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**Title:** *Culture, light and latitudes: A comparative study of lighting conditions and habits in Berlin, Brasília and Copenhagen.*

Aalborg University Copenhagen

Frederikskaj 12,

DK-2450 Copenhagen SV

Semester Coordinator: Georgios Triantafyllidis

Secretary: Lisbeth Nykjær

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**Supervisor(s):** Nanet Mathiasen

**Project group no.:**

**Members:**

Raquel Moraes Rosildete de Oliveira

**Abstract:**

This theoretical work presents a comparison between natural light conditions and artificial lighting habits in the cultures of Brasília, Copenhagen and Berlin. The analytical discussion about light perception in the three cities is based on theories about the physiology of the visual system, concepts of phenomenology, day light analysis and climate studies.

Study cases of living rooms document lighting situations and are used as background material to analysis the lighting habits of the compared cities. The influence of the natural light of those latitudes in the lighting habits of the cultures is discussed based on established equivalencies between natural light and artificial lighting settings.



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SUPERVISOR Nanet Mathiasen

SEMESTER COORDINATOR Georgios Triantafyllidis

SEMESTER SECRETARY Lisbeth Nykjær

**RAQUEL MORAES ROSILDETE DE OLIVEIRA**

# CULTURE, LIGHT & LATITUDES

## A COMPARATIVE STUDY OF LIGHTING CONDITIONS AND HABITS IN BERLIN, BRASÍLIA AND COPENHAGEN

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*The influence of the natural light of those latitudes in the lighting habits of the cultures is discussed based on established equivalencies between natural light and artificial lighting settings.*



The image shows a dark, minimalist art installation. A central light fixture with three adjustable shades is suspended from the ceiling. A spotlight on the floor illuminates a small, circular object on the ground. The background is dark and indistinct.

# CULTURE, LIGHT & LATITUDES

RAQUEL MORAES ROSILDETE DE OLIVEIRA



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# 1 INTRODUCTION

The phenomenon of light and its perception is common to all sighted human beings. Thus, do we all perceive light in the same way? And, if we do see light in the same way, why are our lighting cultures then so vast and different from each other? How can we explain light perception and the lighting habits in different cultures? This work analyses and compares the day light and the artificial lighting in the cities of Brasília, Copenhagen and Berlin.

The topic of this theoretical and investigative work is the space perception of light and how it is experienced in different ways by all of us. The first impulse that led to the research presented here is personal, and it would be impossible to talk about this experience without conjugating it in the first person. This work intends to explain the light that I have experienced in the last three years. During this time, I had the opportunity of experiencing the natural light of three different cities and how their respective cultures deal with the sun and, additionally, what are their artificial lighting habits.

This work is investigating different latitudes and, consequently, different cultures. Explaining the sunlight throughout the seasons in these different locations is part of the work and it explains some of the light phenomena that are so characteristic of these places, but it does not intend to embrace all the aspects of light in these cities.

To live in a city relates to not only climate aspects but, most of all, culture. It involves history, social economic conditions, different architecture styles, marketing trends, fashion, behavior. In a summary, a whole ethnology that can explain every single object used by one group of people. The researcher Mikkel Bille discusses the material culture

*"The relationship between persons and things is at the heart of most material culture studies. Within the previous decades, one aim in these studies has been to understand how the sensation of things is inseparable from the meanings and sociality of things, and their production. (Bille, 2007, pg 264).*



With lighting it is not different. The relation of different communities with their light objects is a consequence of endless aspects that varies at every moment. Societies are dynamic and organic, people inspire and are inspired by others, and in our century in big cities there is no possibility of isolated societies without external influences. Cultures are the most complex subject that could be studied, and it can be extremely deeply researched.

Lighting cultures will be analyzed here, but this work does not intend to explain the differences between the visuality of the complex societies. This report has as its main objective to document and compare the lighting in Brasilia, Copenhagen and Berlin. Therefore, the present discussion is about what their differences and similarities are. It is important to state that the discussion is not about why people choose their lighting the way they do, but how. Explaining reasons for cultural choices can be deterministic and superficial, because, as said before, cultures are rich, dynamic and self-transforming constantly and there is not only one reason for a specific cultural aspect, but there is a chain of reasons along centuries that explain the way we inhabit our intimate and public spaces the way we do.

Therefore, this report is documenting the daylight and artificial lighting of specific living rooms in Brasilia, Copenhagen and Berlin. Cultural aspects or behavior explanations won't be discussed through this work. But what was the criteria for choosing these cities?

I was born in Brasilia, the modern city utopia, and raised in these lighting conditions: In the south hemisphere, 15.79° south of the equator, one of the cities with highest sun incidence in the world and with a majority of sunny days throughout the year. It is unnecessary to say how much this shaped my comprehension of light or how natural light should be treated and how artificial light should be designed.

The second light situation to be analyzed is Copenhagen, where I am about to complete my master studies, in the north hemisphere, 55.67° North from the equator. Compared to other cities that I have visited, the specificity on the Scandinavian light was obvious. The way the Danish culture treats artificial light also called my attention on how different it was from my previous lighting experiences.

The third city, the one in which I live now, is Berlin. Berlin is situated in 52.52° North from the equator. The inclusion of Berlin in the research is based not only in my personal curiosity, but also in my



methodological strategy. The simple comparison between Brasília and Copenhagen, two cities in such different latitudes and cultures would be easily done and probably deterministic. A third point in a similar latitude of one of them makes clear the difference between the natural conditions and the cultural aspects. Berlin is the third point of comparison to avoid bias and to prove that we all see and have to deal with light and darkness, but how we do it is cultural heritage, not only in a logical adaptive involuntary way.

Thus, visual perception and lighting cultures will not be explained, but discussed and analyzed. We are cultural beings and the main assumption of this report is that cultural background shapes our visuality, our preferences and even the way our brain processes information. Therefore, the argument here is not about why we perceive light and create light scenes in our homes, but how we do it, and how diverse our spatial experience can be.

This investigative thesis bases its structure in four main pillars:

The first theoretical base of the analysis is the physiology of the visual system and how the human body comprehends light and processes the spatial information. This section introduces the most universal mechanism of visual perception. Once more, the light will be explained in the human body. Not how it behaves in our surroundings, but how our bodies absorb this phenomenon.

Aiming to base the comparison between the light visuality in the three chosen cities in a natural science theory, the second part of the theoretical background describes the day light conditions in each of the respective latitudes and the consequences on the spatial impressions and light quality will be explored.

The third metaphysical part structuring the argument is the phenomenological theory about spatial perception and the individual aspect of the apprehension of the reality, influenced by our linguistic (or cultural) limitations.

As its last analytical tool and fourth pillar, this work investigates the artificial lighting conditions of living rooms in Brasília, Copenhagen and Berlin. These study cases intend to document the reality of the lighting cultures in the presented latitudes.



## PERSONAL MOTIVATION

The master degree at Aalborg University Copenhagen is one important step in long a journey about lighting. I started thinking about lighting in 2007, when I started studying it in a course in Barcelona.

From 2008 on, still as an architecture student, I started working with lighting in manufactures projects, exhibitions, events, parties, urban installations and theater. Life made me see light under several areas, in different circumstances, with different points of view. Before arriving at Aalborg University, I have been for eight years producing lighting design in the most different conditions and spaces.

This variety was shaped not only because of my choice of having a diverse and holistic formation, but also by the necessity of producing lighting design as my main creative expression. Over these years, I always preferred to make lighting as a professional choice. My personal and professional choices were always pursuing lighting design and the spatial creation.

The most rewarding and important of them was what I have learned at a research group Laboratório Transdisciplinar de Cenografia, where I have worked for five years as a researcher and creator. This laboratory was a transdisciplinary group of creation in theater and visual arts, in which I learned how to create, share ideas, support the ideas of others, develop these ideas until the final production was possible and, most of all, to see the space as a scene. No matter where I am, all the spaces, all the circumstances, have a clear understanding of the world as a set, the people as characters and the behavior as performances, the spaces as a stage and ourselves at the same time acting and observing life. I learned in this rich and collective environment how to look at the reality with the eyes of a creator: Observing the reality as material for creation and as a reflex of the daily production of cultural beings.



1



2



But the most important learning aspect of those years in the transdisciplinary laboratory of Scenography was that the theory does not work without practice and that the best way of learning the theory is living the experience. The basis of the learning process is the experience and all the theory must apply to what we have learned from the reality. Because of this, this thesis is based upon my personal experience allied with the theories that could support my thoughts or maybe the opposite, the theories would teach me another way of looking at the reality.

In that sense, the method adopted by Aalborg University called Problem Based Learning fits my background in an unexpected way. Basically, both study environments believe that the learning process should come from the experience. The problem you have to face in the reality itself will give the solutions to solve it.

The thesis presented here is a result of my study merged with my way of seeing things. The academic space is a diverse and fruitful environment to present and share ideas with different thoughts and theories, with different approaches of the same subject. In the last years I have been to places, seeing things, with the eyes of a lighting designer and a space creator. In each room that I would get in I would look at people's behavior, lighting as an expression, the light of the days in the cities as the best scenario for their cultural manifestations. This master thesis is the perfect space to explore and discuss these impressions.

The knowledge apprehended in the last two years in the master studies in Aalborg University Copenhagen and the courses and literature about how to see light, how to apprehend light and how to investigate the context of it as a tool in the design process were extremely encouraging. The phenomenology theoretical scope of some courses served as a port in which my personal background and professional approach could be understood and developed.

Hereafter, the presented thesis is a result of a long process of seeing light and trying to explain it, of searching the theories that could explain what is comprehended in the reality. The following lines were motivated by the spatial reality absorbed and discussed in these three different cities, and it aims to show my visual experience in a scientific method with all the respect for the analyzed lighting cultures.



## 2 Method:

This chapter guides the reader into the work method presenting the work structure and What the purpose of each chapter of the work in the methodology is. The working method used in this research thesis is based in the Problem Based Learning method in course at Aalborg University.

In the Lighting Design master's degree the Problem based Learning is used for design projects in divided in the phases of idea generation, problem solving, test and communication. When there is a design project, the phase of the design is in the problem solving phase. In the case of this thesis that is a research project, there is no design phase (or problem solving), so there was an adaptation of the method in order to make it an academical project, structured in the same learning methodology.

