different shapes and strengths, suggesting the possibility of making corrections to one's designs by working on the centers, the directions of the volumes that generate the field, or their distance from one another.

This illustrates the concept, well known to phenomenology and cognitive psychology, that space is born as the relationship between objects. On the basis of this idea, shifting attention from the shapes of objects and their interaction to the void that separates them, the lesson then also discussed the concept of "interspace," and along with it the fundamental law of attraction-repulsion: "Objects that look 'too close' to each other display mutual repulsion: they want to be moved apart. At a somewhat greater distance

19 R. Arnheim, *The Dynamics of Architectural Form*; P.P. Portoghesi, V.G. Gigliotti, "Ricerche sulla centralità. Progetti dello studio di Porta Pinciana," *Controspazio* 6 (1971); A. Marcolli, *Teoria del campo* (Firenze: Sansoni, 1971) and *Teoria del campo 2* (Firenze: Sansoni, 1978).

the interval may look just right or the objects may seem to attract each other."[20]

The final theme concerned the typical fields of basic shapes such as the circle, triangle, and square. This discussion was then applied to bidimensionally-perceived spatial forms, such as the shape of the window in respect to the wall in which it is placed.

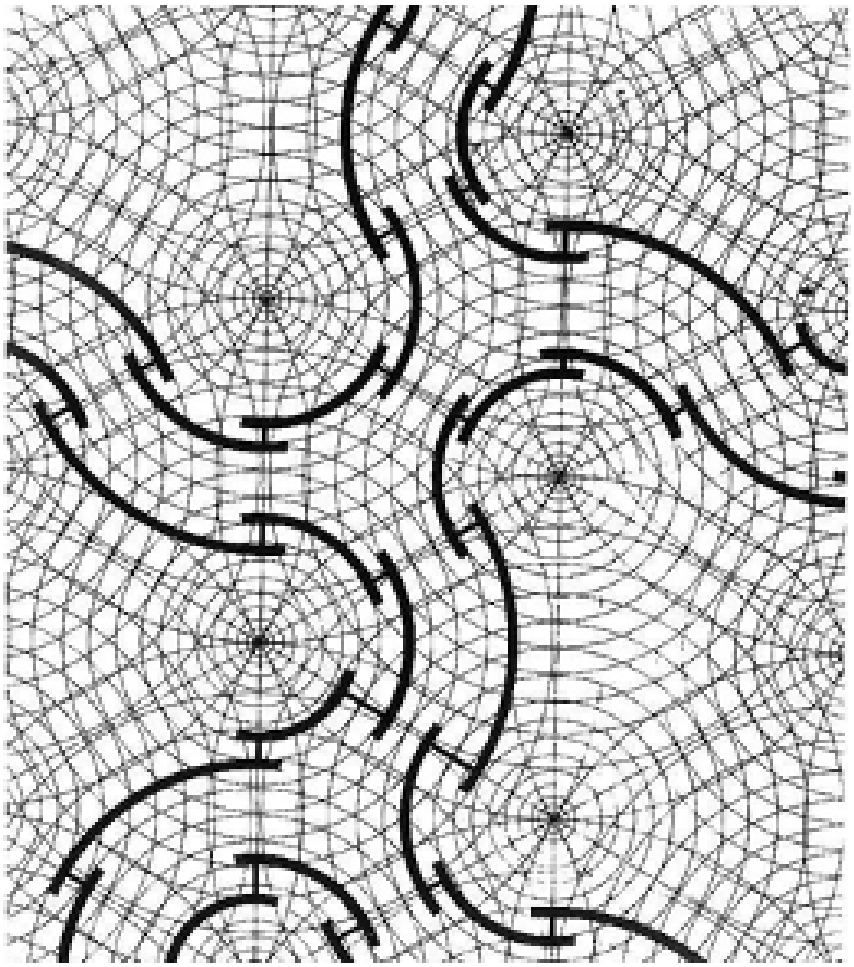
Finally, it bears noting in relation to point "C" of this unit's exercise that VR does not exclude interaction with physical objects. Virtual and material reality can in fact overlap, generating a significant enhancement of spatial experience. In the present case, it was sufficient to place a real table where the virtual table designed by the students was, in order to allow a group of four people to share the same situation from different perspectives. The members of the group sat around the same virtual table (sharing the same design simultaneously in multiple Oculus viewers), but could at the same time establish a tactile relationship with the table around which they were seated in real space.

The lesson made wide use of examples taken from architecture as well as city planning in order to explain how field theory adapts to each scale.

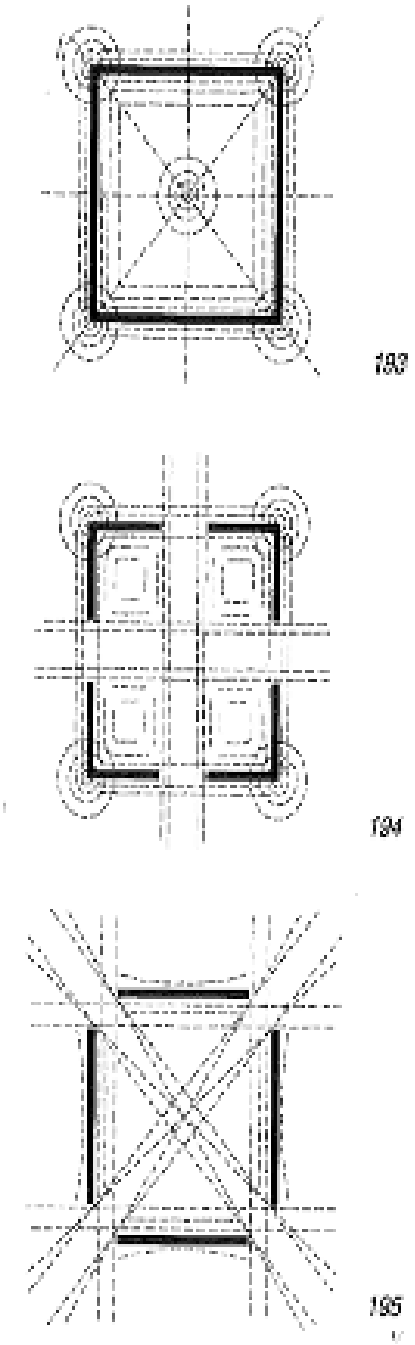
20 R. Arnheim, *The Dynamics of Architectural Form*.