Idea generation: the phase of the idea generation includes the theoretical background, the use of an established methodology and the proposal of a research question. In this work, it is divided in three main theoretical areas that evolved to a research question (presented below)

Test and communication: The test and communication phase is presented here as comparative study cases that test hypothesis, compare samples and discuss the results. Also in this phase is the conclusion that consummates the discussion about the relation between the idea generation, the research question and the result of the study cases. The PBL methodology was applied in the development of this thesis in the following work structure:



## Theoretical Background:

The main theoretical part of this work and is divided in three chapters: Vision and how we see light, Daylight as site specific situation in Brasília, Copenhagen and Berlin, and The light perception as a cultural experience.

### Vision and how we see light

What is meant by the universal in the spatial perception, or what is common between sighted human beings around the globe? What most of all have in common is the vision, the capacity of visualizing a certain wavelength of light and process this information to understand our surroundings (source). This physiologic mechanism is called “vision” and will be elaborated on in the first part of the analysis. To explain what we see differently and what our preferences are, it is important to understand first how our body shapes our visual background.

### Daylight as site specific situation in Brasília, Copenhagen and Berlin

As the theoretical second part, this chapter studies the daylight conditions in the three cities previously mentioned, attempting to classify and organize what kind of direction, quality and sunlight hours per day are varying in these different latitudes throughout the year. As a result of this analysis, there will be a scheme in which the author defines a few relevant light characteristics in the three different conditions. Also, personal impressions about the natural light in the urban centers core to my research will be outlined as a tool of communicating the visual experience found in each of them.

### The light perception as a cultural experience

In the third part of the analysis, the concept of phenomena will be studied. How do we experience light, and how do previous experiences shape our present perception of light and space? Here, I will refer to scholars related to the phenomenological school of thought. Phenomenologists present the concept of phenomenon and how atmosphere is formed by the space in between the reality and



the user, the subject and the object. Accordingly, when exploring concepts of visual preferences and experiences of lighting in different circumstances, phenomenology is a strong conceptual base. A phenomenological approach puts the human experience to the fore premising that light perception is an individual experience, influenced by culture and previous assumptions.

## Research question:

In a short chapter, the research question will be presented.

## Study Cases

In this chapter lighting habits, or what can be termed “lighting culture”, will be analyzed in order to understand how people artificially illuminate their living rooms. What is the difference from one city to another? Where are the luminaires placed, and finally what kind of lighting sources are there?

A hypothesis regarding what kind of lighting is culturally settled in each city will be presented. This hypothesis will be outlined before the analysis of the reality to question the perception that there is a relation between the natural light conditions in the inhabited place of a culture and the artificial lighting habits.

Schematic visual reports will present different living rooms of each city including the information of what, where and how many lighting sources are there in each space. This luminaires types and positions will be called typologies.

Before the conclusion, all the documentation will be analyzed and compared pursuing the understanding of a possible relation between the lighting habits of a culture and the natural light that is given in the three different latitudes. The hypothesis will be analyzed and compared with the reality: How do we make different lighting in different cultures? Is the connection between daylight and artificial light correct or is it just determinism? Does the artificial light follow or represent the daylight characteristics? Do we try to reproduce the light of our surroundings in our houses?



# 3

## ANALYSIS

### VISION AND HOW WE SEE LIGHT

The experience of light and space can be described in distinct ways and under different areas of knowledge. Optics can explain scientifically how light behaves and how the surfaces and volumes reflect, absorb or transform light properties. However, this report brings a reflection about the other side of light. This work develops how light behaves not in our surroundings, but inside our eyes and our minds. Explaining how we physically see light is different from explaining how light physically exists. In the following chapters, I aim to describe the behavior of light inside our bodies and how our minds interpret it.

In his essay *Lighting visually and physically*, Anders Liljefors defends the relevance of the visual experience on the lighting theory: *“The obvious starting point for a discussion of theories for the lighting practice is not the physical radiation, but the visual experience of space and its objects.”* (Liljefors, 1999, p. 2)

Correspondingly, I do not mean to investigate the measurable physicality of light, but rather shift the focus to how light is seen, or how the space is physically perceived through the use of our visual system. This chapter will briefly present the physiology of the eye and its photoreceptors and provide a summary about the respective information perceived by the eye and transferred to the brain.

The vision is a mechanism of recognition of our surroundings that translates and communicates information about the environment from the eye to the brain. As this work intends to discuss the experience of the space, a brief introduction must be done, regarding the scientific explanation about the most universal phase of the perception: the vision. To demonstrate this mechanism, some basic concepts will be presented as parameters to be used through the scope of this work.



## PHYSIOLOGY: PHOTORECEPTORS AND INFORMATION PROCESSING

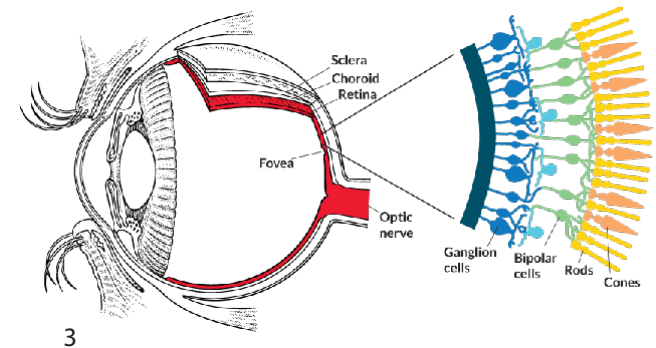
The eye, the first agent in the process of visual information coding, is responsible for transforming optical radiant energy into neural impulses. After the optical radiation passes through the lenses and liquids of our eyes, it arrives into the retina, where the photoreceptors are located. The information delivered by the photoreceptors is binary, that means they send only one kind of information to the brain: Either that receptor is receiving light or not. But how can this system differentiate the millions of nuances of depth, movement and colors we perceive? The answer is quite simple: We have different kinds of photoreceptors, and the only information they send is how intense is the light that stimulates them.

The retina consists of two kinds of photoreceptors: Rods and cones, both generate neural response when exposed to light. These two photoreceptors can, sometimes, work together, but they have two different main functions.

The rods, located on the periphery of the eye, are sensitive to light and are activated by dim light, or by what can be called night vision. They are responsible for the differentiation of brightness (or luminance). Under daylight, rods are saturated (that means they do not send information because they are exposed to more light than they can process). The limitation of the rods is that they can only read light intensity, but not colors. That means if we are using our night vision, we do not see colors, but only light intensities. They absorb contrast information, signaling depth, brightness and spatiality, but they have no sharp focus or accuracy.

In the other hand, the cones have the function of sending signals of color information. Only activated by a certain level of light, they are basically responsible for our day vision and can be divided in three types, classified by the wavelength that sensitizes them. They enable our accurate vision and are located in the center of the retina.

*Most of us have three different kinds of cones, each of which contains a different kind of pigment and responds best over a range of different visible wavelengths. The neural signal is binary – that is, either a neuron signal is, or it doesn't – and does not itself carry information about the amount of color of the light that produced it. In order to perceive color, we compare the amount of activity in different cone types; in order to perceive luminance we add the activity in the different cones. (Livingstone, 2012, p. 28)*





The differentiation between functions and location of our two different types of photoreceptors define our vision in two types:

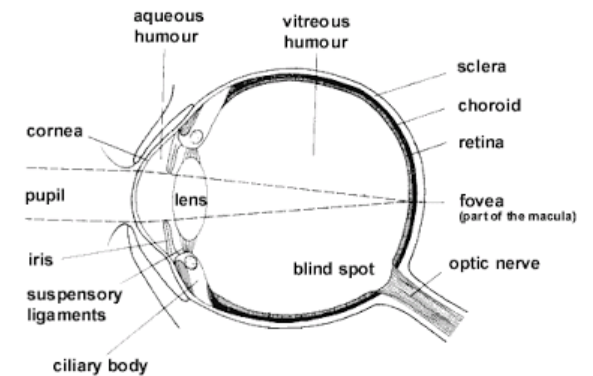
**FOVEAL VISION:** It enables information on details, the focus angle of it is only of 2 degrees.

**RETINAL VISION:** it enables our sense of orientation and spatiality:

*"The retinal vision gives an overall impression of the surround space and lacks acuity. Yet it serves as the base of the visual experience, of what we see, orientation and provide us almost instantly with an impression of the surrounding space and its major/big objects."*(Liljefors, 1999, p. 10)

Vision is a biological mechanism to recognize and understand the physicality of our environment. (Livingstone, 2012, p. 10) It has other sub mechanisms that allow us to recognize edges, lines, colors and depth as soon as the information arrives to the eye sensors. In other words, the brain has some shortcuts of interpretation that translate visual contrast into spatial/time information. Presenting vision and its information processing is basically talking about how our brain works, how it organizes the data that arrives to it. To see is not only a process of absorbing inputs, but, most of all, of interpreting it.

*"Many areas of the brain cooperate in these interpretation processes, producing a continuous flow of visual impressions. The mind has a decisive influence on 'what we see', visual experiences create meaning as well as feelings."*(Liljefors, 1999, p. 6)



4



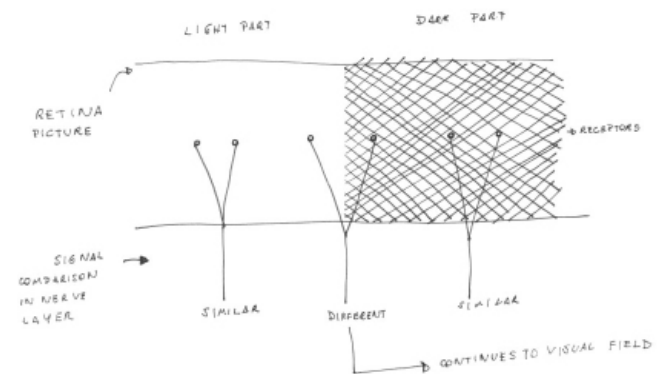
## LUMINANCE AND CONTRAST: SIGNAL COMPARISON

As previously mentioned, the behavior of light in the “measurable world” is different from the scientific world of perception, in which some phenomenon can be measured, but the units are not the same. When talking about lighting design practice, for example, the light parameter is Illuminance, or how many lux can be measured in the task area. Still, when light is reflected by surrounding surfaces towards our eyes, our eyes can absorb the information of brightness. This brightness is called luminance.

*Luminance is defined by how the human visual system responds to light – in particular, how bright the average human judges a light to be. It is sometimes thought of as the amount of light (the number of photons), but that is not correct. Luminance is not a physical measurement, and the luminance of any particular number of photons varies depending on the wavelength of that light: it is determined by how sensitive our eyes are to that color of light. Understanding luminance is important because our perception of depth, three dimensionality, movement (or the lack of it) and spatial organization are all carried by a part of our visual system that responds only to luminance differences and is insensitive to color. (Livingstone, 2012, p. 31)*

The photoreceptors have a light absorbing chemical (pigments) that generate a neural signal when they absorb light. (Livingstone, 2012, p. 32) When the photoreceptors in our retina absorb the luminance values reflected by the surfaces we see, they send a signal not only of this luminance value but the comparison between the value absorbed by one photoreceptor and the next one. That is called signal comparison. Essentially, the logic of our vision is based on the perception of contrast, that is fundamental to spatial understanding.

*“The term contrast is therefore fundamental to the understanding of vision and visual quality. Optical radiation produces environmental information through the flow of retinal images. The radiant differences of these pictures are continuously detected by the receptors, hereby producing information on contrasts – the initial key to the visual world.” (Liljefors, 1999, p. 7)*

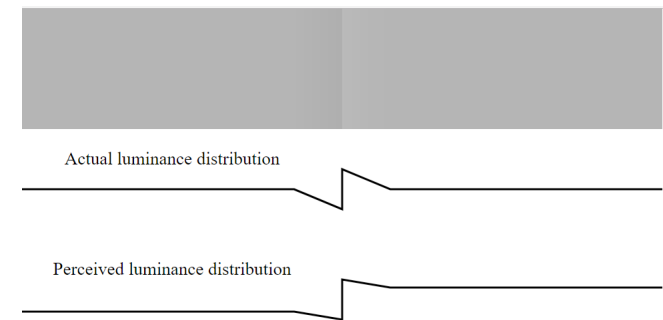




Our brain is encoding information sent by the neural cells all the time. Similarly to computers our system is saving data to save energy. That means our brain is only registering signs when there is contrast or change in the luminance or in the color stimulus. Thus, the limulus (neural fiber between the retina and the brain) is activated only by discontinuity, therefore we have an easy understand of the contours and lines, or the object distinction from its background, because it is the interruption of one hue stimulus that causes the limulus to send information to the brain. This same kind of encoding system also explains why focus light or point lights are more stimulating than diffuse light to our brain. <sup>1</sup>

This same phenomenon, called contour/surround suppression, is responsible for the perception of discontinuities better than continuous stimuli. That way, our body perceives more light discontinuities than total high levels of light. This phenomenon is also responsible for the fact that we perceive better abrupt changes of light levels than high levels.

*"Many visual perceptions, such as luminance, color, motion, and depth, exhibit greater sensitivity to abrupt than to gradual change, and in each modality this selectivity is due to and underlying center/surround organization. The image above illustrates this point for luminance with the Cornsweet illusion. The center/surround organization of the cells in our visual system makes us more sensitive to the light-to-dark transition at the middle than to the gradual changes of exactly the same magnitude, on either side of this discontinuity." (Livingstone, 2012, p. 49)*



5A

<sup>1</sup> "What was surprising though, was that small spots activated the cells better than large spots, as Hartline had found in simple horseshoe crabs. (...) Kuffler deduced that the reason large spots of light were ineffective was that ganglion cells were not excited by light impinging on their receptive field centers, but they were also inhibited by light falling on the immediately surrounding region. This organization is also called center/surround or surround suppression. (Livingstone, 2012. p. 49)



## OBSERVATIONS ABOUT VISUAL PERCEPTION

Until now this chapter discussed day and night vision, diffuse and focused light, contrast and perception of the space depending on what photoreceptors are activated under different light situations. If considering that in some latitudes people live under night conditions 16 hours a day, can we say that the rods of this population are used more often than in countries that have a maximum of 12 hours of night vision during the whole year? We just understood that contrast is the basis of visual perception. Northern European populations are exposed to overcast sky for 2/3 of the year, therefore with diffuse natural light this whole time. Can we say that in northern European countries the visual background is formed by components with less contrast?

In a study conducted by the University of Michigan (Shah, Boduroglu, Nisbett. 2010) scientists concluded that people living in the Western and Eastern hemisphere showed different patterns of attention allocation regarding the relation between focal and background elements when in their spatial apprehension. That means foveal and retinal vision have different time responses in the space comprehension in different cultures.

Analogue studies had already proved cultural differences on several aspects of visual information processing. That proves that our eyes work the same way but our brains value different aspects of spatiality. This is important when exploring visual perceptions and the vision, emphasizing that the brain is the main part of vision, because it interprets what is filtered by the eye. Now, based on the understanding that everything that arrives to our bodies must be explained by our minds, we can go further and investigate what “filters” our minds have. After we see a particular space, how do we interpret it? Since it is known we see light, we can ask ourselves how do we feel and experience light.



## **DAYLIGHT AS SITE SPECIFIC SITUATION IN BRASÍLIA, COPENHAGEN AND BERLIN**

In this chapter the daylight of the three cities will be analyzed under scientific theory and thereafter there will be a personal description about the same topic.



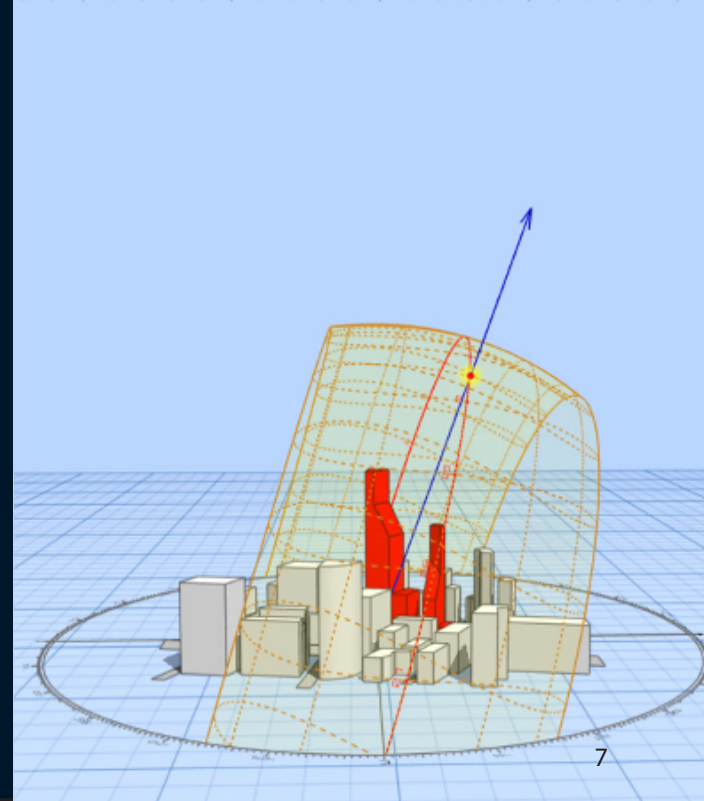
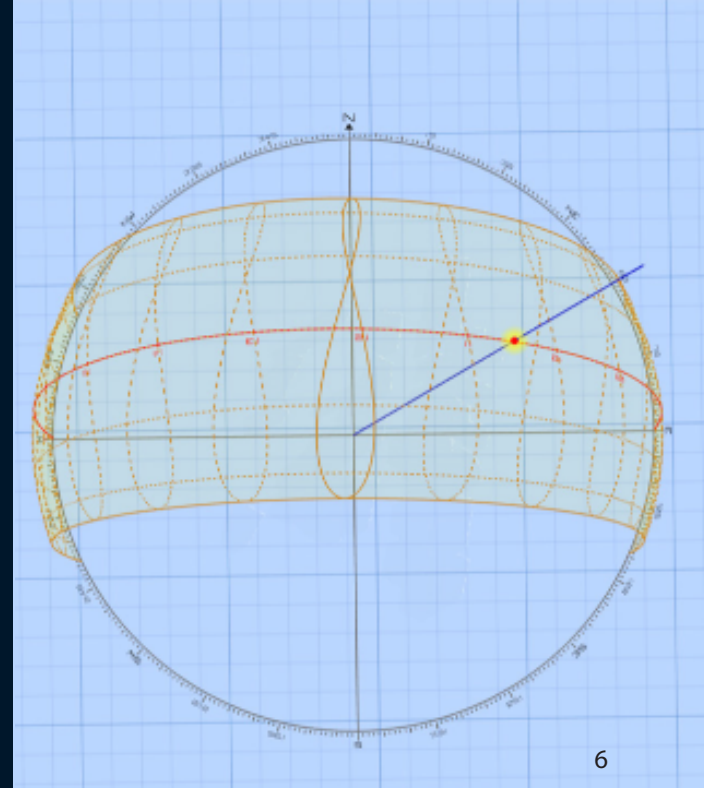
## BRASÍLIA CLIMATE CONDITIONS

Brasília is located at 15.79° South of the Equator<sup>2</sup>. This latitude enables the sun minimum height to be at 50 degrees, in midday of June 22<sup>nd</sup>. throughout the rest of the year, at midday, the sun is always higher than that, in the maximum of 82 degrees, leading to an almost vertical sun incidence the whole year at these hours. Brasília stands in the center of Brazil and belongs to the tropical highland climate. In this climate type there are two seasons, the dry (between April and September) and the hot humid (from October to May) (Naves, 2003, p. 1)

The light is predominantly direct over the year, mostly in the dry season, when its incidence can achieve up to 100.000 lux in open sky days. (Naves, 2003, p. 1) In the humid season, the diffuse light is predominant, enabling the numbers of, in the maximum, 30.000 lux in days of overcast sky. Annual average of sunlight is of 2400 hours<sup>3</sup>. almost 120 days without rain.