## Expected outcomes:

- Understanding and experimenting with the influence of the center and the relationship between centers.
- Perceptually experimenting with the field in terms of scope and shape of irradiation, as well as the relationship between fields in terms of interference, conflict, or harmony.
- Perceiving the language of voids in relation to solids in terms of visual balance and variable density (compression and decompression of the spaces between elements).
- Testing the symbolic/perceptual power of fire (that of a fireplace) in establishing a center and a space.
- Observing the dynamics of the field together with the other students, developing a suitable language.
- Putting the dynamics of the fields into the form of a graphic representation.



P. Portoghesi, *Field Theory. Space as a system of places*, 1974.



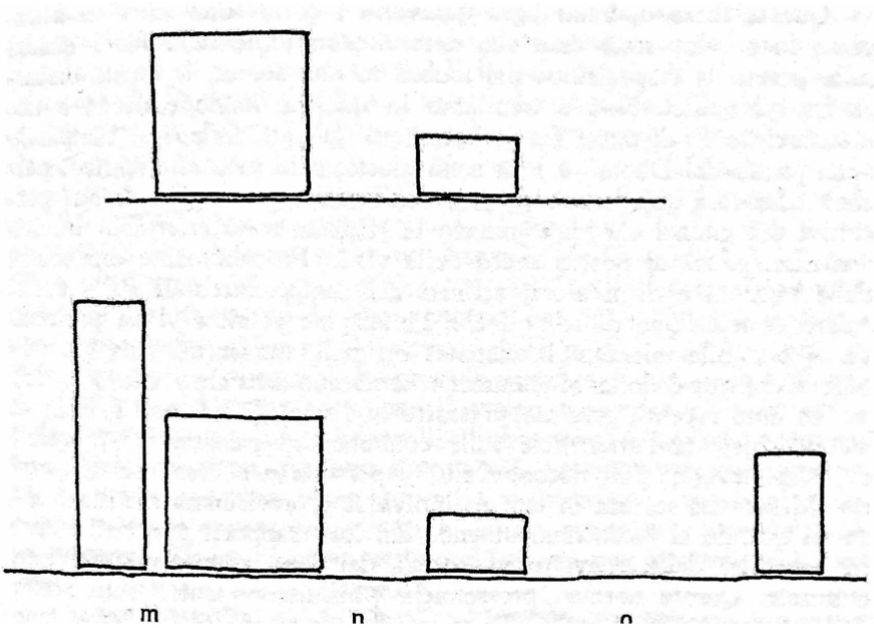
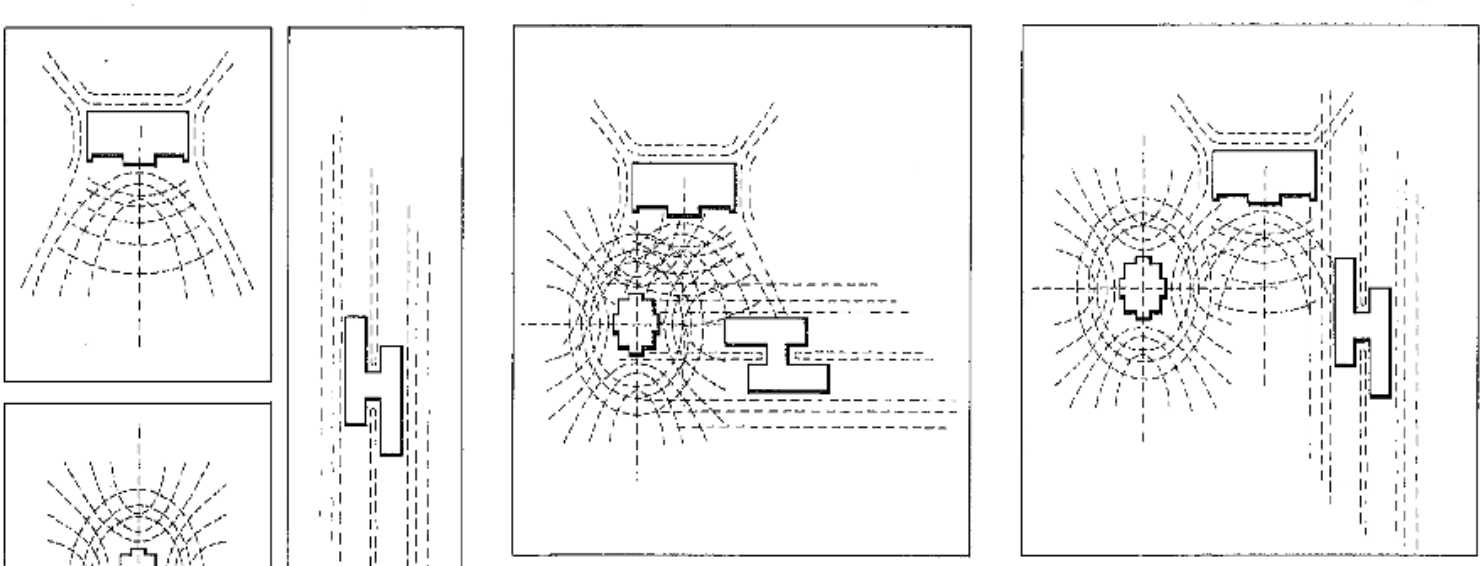




Fig. 4. Modification of forces internal to a rectangular field based on the positioning of the door-openings. From P. V. Meiss, *De la forme au lieu* (Lausanne: Presses polytechinques et universitaires, 1986).



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"Irraggiamento spaziale" approssimativo di tre edifici in funzione delle loro caratteristiche geometriche. La prima disposizione, combinando i tre volumi, provoca dei campi conflittuali. Nella seconda, i campi sono coordinati e contribuiscono alla formazione di uno spazio ben definito e coerente.

Fig. 5. "Irraggiamento spaziale."

## Exercise

Beginning from the final state of the work undertaken in the previous exercises, inserting objects and volumes in space, we will analyze the force fields that these create.

A) Begin the exercise by observing and analyzing the space already created on the basis of field theory.

B) Among the four volumes from the previous exercise, we have one that already contains the sculpture. In the three remaining, place:

a) A fireplace and a table for 4 people

b) 5 monochrome volumes (1 cylindrical, 1 cubic of 1x1, 2 parallelepipeds of 1x1x2, and a column): create a harmonious field out of these volumes, which may not touch the wall (the volumes can be sized in respect to

the space that hosts them). Describe the fields that you think you have generated.

c) In the third room, place a painting and a mirror on one of the walls.

C) Sit in a group of four at the table, and together analyze the space with the fireplace from inside of the simulation. Improve the previous solutions by changing the placement of the volumes, or try an alternative solution.