<sup>2</sup> All the daylight analysis information and graphs used an online tool to calculate and generate the results. Source: <http://andrewmarsh.com/apps/staging/sunpath3d.html>

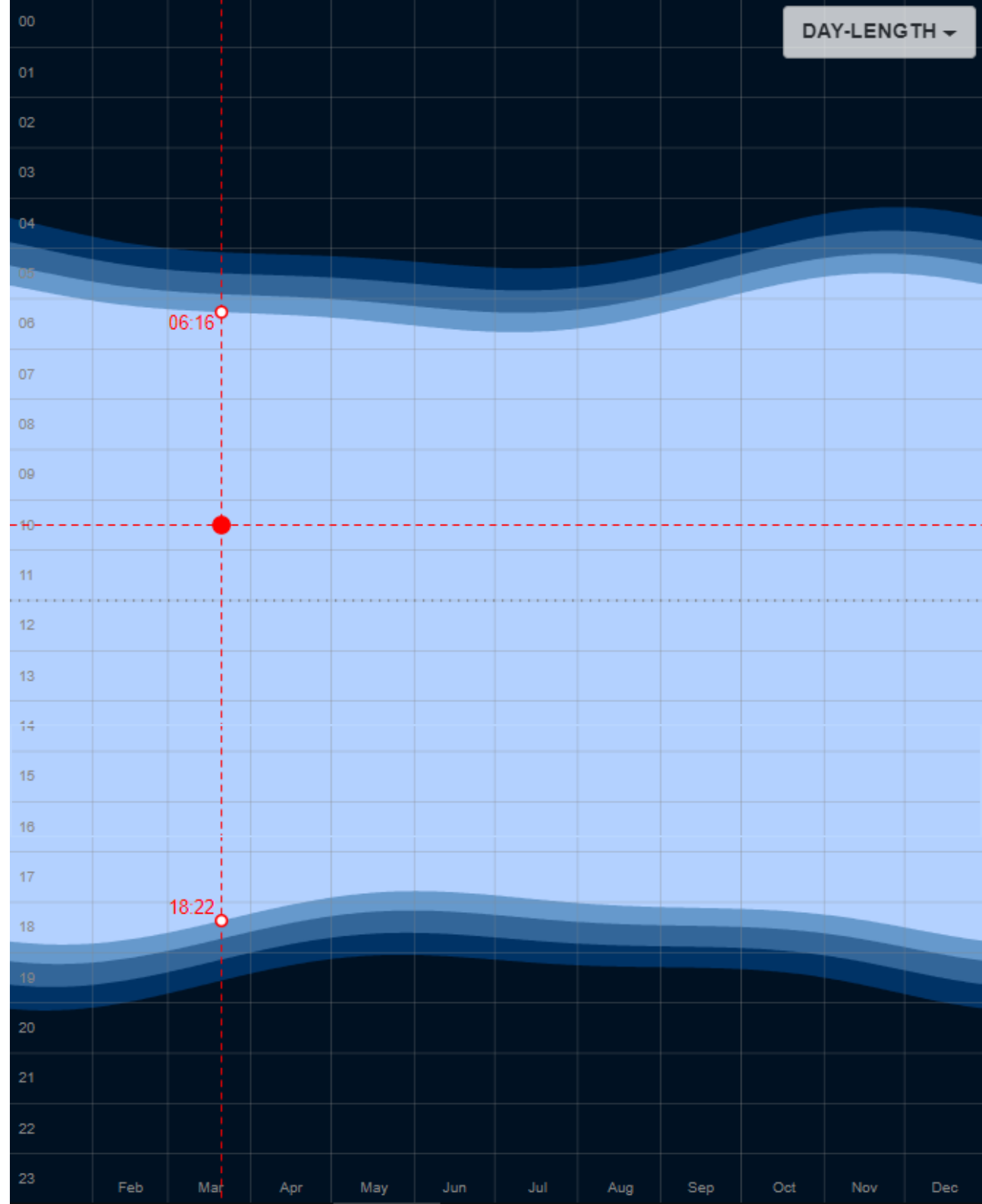
<sup>3</sup> It is important to say that the measuring standards of outdoor illuminance only in overcast sky aren't optimal for the measurement of Brasília's sky, due to the specific lighting conditions of this region. During the dry season, they city can achieve





The day length has a small variation throughout the year, meaning that the day and night hours are balanced, so these differences are not noticed or considered as a relevant characteristic of the sunlight.

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The natural aspects of the sun are determinant in the spatial perception. In the other hand, the architecture of a city is a relevant aspect regarding the analysis of its sunlight conditions. Brasília is a modernistic city, built in the 1960s, and its urban planning followed the modernist ideology. That means the buildings are maximum six floors height in the residential area, the horizon was a visual priority in its urban planning. Therefore, the high sky of Brasília is always apparent, present, and the light incidence is more than present, overwhelming.

As in any other cities, Brasília's inhabitants share a strong relation with its natural light and its sky. The presence of the sky and the lightscape in the city life makes it not only present but a constant subject in the inhabitant's identity. In Paulo Barnabé's article on natural light as a project guideline, he exemplifies the different layers of light perception in the identity sphere:

*"Some of the perceived relations with the light experience are universal, archetypical images shared by humanity; certain meanings are cultural, absorbed by rituals or life attitudes, other are personal, associated to specific lived events. The same way you can choose or not what to wear because of some associations, in a specific way, light patterns reminds us of a place, allow correlations with other places, enables multifaceted accumulated experiences"* (Barnabé, 2008, p. 67)

Based on the belief that the personal description of the experience in a place can be more effective in the communication of lighting conditions than just the numerical data, some personal impressions will be described about the lighting experiences I have had in those three cities. Even when talking about natural lighting conditions in a specific city, individual descriptions can be used not only as a poetic theme, but as a descriptive method:



*“However, this minor cultural crisis, this crisis on the simple level of a new image, contains the entire paradox of a phenomenology of the imagination, which is: How can an image, at times very unusual, appear to be a concentration of the entire psyche? How – with no preparation – can this singular short-lived event constituted by the appearance of an unusual poetic image, react on other minds and in other hearts despite all barriers of common sense, all the disciplined schools of thought, content in their immobility?”*

*It seemed to me, then, that this transsubjectivity of the image could not be understood, in its essence, through the habits of subjective reference alone. Only the phenomenology – that is to say, consideration of the onset of the image in an individual consciousness can help us to restore the subjectivity of images and to measure their fullness, their strength and their transsubjectivity.”* (Bachelard, 1958, p. 03)

Thus, describing my personal experience is a relevant and visual tool of presenting the natural light of those cities. Presented as a qualitative observation and descriptive tool, it is important to say that my personal impressions of Brasília are based on 30 years of life experience and, at the same time, the description of Copenhagen and Berlin is based on one-year experiences. That said, the first is more intimate, deep and biased than the others. The second and third cities, even though experienced for less time, were observed by the “foreigner eye”, that enables the observation from the outside, with distance and criticism.



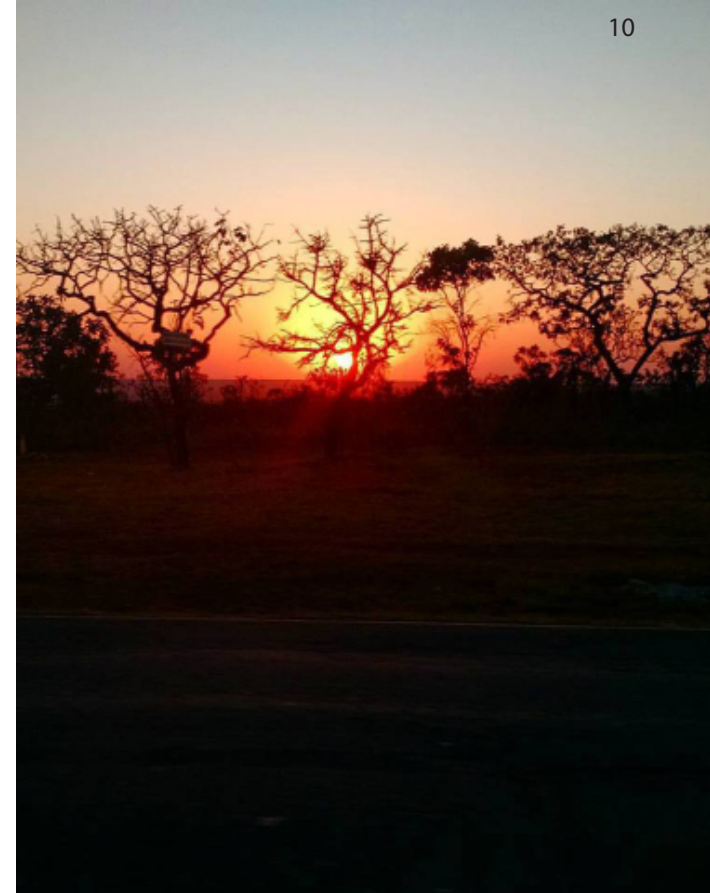
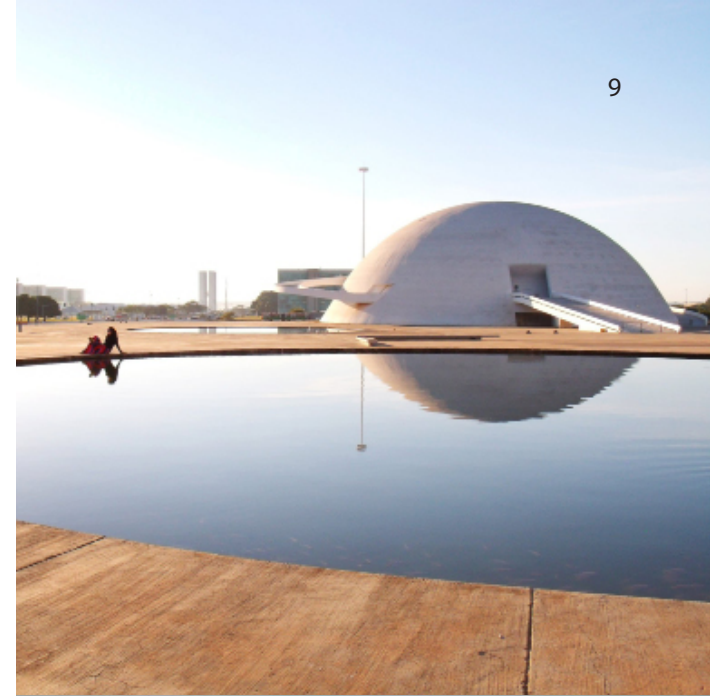
## BRASILIA AND ITS INEVITABLE LIGHT: PERCEPTION OF THE LIGHT IN BRASILIA

*"Brasília is built in the horizon line. Brasília is artificial. As artificial the world should be when it was created. When the world was created it was necessary to create a man specially for that world. We are all deformed by the adaptation to God's freedom. We don't know how we would be if we were created at the first place, and then the world deformed to our necessities. Brasília still doesn't have the men from Brasília. If I say Brasília is beautiful, they would say immediately that I liked the city. But if I say that Brasília is my insomnia's image, they see it as an accusation; but my insomnia is nor beautiful or ugly, my insomnia is myself, is alive, is my astonishment. The two architects didn't think about building beauty, it would be easy; they raised their astonishment, and left the astonishment unexplained. The creation is not a comprehension, it is a new mystery."* (Lispector, 1968)

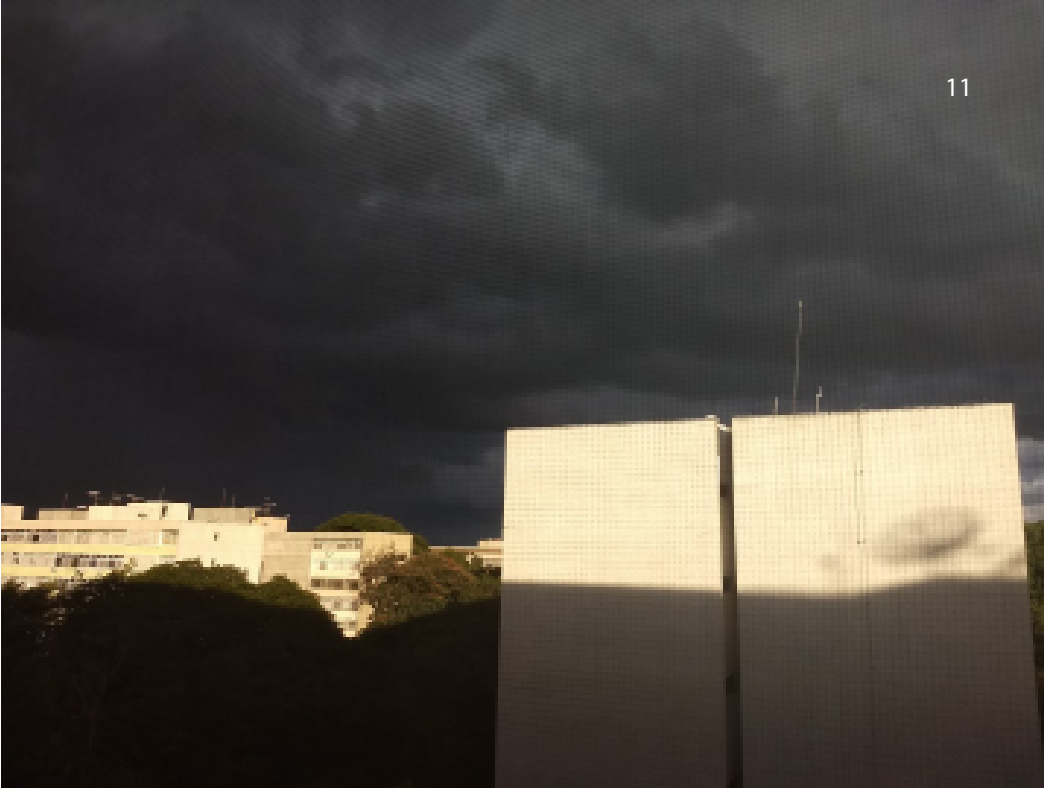
Brasília is all about sky. Our sky is high and our architecture is made to contemplate that very specific highland infinite. We see the sky at every second, we are intimate with the horizon. The small talk in the elevator is about the sky, about the sunset last evening. In Portuguese, the word evening doesn't exist. We have "afternoon" or else we have "night". Our sunrises and sunsets are fast, the rest of the time the sun is mostly up, going up, going down really fast, but always merciless. Brasília's architecture avoids the sun, postpones its heat to the night, we live in a desert. The west façades are protecting our houses from the heat and the blinding light with brise soleil and cobogós. The brise soleil s we got from the Le Corbusier modernism and the cobogós<sup>4</sup> are an adaptation of our Moorish Portuguese heritage. Because of the constant presence of these elements, our direct light always has geometrical shadow patterns dancing through our inner spaces.

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<sup>4</sup> Cobogó is the name of the hollow elements, originally made of concrete or ceramic, created in the 20th Century. Its name derives from the initials of the surnames of three engineers that worked in Recife, Brazil: Amadeu Oliveira Coimbra, Ernest August Boeckmann and Antônio de Góes. These elements follow the same principle of the old wooden elements of Moorish architecture: solution to the closure of structures. (IAAC Blog, 2018)







The high blue sky has different colors throughout the year, and we name those colors by the months. We have the deep blue from May, other blue for our typical parties of June. In September, when the city is only dryness and suspended red dust, the sunset is red because of how the dust in the atmosphere filters the light. In that moment, we remember that our earth is red and that is our unavoidable color, the color of the end of the day. When the night comes, the sky is a mixture of clouds and dust, and, together with the sodium lamps, if you look up, the clouds are as orange as your shoes.

In that part of the globe, the storms are extremely dark and noisy, and we call them the maroon storms. After the dry season, the heavy clouds keep accumulating for days, getting stronger and darker, preparing us for the next season. In our sky, all the changes are dramatic.

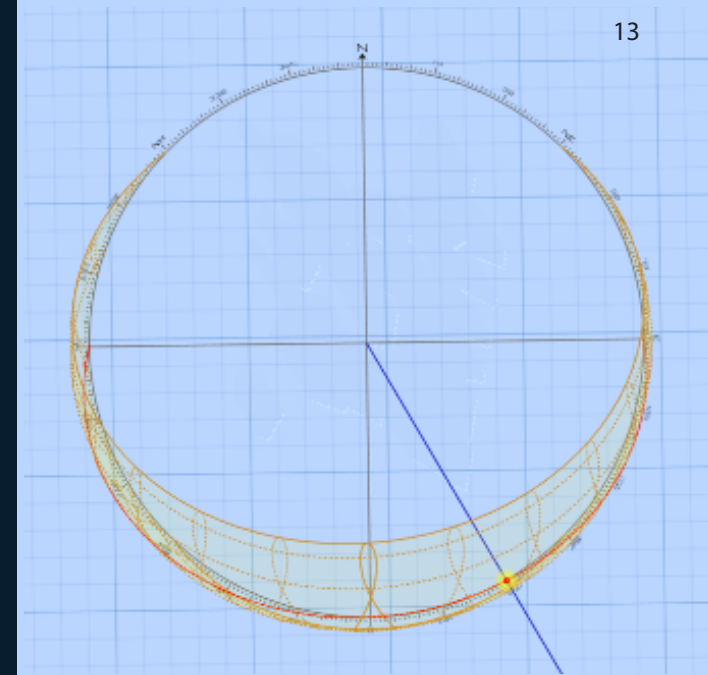
If you walk outside, the sun is always crossing your eyes. There is the time of the day in which you almost have no shadow, you have just a small shadow spot near your feet. When it is dry, even the birds hide from the sun in the small shadows of the poles. Because of the urban design, the distances are always too long to walk, the concrete is gray but it shines, even the reflecting concrete blinds you. The eye adaptation when you get inside the buildings makes you dizzy, you must wait and look again. The light is just about dryness and intensity, and too much light makes you blind.



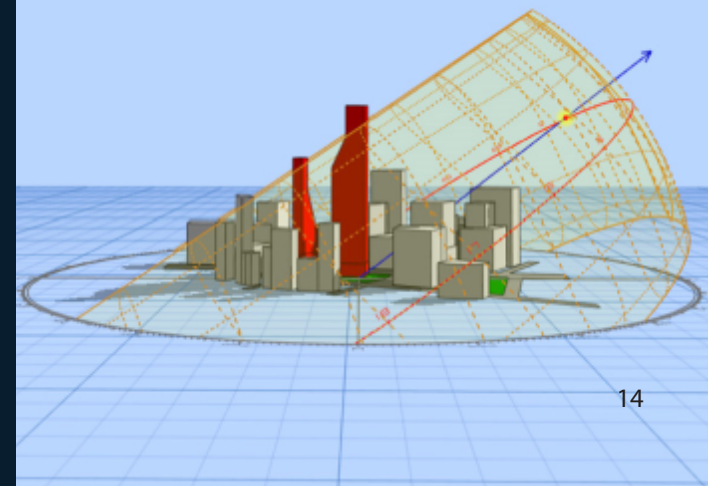
## COPENHAGEN CLIMATE CONDITIONS

Copenhagen is located at 55,67° North from the Equator. This latitude enables the sun minimum height to be at 15 degrees, in midday of January 1<sup>st</sup>. Through the rest of the year, at midday the sun is always higher than that, achieving its maximum altitude in 57,5 degrees. As a result, the sun is always resulting in a side light, even more accentuated in the winter.

Copenhagen has a temperate climate, with four defined seasons. In Denmark, the sky is overcast in 2/3 of the year, making the diffuse light a predominant light characteristic. In other words, Copenhagen has 1603 Hours of sunlight per year.