D) Now, enter the space with the geometrical volumes and analyze the field/fields generated. Improve the previous solutions by changing the position of the volumes, or try an alternative solution.

E) Analyze how the spaces change at different hours of the day due to natural light and shadows. Create a film of 30 seconds, based on a narrative strategy, that shows how the fields are modified by natural light at different times of the day. Walk through the entire space, back and forth, at three different times of day: morning, afternoon, and twilight.

F) Now, enter into the space with the geometrical volumes and analyze the field/fields generated. Improve the previous solutions by changing the position of the volumes, or try an alternative solution.

G) From inside the space, take three photographs representative of the perceptual/visual experience of the field.

H) Extract the building plan from Archicad (1/100) and draw the fields, centers, and vectors that you think you have generated within the space.

## UNIT 3 - Multisensoriality and synesthesia

"...every architectural setting has its auditive, haptic, olfactory, and even hidden gustatory qualities, and those properties give the visual percept its sense of fullness and life. Regardless of the immediate character of visual perception, paradoxically we have already unconsciously touched a surface before we become aware

of its visual characteristics; we understand its texture, hardness, temperature, moisture instantaneously." [21]

The third unit was carried out in collaboration with Dr. Fabrizia Bandi, researcher in the "AN-ICON" group led by Andrea Pinotti, who was a guest of the course thanks to the SEMP international exchange program. The aim of the unit was to guide students to the discovery of the universe of synesthetic effects attributable to sight and hearing.

Fabrizia Bandi, an expert in the thought of Mikel Dufrenne, introduced the students to elements relating to synesthesia in the phenomenology of Merleau-Ponty, Pallasmaa, and Dufrenne.[22] The lesson insisted on the importance of understanding the multisensorial character of perception since, whether one likes it or not, space communicates with bodies in this way, through the intertwining of different perceptual faculties.

Synaesthetic perception is the rule, and we are unaware of it only because scientific knowledge shifts the center of gravity of expe–rience, so that we have unlearned how to see, hear, and generally speaking, feel, in order to deduce, from our bodily organization and the world as the physicist conceives it, what we are to see, hear and feel . . . The senses intercommunicate by opening on to the structure of the thing. One sees the hardness and brittleness of glass, and when, with a tinkling sound, it breaks, this sound is conveyed by the visible glass. One sees the springiness of steel, the ductility of red–hot steel, the hardness of a plane blade, the softness of shavings.[23]

By relativizing the predominance of sight in the structure of perception, the theorists of synesthesia invite us to discover the persistence of "unauthorized" sensory registers (like sound and temperature in colors, or touch in something perceived visually), which condition experience

21 J. Pallasmaa, *The Embodied Image* (Hoboken: Wiley and Sons, 2012): 51-52.
22 M. Merleau-Ponty, *Phenomenology of Perception*; J. Pallasmaa, *The Embodied Image*; M. Dufrenne, *L'oeil et l'oreille* (1987) (Paris: Nouvelles Éditions Place, 2020).
23 M. Merleau-Ponty, *Phenomenology of Perception*: 266-267.

in mostly unconscious and unconditioned ways. The many examples referring to the field of architecture had the aim of leading the students to a decisive point: given the original complicity between body and space, to design means, perhaps before anything else, to organize a complex perceptual environment in which each element not only has multisensory potential in itself but also inevitably relates with that of the others. By experimentally testing the synesthetic effects of the designed space in virtual reality, intertwining their own bodies with it, the students had a way to determine the results of their choices on multiple perceptual levels. These could work towards creating syntonic or dystonic effects, or could play with the composition of different synesthetic qualities within the same element, for example, combining a given material with a color that contrasts with it in temperature, or background music of a certain kind, for example, soft and enveloping, with an environment imbued with the opposite synesthetic characteristics (cold, sharp, shrill). The general goal was to create a perceptually rich and coherent environment. Here, it is important to note that it is possible to import images of any material, including photographs of existing surfaces, into the Oculus.

This unit also allowed for the development of a discourse straddling the border between the phenomenological aspects of multisensory experience and the findings of the neurosciences.[24]

24 For example N. Bruno, F., Pavani, M., Zampini, *La percezione multisensoriale* (Bologna: il Mulino, 2010).

## Expected outcomes:

■ Cultivating sensitivity to the multisensory aspects of material and texture.
■ Developing a language capable of translating synesthetic experience and allowing it to be shared with others.
■ Studying the possibilities of using multisensoriality to design and compose different perceptual environments in logical sequences.
■ Experimenting with the encounter between the synesthetic aspects of music and those of the designed environments.
■ Verifying the efficacy of the desired perceptual effects through a questionnaire.

## Exercise

Beginning with the previously-created space, generate four different perceptual environments, working with materials, colors, and sounds. The environments must create an ordered sequence, a perceptual-synesthetic path imbued with meaning.

A) Work with tactile perception: use textures on different parts of the environment (floor, ceiling, objects present in the room, etc.) while also modulating the qualities of the materials (transparency, opacity, reflectiveness, etc.) to create an effect that induces a multisensorial/synesthetic sensation.

B) Use materials and colors to elicit a specific sensation (hot/cold; rough/smooth; sharp/soft; enveloping/repelling; lightness/oppression, etc.)

C) Work with sound: test the impact of the sound of footsteps, introducing different numbers of people into the space based on its size as follows:

- 2.5x2.5: 1 person, 5 people, 20 people
- 5x5: 1 person, 10 people, 40 people
- 10x10: 1 person, 20 people, 80 people
- 20x20: 1 person, 40 people, 400 people
- 2.5x5: 1 person, 10 people, 40 people
- 5x10: 1 person, 20 people, 80 people
- 10x20: 1 person, 40 people, 400 people

Once the highest number of people within the space has been reached, add voices. Finally, walk through the space and test the sounds of your footsteps in different environments.

D) In an environment of your choice, introduce a sound effect (natural or artificial) or music that reinforces the synesthetic character of the space.

E) The environments must create a perceptual itinerary. Through the characteristics that you give the environments, try to construct a pathway that will make a hierarchy apparent, with the clearest possible succession.

F) Describe in writing the synesthetic effect that you think you have generated in each of the fourenvironments (without sharing the responses with the rest of the class);

a) How can the environments that you have created be defined as multisensory?

b) What type of sensation did you want to make emerge from the different spaces?

c) What is the relationship between the choice of materials/sound and the sensation that you wanted to transmit to those within the space?

d) How did the choice of sound relate to the choice of materials and colors?