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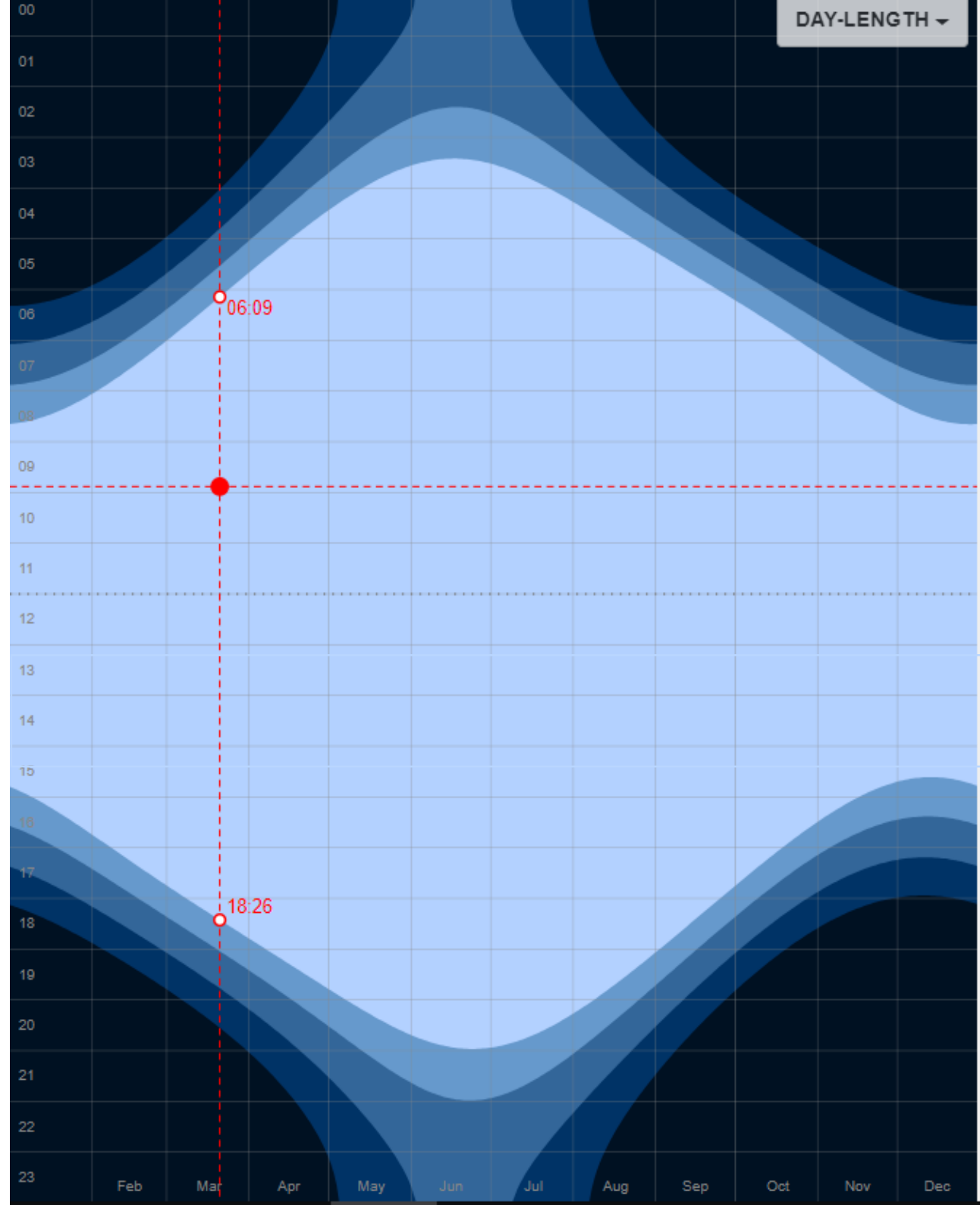
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In Copenhagen, the day length varies dramatically over the year and this is one of the strongest light characteristics of this latitude. The longest day of the year is 17:15 hours long and the shortest day has 6:44 hours of daylight, that means the longest day is 10:30 longer than the shortest day.

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## THE WHITE IN EVERY COLOR: PERCEIVED LIGHT IN COPENHAGEN

*"In the north, then, the sun does not rise to the Zenith but glazes things obliquely and dissolves an interplay of light and shadow. The land consists not of clear massing and distinct spaces; it disperses as fragment and repetition in the boundless" (Shulz, 1997, p. 9)*

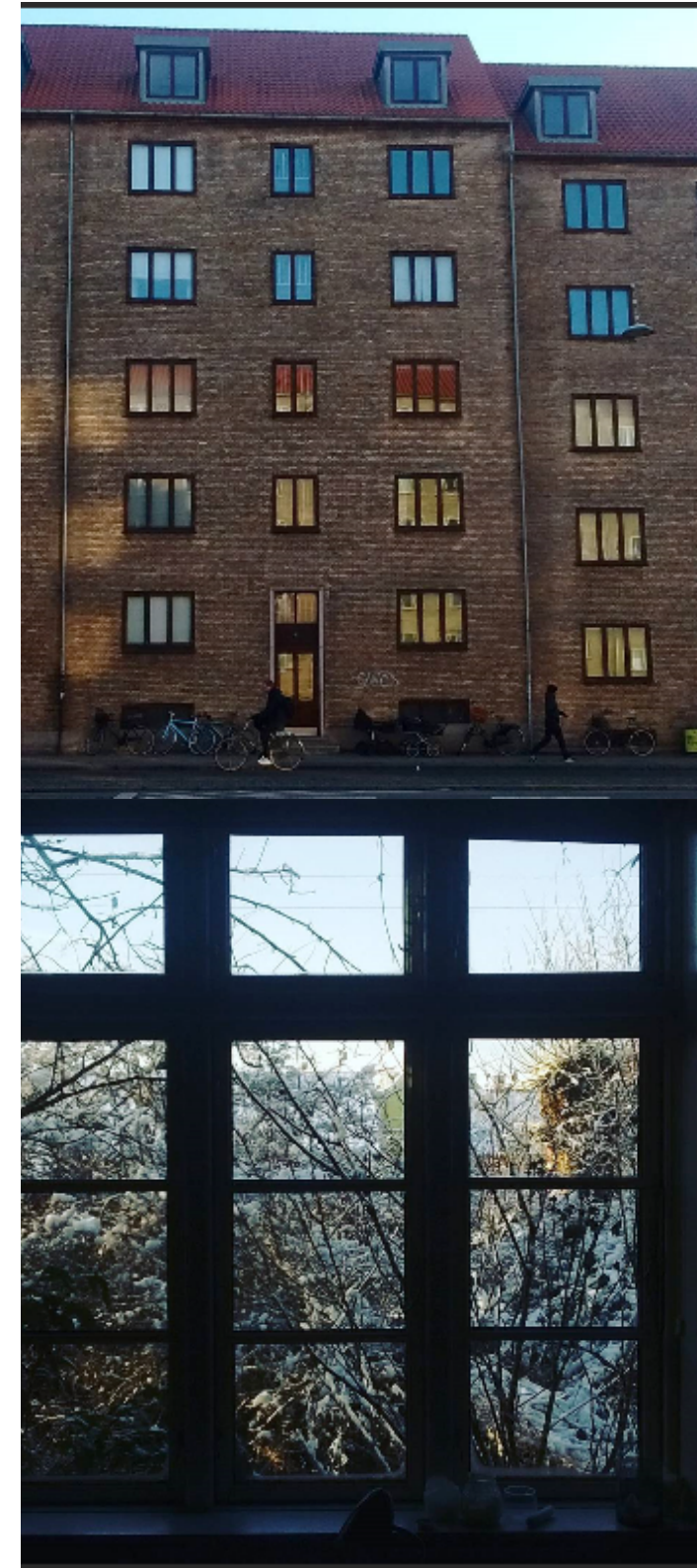
Copenhagen's light cannot be described as one. The changes through the year are so extreme and the way its culture react to it make those changes so clear that one could not describe the winter in the same way as describing summer. The temperature varies, but most of all, the length of the days.

### MY WINTER

I wake up and it is dark. I look at the sky and it is so black that you can't even see its shape, where should the sun be? I remember it was a low sky yesterday. The day is grey again, I keep thinking about the darkness of the roofs, these black roofs, always thought about how impossible that architecture would be in my hometown. Our architecture is white, light should be kept out. In Copenhagen the light is always welcome, the windows are wide and with no blinds, the streets are asking for light's presence.

When the sun is out, it is always by my side, maybe behind that building, it is not high enough, sometimes I just cannot see it. I bike through the streets and there is always a reflection of the windows in the asphalt, in other buildings, as you don't see the sun you can't actually find it, but you can see its reflections everywhere. Once you can see it, its presence is so discreet that you can look directly to it. It seems like a sun in a screen, is so delicate, as delicate as the colors it paints the city and the sky.

In Copenhagen there is always a layer of whiteness over all things. The sky colors are not saturated, the windows are white, the sunlight is so much whiter, the sunset is so long and smooth. Now the sun is above the buildings, you can actually see it, but maybe it is leaving again. In Copenhagen's winter, is always sunrise or sunset, you can never know.

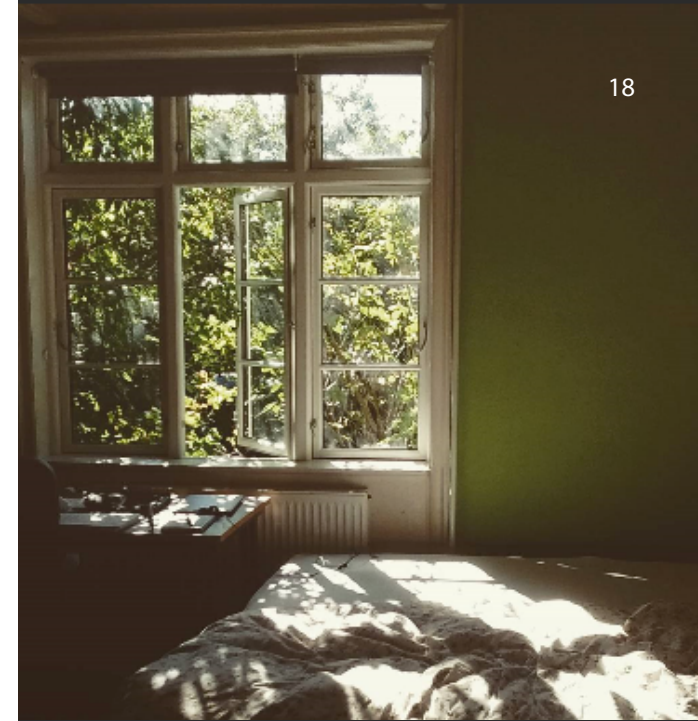




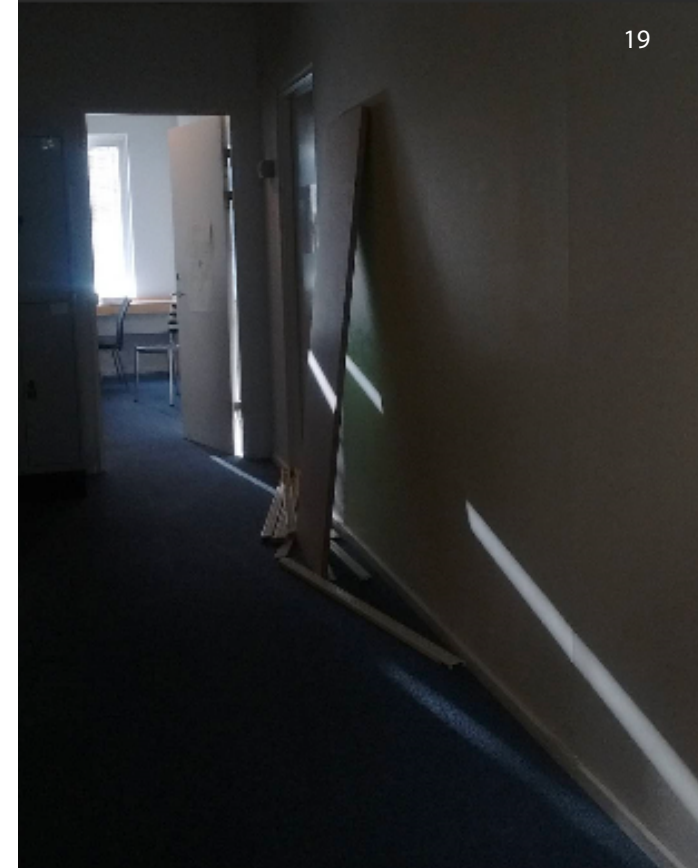
## MY SUMMER

It is five in the morning and it is already extremely bright, I don't know what time it is. The windows have no blinds, the light gets in, I start to get used to sleep during the day since now it is always day. In the streets the sun is not above your head, but you can see it over the buildings. It is still there, its 20hs and it is still extremely bright, the light crossing the windows as the wind, in its entire form. There is water everywhere, the city is sparkling, everywhere reflects the sun, the water, the buildings, the city finally have colors, finally Tivoli makes sense. The day is never over, maybe now, now it will be dark, the sky is so close, I can almost touch it. When it is finally dark, there is no black sky, but this pale blue. In the high summer is not even dark blue, you can see that the sun is already on the way back, that non-saturated yellowish orange ready to show itself again.

This white light diffusion crossing the city, it is not sunny today, it rains, the grayness is a little bit brighter than in the winter and the day is a long grey day, I lose the hours. It feels that there is a very thin veil between me and all the other things, it feels that you can barely touch the light because it is there, between things. It is not a bright light, just a thin layer of white between you and everything else.



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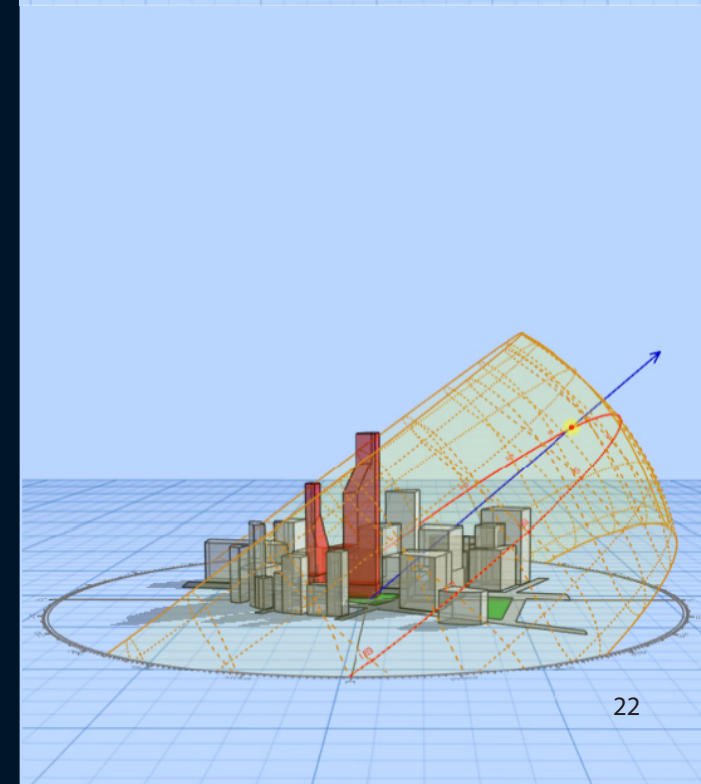
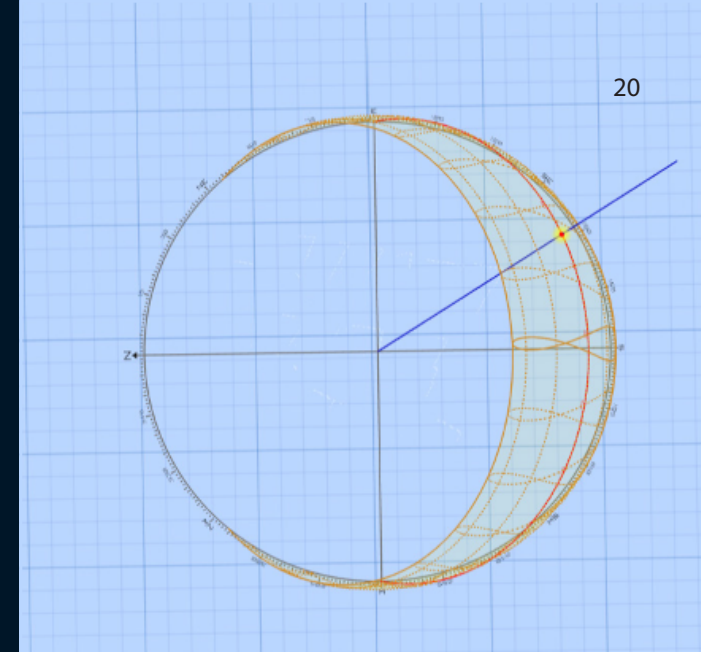
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## BERLIN CLIMATE CONDITIONS

Berlin is located at  $52.52^\circ$  North from the Equator. This latitude enables the sun minimum height to be at  $14,5$  degrees, in midday of January 1<sup>st</sup>. Through the rest of the year, at midday, the sun is always higher than that, achieving its maximum altitude on the 21<sup>st</sup> of June at  $61$  degrees. As in Copenhagen, the sun is always resulting in a side light, even more accentuated in the winter.

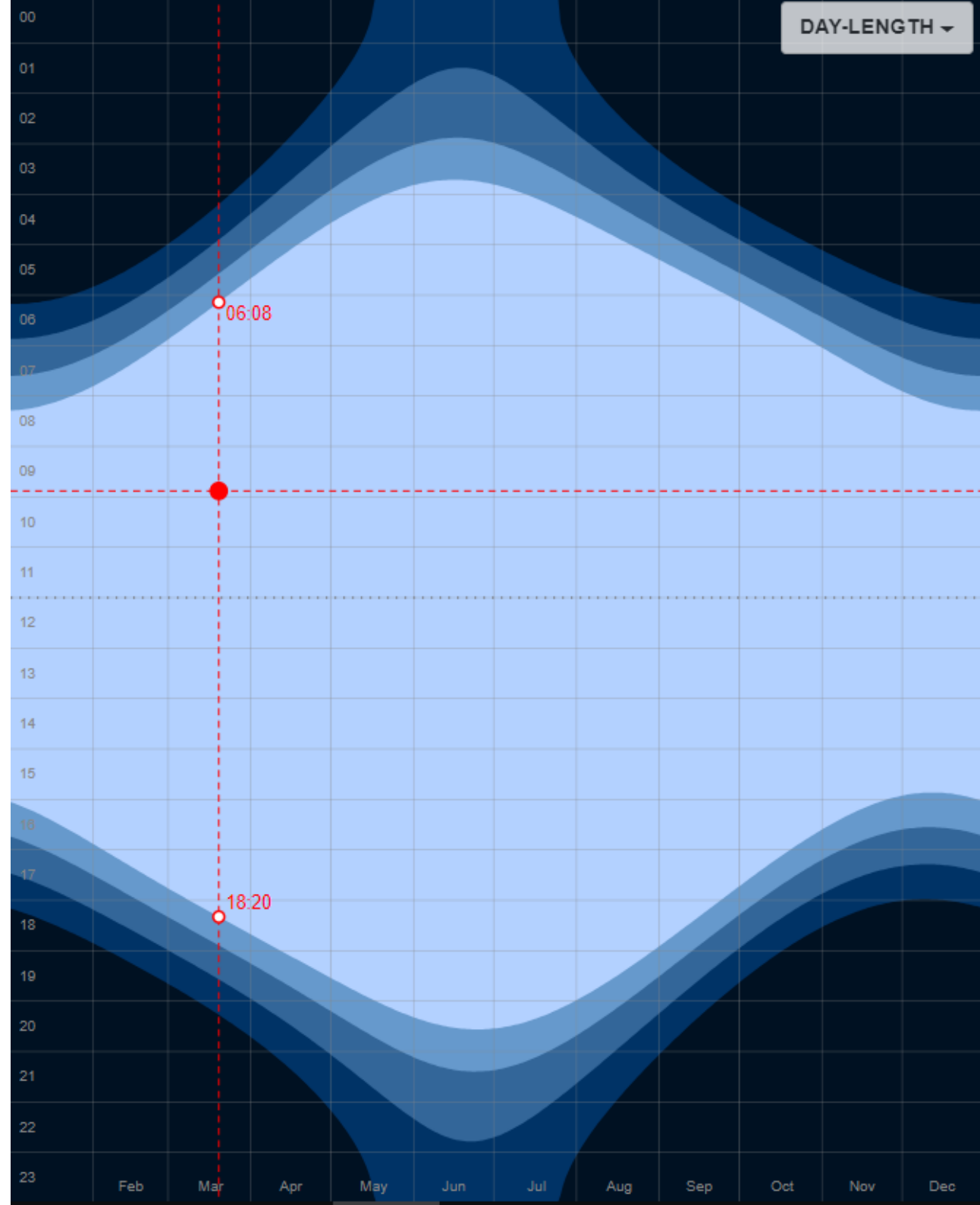
Berlin has a temperate climate, with four seasons well defined. In Berlin, the sky is overcast in  $2/3$  of the year (only 3% less than Copenhagen), making the diffuse light a predominant light characteristic, with 1738 hours of sunlight per year.





As in Copenhagen, in Berlin the day length varies dramatically over the year, and there is a difference of 1 hour on the longest daylength from Copenhagen to Berlin. In Berlin, the longest day of the year is 16:34 hours long and the shortest day is 7:25 hours long, that means the longest day is 9:09 longer than the shortest day.