G) Take one photo in each environment.

H) Shoot a video of the four environments, lasting 24 hours (with all natural light). Compress it into a film of 2-3 minutes.

I) During the morning of the second day, each group will visit the rooms created by the others and respond in writing to some questions aimed at verifying the effect produced by the space on its users:

a) How do the spaces visited constitute an example of multisensoriality? Which factors contribute most?

b) What sort of sensation emerges from the different spaces. Try to describe which elements caused this sensation.

c) Was the sound particularly significant in your experience of the space? Why?

## UNIT 4 - Light and color: phenomenology of atmosphere

The fourth didactic unit was dedicated exclusively to the topic of light and color. The reason for this choice resided primarily in the importance of these two factors for spatial perception (in various ways: from colored light to the relationship between natural light and materials that reflect it). Furthermore, light and color play a decisive role in the connotations of atmospheres. In dialogue with various others, from Goethe[25] to Conrad-Martius,[26] from Sedlmayr[27] to James Turrel,[28] the lesson highlighted both aspects: the perceptual dimension and what Conrad Martius calls "the character" of light, or rather the way in which a given property of light is intermittently given expression. Light is undoubtedly a special atmospheric agent, since temperature and color can give space a very clear emotional timbre. But it can be used—as in the phenomenological art of James Turrel and Robert Irwin—to change the form of space, up to the point of distorting it and erasing its borders.

VR is a unique instrument for testing how light reacts to surfaces, their textures, and their colors in the widest range of different conditions (for example, depending on the time of day, and also by adding natural light to artificial light sources).

It is also useful, though, to create spaces and spatial languages linked to the psychology of shapes. Five possible functions of light capable of perceptually altering space in respect to different design aims: illumination, indication, division/unification, connection, creation of rhythm. Of course, each of these functions raises specific questions

25 J.W. Goethe, *Theory of Colours* (1810) (Cambridge MA: The MIT Press, 1970).
26 H. Conrad-Martius, "Realontologie," *Jahrbüch für Philosophie und phänomenologische Forschung* 6 (1923): 159-333; H. Conrad-Martius, "Farben. Ein Kapitel aus der Realontologie," *Festschrift Edmund Husserl zum 70. Geburstag gewidmet* (*Jahrbüch für Philosophie und phänomenologische Forschung*) 10 (1929): 339-370.
27 H. Sedlmayr, *La luce nelle sue manifestazioni artistiche*, ed. A. Pinotti (Palermo: Aesthetica, 2009).
28 J. Turrell, *Extraordinary Ideas-Realized* (Berlin: Hatje Cantz Verlag, 2018). See also M. Govan, C.Y. Kim, eds., *James Turrell: A Retrospective* (Los Angeles: Los Angeles County Museum of Art, 2013).

(the type of light source and its temperature, the shape and position of the light sources, the relationship between light and darkness, background and foreground, etc.), but in a theoretical sense, the exercise aimed above all to demonstrate the potential applications of a complex theoretical framework like the one mentioned above.

Finally, the discussion turned to the phenomenological theme of atmospheres, a field that, as already noted, could only appear last, once the basic elements for an analytic understanding of the body-space relationship had been acquired. With few exceptions, "atmosphere" is a concept used in a very intuitive way by architects, yet is central to their specific form of spatial intelligence. It is here that VR perhaps offers its greatest contribution: it is one thing to introduce students to the thought of the usual authors on the subject, such as Böhme,[29] Norberg-Schulz,[30] Schmitz,[31] Ströker[32] or Zumthor,[33] and quite another for them to have the chance to analyze atmospheres from within, to study their perceptual effects, and to modify their factors in the desired (often experimental) way. Describing the extraordinary power of atmospheres to influence our mood is much simpler and more effective when one has the possibility of interacting with a virtual environment. From within these environments, variation in light can be understood atmospherically in all of its significance. The capacity to design an/the entrance as a tool to understand, expand, or focus an encounter with a given atmosphere can be carried out in all possible ways, giving life to the theoretical hypotheses learned through the creativity of the designed. The symbolic and potential connotations of an atmosphere—which are often an involuntary outcome, but

29 G. Böhme, "Atmosphere as the subject matter of architecture," in P. Ursprung, ed., *Herzog and de Meuron: Natural History* (Montreal: Lars Müller and Canadian Centre for Architecture, 2002) and *Atmosfere, estasi, messe in scena. L'estetica come teoria generale della percezione*, trans. T. Griffero (Milano: Christian Marinotti, 2010).
30 C. Norberg-Schulz, Genius Loci: *Towards a Phenomenology of Architecture* (New York: Rizzoli, 1991).
31 H. Schmitz, "Atmosphärische Räume," in *Atmosphäre(n) II. Interdisziplinäre Annäherungen an einen unscharfen Begriff* (München: Kopaed, 2012).
32 E. Ströker, *Investigations in Philosophy of Space* (Athens: Ohio University Press, 1987).
33 P. Zumthor, *Atmospheres: Architectural Environments, Surrounding Objects* (Basel: Birkhäuser Verlag, 2006).

nonetheless entirely controllable, through the composition and interaction of the conditions present in a given space, and at times even a result produced by a "heterogenesis of ends"—can finally become the objects of direct experience, which would otherwise be impossible. I think these examples are sufficient to illustrate a field of research that goes far beyond virtual reality's capacity to change one floor into another, in order to find which one best suit the environment.

For architectural professionals, though, this aspect should truly not be underestimated. VR offers them a precious medium of communication with their clients, who often lack the ability to imagine the design solutions being proposed, or to read plans and "visualize" them in three dimensions. But even if bridging the gap between the spatial competencies of architect and client may sooner or later prove to be the main use of virtual reality, it is not, however, the most important for, nor does it lie within the specific aims of the course.

## Expected outcomes:

- Experimenting with environmental effects of lighting.
- Experimenting with the semiotic and Gestaltic use of light.
- Testing the atmospheric effects relating to light and color.

### Exercise

A) Use artificial light to strengthen the synesthetic connotations of the environment in an atmospheric way.

B) Use light to unify a part of the space and the objects within it.

C) Use light to generate a threshold.

D) Generate variations in the temperature, intensity, and type of artificial light, and observe how the colors of surfaces and the texture of materials change.

E) Analyze how the spaces change under the different variations of artificial light.

F) Modify the color of the materials through the effects of variations of artificial light.

G) Using a narrative strategy, make an atmospheric film of 30 seconds that shows how the spaces are modified by different types of artificial light. If necessary, you can animate the space with the movement of a virtual character.

### UNIT 5 - Orientation and legibility of space

The final didactic unit dealt with the theme of spatial orientation on the basis of the line of research opened up by the work of Kevin Lynch.[34] At the basis of this choice are two assumptions. The first is that Lynch has given us a scalable methodology, which can also be effective when applied to interior spaces. The second is

34 K. Lynch, *The Image of the City* (Cambridge MA: The MIT Press, 1960). See also L. Letenyei, J. Dobák, eds., *Mental Mapping* (Passau: Schenk Verlag, 2019).

that such a methodology, based on psychology of shapes and on a study of mental maps that we might say are akin to phenomenology, places itself in continuity or in dialogue with the content already explored in the preceding units of the course. The formation of mental maps takes place in the interaction between subject and environment. On a cognitive level, for Lynch the maps reveal the constant presence of five elements, which we can also define as structures, in the sense that they structure the experience of (urban) space by connecting it back to a universal mental schema. Such irreducible elements, even if they are not necessarily always co-present, are the path, the edge, the district, the node, and the landmark. A space's degree of comprehensibility, or rather our own capacity to orient ourselves in space and to have a clear mental image of it, depends on the form, character, and composition of these structures. The capacity of design to give spaces identity, structure, figurability, and meaning is fundamental in fostering a positive interaction between subject and environment, or even to induce emotional well-being. This gives us the capacity to anticipate how space will be understood, to support our spatial awareness (and hence our confidence in the space), and to develop a positive identification with spaces.

All of this holds for any interior space, even if it is clearest on a large scale (for example that of a museum).

Each interior indeed presents us with paths, both introverted and extroverted nodes, helpful or disorienting edges (like walls, partitions, or anything that divides space), landmarks (prominent aesthetic elements), and even districts, since the term designates first and foremost for Lynch whatever distinguishes the characteristic atmosphere of a place.

To demonstrate and test this hypothesis, the students had to empty out the spaces they had created up to this point, multiply them by four, and connect them in a freely-chosen sequence. Using only the spatial language of the five fundamental elements and working in syntony with the principles of the psychology of shapes that make space recognizable and possible to remember (uniqueness,

formal simplicity, continuity, preeminence, clarity of connection, directional differentiation, visual field, awareness of movement, rhythm) the students were asked to give their design a high cognitive value for the users. In order to test the result obtained, each student visited the design created by the others in virtual reality, and at the end of the visit drew a mental map for each.

The study of the maps, finally, allowed several problems linked to the understanding of space to be brought into the discussion: errors in the reconstruction of the shape of the space, missing places, unclear dimensions and hierarchies, and incongruencies and hesitations of various types. The critical evaluation of the most problematic spaces (and, on the other hand, of those that almost always elicited a clear representation) allowed the students to rethink their design, seeking effective solutions. VR is a very useful tool for studying phenomena of orientation and environmental image. Its usage, however, can be extended to other psychological aspects related to the design of the environment, as for example to the concept of affordance, which in Gibson's language refers to the physical qualities of objects that suggest to a subject the appropriate actions for manipulating them.[35] The greater the affordance, the more the use of the tool becomes automatic and intuitive (a passage to cross, a door to open in a given direction, a switch to turn or press, etc.). Another possible use of a virtual space with "public" dimensions, like the one created in the last unit, is the study of the rules of proxemics.[36] This can be accomplished through the possibility of inserting a number of virtual people, who move according to established or casual paths, interacting in various ways, into the scene.

35 J.J. Gibson, *The Ecological Approach to Visual Perception* (1979) (New York: Psychology Press, 2015).
36 T.E. Hall, *The Hidden Dimension* (New York: Anchor Books, 1990).

## Expected outcomes:

- Experimenting with the principles of Lynch's theory from the perspective of design and develop a sensitivity to the cognitive structure of space.
- Learning the method of mental maps.

## Exercise

A) Return to the basic space in its starting condition, taking away all of the elements aside from the openings (doors and windows). Multiply the space you created before by four times. Then generate a sequence of twelve connected environments.

Four spatial elements must be present in the design: pathways, edges, introverted nodes, extroverted nodes, and landmarks. Design the entrance and exit of the building. The goal is to create a fluid and figurable space. To achieve this goal, plasterboard walls can be taken away or added (also to change the shape of the space); or you can redesign them in such a way as to weaking or strengthen the frame (the edges) to create visual and auditory connections, light effects, or transparencies.

Each room can have a landmark (painting, statue, mirror, geometric volumes).

In order to orient the user on the path and to support the figurability of the space you can use: colors, materials, lights, sounds, and frames.

You may not, however, use symbols or signs.

B) Make a film of the space.

C) Once it has been designed, the space will be visited by other groups for a set period of time. These visitors will then be asked to draw a map of the space as they remember it. On the basis of these mental maps, try to understand the strong and weak points of the designed space through a synthetic map.

The project will be evaluated in respect to the following categories: uniqueness/originality, formal simplicity,

hierarchical continuity, clarity of connections, directional differentiation, scope of vision, awareness of movement.

The maps will be collectively discussed. We will try to understand why certain spatial elements were forgotten, misunderstood, and memorized with difficulty.

D) Change the space in order to modify it on the basis of the suggestions that emerged from the discussion.

## Technical specifications

There are dozens of 3D and VR software programs specialized in various types of applications. The criteria that guided our choice were the following: possibly free software, so that the students could continue to use it as professionals, simplicity of the interface and usage, simplified workflow, and the capacity to model in 3D and have VR visualization and navigation functions.

Based on these criteria, we chose Twinmotion (https://www.unrealengine.com/en-US/twinmotion), a software specifically designed for architecture and interior architecture based on the Unreal motor; the VR experience is native “out-of-the box,” with features allowing for the real-time modifications of materials, time of day, etc.

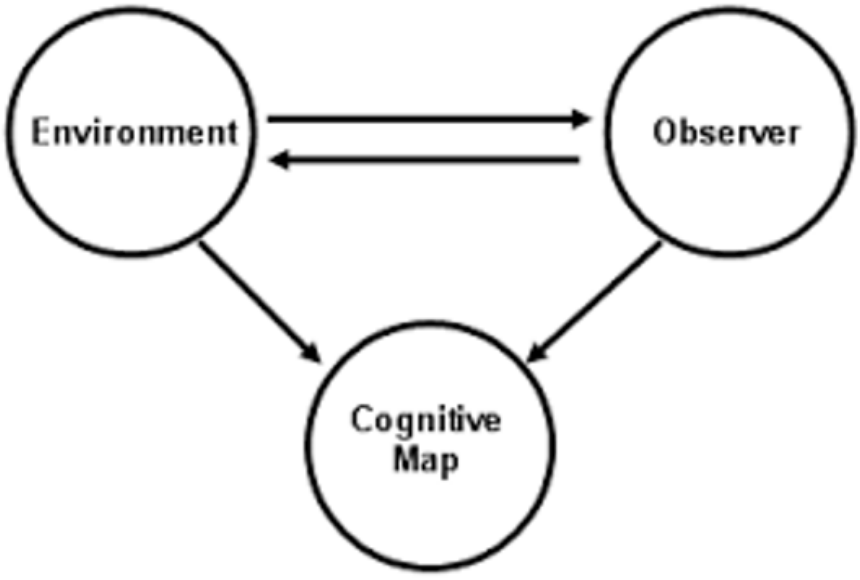



Fig. 6.

The interface is very simple, but on a deeper level allows for all of the necessary modifications of

parameters. It can also simulate sounds in the space when one moves through the VR scene.

Twinmotion has an internal library of 3D models (animated and otherwise) that can be added to the scene one is working on in a very intuitive way, but does not allow for the creation of new 3D models from within.

The solution to this problem was to use the Twinmotion plugin, which allows for the importation from various 3D modelling programs such as Rhinoceros, ArchiCAD, or 3DS Max, of 3D objects with a simple transfer.

This solution was ideal insofar as the students were able to use ArchiCAD for 3D modeling and then to synchronize it with Twinmotion for VR and rendering.

Also, the main design remained in ArchiCAD, where various sections and plans were designed as usual.

The VR viewer market has developed in interesting ways in the past few years, moving from solutions with fixed stations (with the viewer connected to the computer by cable and external sensors to map the area of the game) to mobile ones, with integrated sensors that function independently, without a cable and the need for an external computer to function.

The main need of the project was to have a quick working process with the fewest possible number of intermediate steps. The product chose was the Oculus Quest 2 (https://www.oculus.com/quest-2), a “standalone” viewer with an integrated graphics processor, which can also function as an external viewer for a computer when connected via cable. The price and the image quality were important factors in the final selection.

The possibility of using the students’ own laptop computers was quickly rejected, due to the issue of the computing power of graphics cards, different operating systems, and the installation of necessary programs that use a large amount of disc space (at least 30 GB).

To solve these problems, Windows laptops with the latest video cards (Nvidia RTX 3070), with all of the necessary programs installed (ArchiCAD, Oculus, Twinmotion) were acquired.

## Discussion and recommendations

The structure of the course proved to be effective and engaging, and gained very positive evaluations from the students, confirming in its own way the positive effects on VR learning already cited.[37] The strongest point was the integration of theory and practice, two dimensions that normally are clearly separated and, despite good intentions, mutually indifferent.

This also signaled a danger and a difficulty: unfortunately, the results of the course could not be measured by looking at the end outcomes —as would take place in a design workshop— because the design, in our case, was the means and not the end.

Furthermore, some of the starting conditions (for example, the position of the door-openings) can seem absurd from an architectural point of view, and are incomprehensible if one is not aware of the specific educational goals of the course.

The attention dedicated by the students to certain environmental, spatial, compositional, formal, perceptual, and atmospheric factors definitely produced surprising results, which were also appreciated by our architect colleagues, but in order to avoid misunderstandings it was always necessary to strongly reiterate the theoretical/philosophical specificity of the course and its objectives. From this point of view, even the spaces that were seemingly less successful from an architectural standpoint could have a positive significance in regard to what interested us: the essential was not in fact in the results in themselves, but in the process that led to them, in the experimental intentions of those who made them, and in the documentary traces that recorded and commented on the experience on a theoretical and critical level. The essential, in short, was the degree of awareness developed by students in each phase of the course and their level of understanding

37 F. Kharvari, L.E. Kaiser, “Impact of extended reality on architectural education and the design process.”

regarding the ways in which certain spatial factors impact our relationship with space on conscious and unconscious, and cognitive and perceptual levels.

However, in view of the Academic Year 2022-2023, in order to better distinguish the intentions of the course from those of the project work, we decided to modify the course.

In particular, we have attempted to simplify the exercises and standardise them so that the results are comparable. In addition, we placed emphasis on experimenting with spatial variants of an element (e.g. the threshold/door) to allow students to test the most significant perceptual changes between the choices made. Finally, we required the students to present the experiments they had tried, a selection of the most interesting results, and written descriptions of their experiences in a common layout. Redefined in these terms, the first point of the new exercise relating to the first unit asks the students to place a gap-threshold in the starting space, to experiment with different solutions capable of generating a meaningful spatial experience; to describe in writing the criterion used, the most paradigmatic solutions, and the quality of space determined by these solutions. The same method, based on the study of variations, was applied to the composition of the rooms, the shape of the threshold/windows, the position of the sculpture, etc. Overall, the course has become much more analytical than before, and somewhat more phenomenological.

Fig. 7.

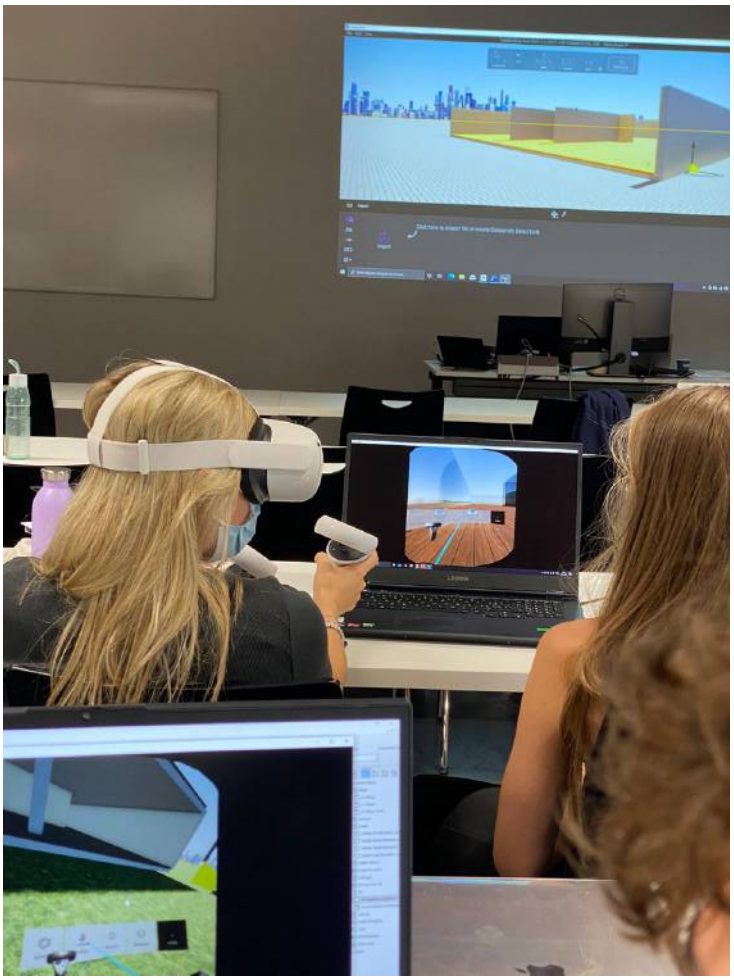


Fig. 8.

Fig. 9.

Fig. 10.

Fig. 11.

Fig. 12.

Figg. 9-12. Four pictures related to the exercise on the thresholds: projects of Elmira Rabbani and Gabriele Luciani, Giada Pettenati and Michelle Rosato, Giorgio Ghielmetti e Mattia Buttinoni. Bachelor of Interior Architecture, SUPSI, DACD.

Fig. 13.

Fig. 14.

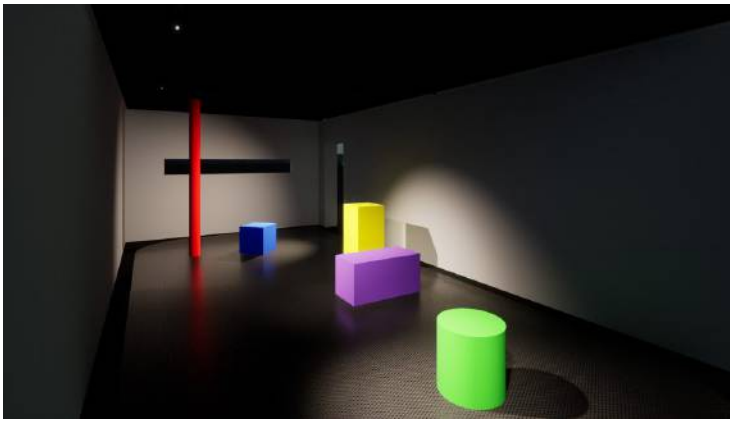


Fig. 15.

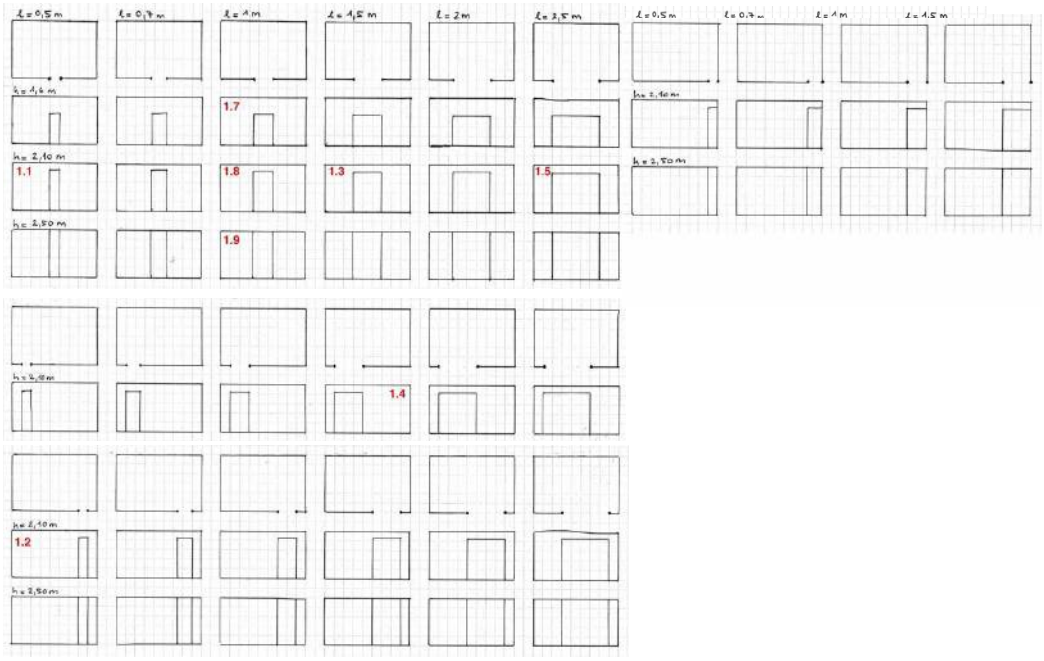
Fig. 16.

Figg. 13-16: Four pictures related to the exercise on light and colour. Projects of Sandra Burn and Asia Camoia, Elmira Rabbani and Gabriele Luciani, Jessica Corti and Silvia Zehnder. Bachelor of Interior Architecture, SUPSI, DACD.

**Unità 1** **es.1** - **Diversi modi di inserire un varco/soglia nello spazio**

spazio analizzato: 3 x 4.5 x 2.5m

Dal momento che il nostro parallelepipedo è di base rettangolare abbiamo iniziato ad analizzare le sperimentazioni in cuiNun varco viene posto sulla facciata più lunga, ossia 4,5 m. Abbiamo sperimentato varie possibilià di soglie utilizzando i seguenti criteri: locazione, altezza e larghezza. Inizialmente abbiamo posto la soglia al centro della facciata e abbiamo osservato come variava la percezione cambiando l'altezza (1.60m, 2.10m, 2.50m) del varco e in seguito cambiando la larghezza (0.50m, 0.70m, 1m, 1.50m, 2m, 2.50m). Successivamente abbiamo decentrato la soglia, ed infine abbiamo fatto lo stesso procedimento anche per la facciata più corta, ossia 3m. Dopo aver sviluppato queste svariate possibilità ne abbiamo selezionate alcune che secondo noi sono più significative:




**1.1:**
- Apertura minima
- Si fa quasi fatica a passare
- Non si è invogliati a varcare la soglia
- Luogo molto riservato

**1.2:**
-Le senzazioni elencate precedentemente vengono accentuate decentrando la soglia

**1.3**
- Forte collegamento interno-esterno
- Luogo arioso

**1.4:**
-Le senzazioni elencate precedentemente diminuiscono decentrando la soglia

**V1.5:**
- Sorge la domanda se si tratta ancora di una soglia

**1.7:**
- Non è vivibile
- Quasi non ci si rende conto che si tratta di una vera e propria soglia

**1.8:**
- Altezza standard
- In correlazione con i cambiamenti di larghezza sperimentati non influisce granché

**1.9:**
- Direzionalità: dona verticalità allo spazio

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Fig. 17.

**Unità 1** **es.2** - **Varianti migliori**

spazio analizzato: 3 x 4.5 x 2.5m

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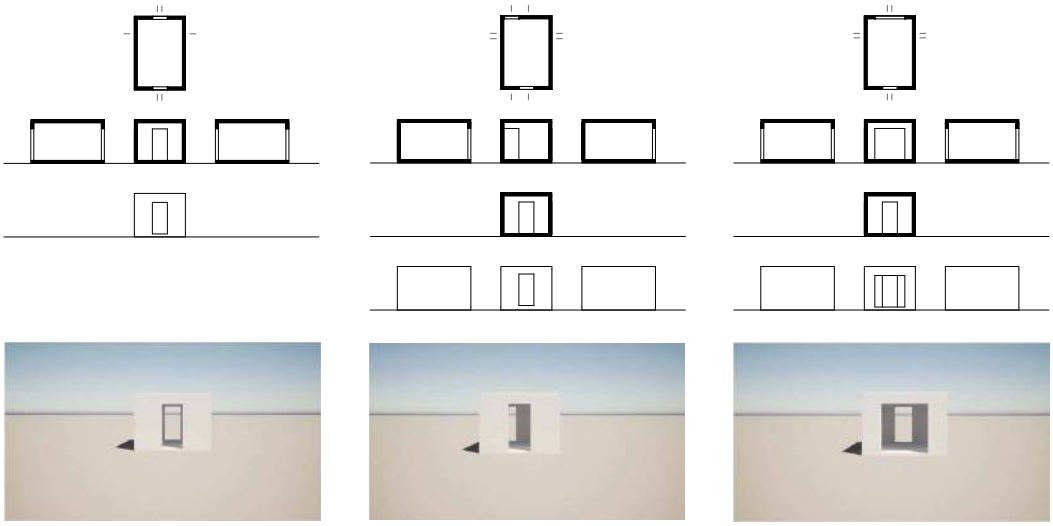

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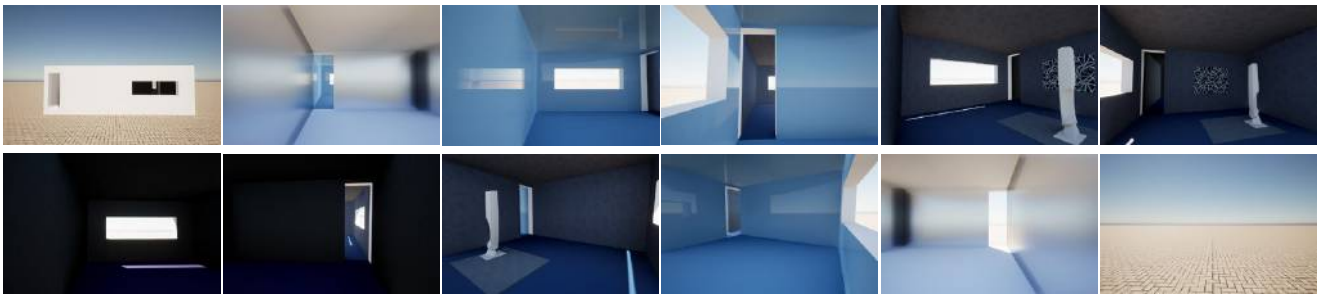
Fig. 18.

Figg. 17-18. Examples of the layout used in the course 2022-2023 (first point of the Unit 1 exercise). Students: Zoe Togni and Silvia Pedeferri.

**Unità 3** **es.G -** **Fotogrammi video**

obiettivi Il nostro obiettivo è di creare un'atmosfera che metta in contrapposizione una sensazione di apertura e leggerezza con una sensazione di chiusura e pesantezza, tramite l'utilizzo di texture, coliri e materiali che possano aiutare ad enfatizzare tali emozioni.

scelte Ci siamo focalizzate principalmente sull'utilizzo di un materiale base, quale il calcestruzzo, che abbiamo adoperato in primo luogo, su tutti i pavimenti, e successivamente sule pareti tre stanze.
La prima stanza è caratterizzata da un pavimento chiaro, con tonalità azzurrastre e pareti in alluminio riflettente per creare un effetto sinestetico che ricordasse il freddo e la leggerezza, qualità innate del metallo.
La seconda stanza, invece, è valorizzata da una colorazione, sempre sulle tonalità dell'azzurro, ma più calde, con tutte le pareti in clacestruzzo, ma questa volta laccate, in modo da dare ancora l'effetto della leggerezza e del freddo, ma creando un climax con la prima stanza.
La terza stanza, caratterizzata da pareti in calcestruzzo grezzo, invece, ha come colorazioni un grigio scuro, che introducono un effetto sinestetico di pesantezza ed oppressione.
L'ultima stanza, invece, è caratterizzata da un pavimento blu scuro, notte, e da pareti e soffitto rivestite da pietra nera.



riscontri Attraverso l'utilizzo del visore abbiamo constatato come le le nostre iniziali ipotesi non fossero del tutto errate.
Nella prima stanza, ci si trova in uno spazio freddo, quasi fantascientifico e irreale, ma a differenza di come pensavamo, si ha una sensazione di maggiore chiusura rispetto alla seconda stanza.
Proseguendo la stanza successiva ci trasporta in una relatà anch'essa fredda, nella quale si crea un gioco di colori che nasconde il fatto che sia stato utilizzato lo stesso colore su tutte le pareti.

La terza stanza è particolarmente tangibile e concreta. Crea un netto contrasto con la stanza precedente, trasportandoci in un'atmosfera pesante e reale. La sensazione che si prova è quasi di calma e tranquillità.
Il contrasto con le due stanze precedente viene inoltre accentutato dall'ultima stanza che è buia, opprimente e quasi soffocante, da non riuscire a stare al suo interno per troppo tempo.

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Fig. 19.

Fig. 19. Examples of the layout used in the course 2022-2023 (Unit 3, synoptic view of tested variants). Students: Anna Bolla e Camilla Tosi.

**AN-ICONOLOGY**
**History, Theory, and Practices of Environmental Images**

UNIVERSITÀ DEGLI STUDI DI MILANO
DIPARTIMENTO DI FILOSOFIA
"PIERO MARTINETTI"


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