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## THE PURPLE SKY AS A BERLINER SOUVENIR: PERCEIVED LIGHT IN BERLIN

In the day I arrived in Berlin it was high summer. The skylight passing through the court yard had one strong monolithic presence. Berlin's light has other colors, different hues, but once this color was already defined, there is only one color temperature. There is this impression that it's sunlight has exactly the same color as the skylight, it is hard to find the difference. Even in the warm season there is a strong blue spectrum getting inside the room, there is this feeling of dawn every once you are there. The low sky, even when blue, has the presence of gray. It seems always that there is another hue of color in the background, here the colors are mixed before they are exposed and extremely unpredictable. Berlin has a lot of sky, you can almost touch it, it is flat in its distance, but it is deep in its color tones. The transition hours in Berlin are always purple. If you want to buy a souvenir from the city, the sky will be purple on it.

The light of Berlin is flat. Is a monochrome flat light, there is always the impression that there is a depth that you cannot see, you do not see the depth in things, they are always right in front of your eyes, in first plan.

The architecture of the city and its wide streets make me feel extremely comfortable. Maybe Berlin reflects the light the same way Brasília does, but before being reflected the light is different. Berlin is not as white as Brasília, but the shape it has make the light so similar to the one I am used to. Berlin's light did not surprise me, but made me curious. There is something behind it, as if there something in the back of the sky, or an invisible reflector that multiplies the light in a way that you cannot see where it is coming from. The light in Berlin comes from everywhere.



## CONCLUSIONS ABOUT THE NATURAL LIGHT ANALYSIS

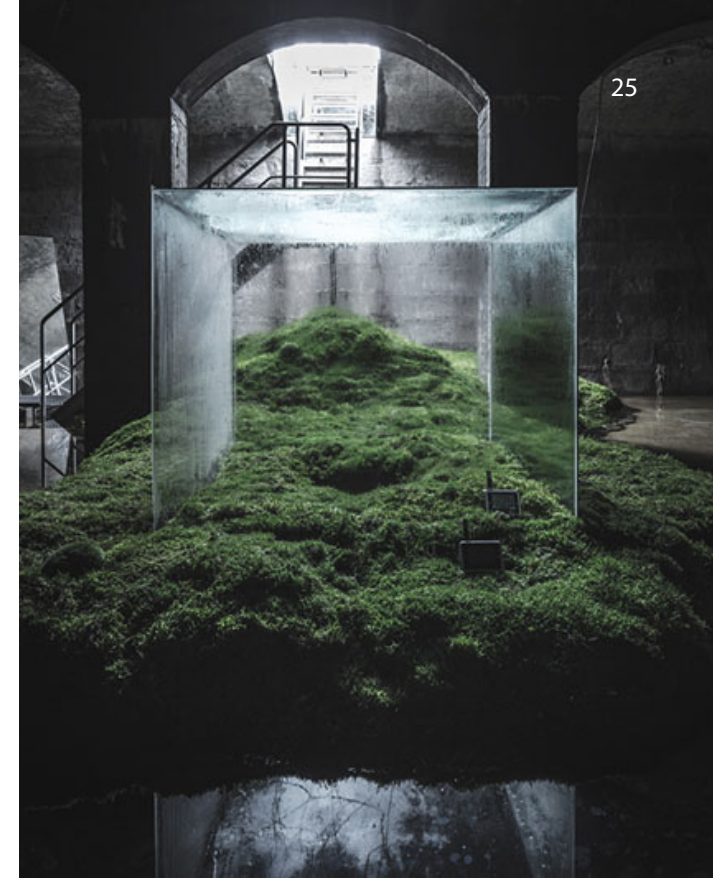
The motivation for the analysis and research about the lighting of Brasilia, Copenhagen and Berlin was to pursue the understanding what natural and scientific factors could justify the impressions I have perceived. In this chapter, I intend to present the scientific analysis of the natural aspects of those places and the personal impressions I have about them. It would be easier and much simpler to just compare two cities, one in the north and the other in the south and discuss the extreme differences between them. However, my approach of a threefold compare, prevents a personal biased and deterministic conclusions based on prejudices and personal impressions that could be confirmed by general beliefs about different cultures and latitudes.

The difference between the light of Brasilia and the two other cities is clear. Brasilia has a strong sun presence all over the year, the sun is typically high in the sky, the modernist architecture appearance is a consequence of how the sun must be treated by environmental comfort aspects to avoid heat and glare generated by the characteristic high insolation of the region.

On the other hand, Berlin and Copenhagen have just  $3,5^\circ$  of difference in terms of latitude, 135 hours of annual sunlight and only one-hour difference in the day length in the winter solstice. The sun angles are analogue and the conditions of clouds in the sky are also similar enough when it refers to the climate scientific discussion.

Even though the natural science explains the Berlin's light is so similar to the light in Copenhagen, how can the different impressions regarding the natural light of Berlin and Copenhagen be explained?

As its main known characteristic, the light characteristic of shaping the space was already discussed in natural science and in phenomenology by several authors. In resume, light can only be seen in the presence of a medium. Böhme, in his discussion about the invisibility of light states that, if a medium is necessary, light is invisible, and it turns into the shape of the material:





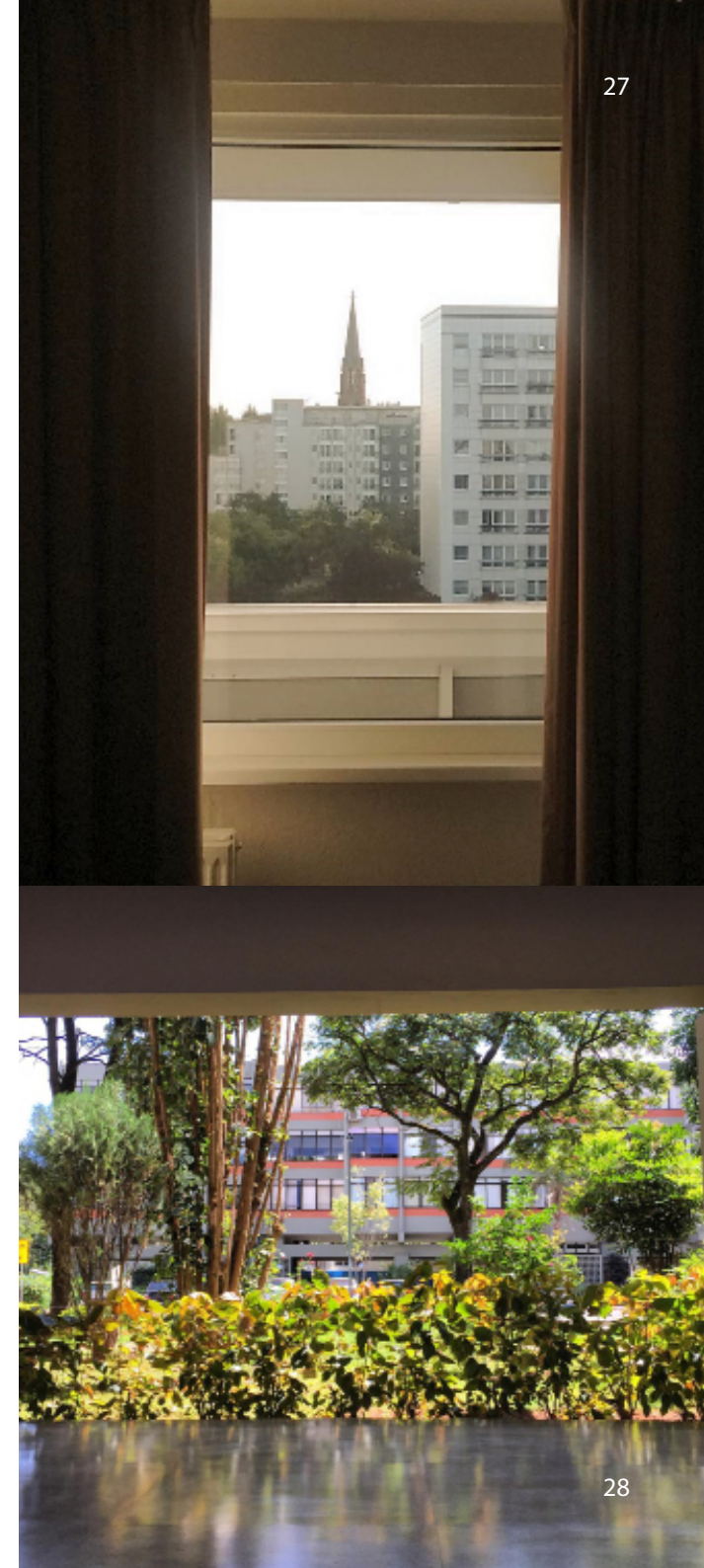
*“on the other hand, one might also decide to recognize seeing luminous bodies as a genuine way of seeing light. To return to the example above (dust particles), we do not actually see the luminous dust particles as dust particles, we simply know that this is the way they are. We see points of light. And the same goes for luminous wisps of cloud or bands of mist. Of course, we can also see them as something substantive, as a cloud or a patch of fog – but only when they stand against a dark background. Otherwise their material character disappears behind the manifestations of light, which they are. Thus, these luminous bodies are light manifestations of a unique kind. Although they are flat surfaces or bodies, because they are expanded and limited, their only imposing feature is the fact that they are luminous. Viewed as a phenomenon, but light manifested in a certain way. Their material character is not evident.” (Böhme, 2017, p. 195)*

According to Böhme, light shapes the particles, so they became luminous because of their immaterial aspect, enabling vision and the understanding of the space. But what if the discussion is the other way around? What if the space and our visual background shapes our comprehension of light? If we have the same light quality in two different spaces, won't we see the light in a different way? If light is reflecting and bounding around the bodies in the space, how can we separate the light perception of the space perception? Wouldn't that be an impossible task for human eyes and human perception?

*“But the process of seeing depends also on the mind that interprets the luminous stimuli, because the human being looks all the time, but really sees only what the mind is interested on assimilating. His or her life experiences, wishes and dislikes influence in the act of visualizing what is around him or her. (Barnabé, 2008, p. 690)*

In this case, the architecture of Berlin, rebuilt after the second World War, is possibly similar to the modernist architecture of Brasilia; not strictly in its typology, but in its scale. The urbanism of wide streets, bright buildings and the open distances between landmarks could change the perception of the light for something that is more familiar to my eyes and to my perception of light. The historical background resulting in the present architecture and urbanism of those cities could be also explored, but that would be a task for future works.

Therefore, light as a natural, cultural and visual phenomenon should not be described only under one of the possible disciplines. The study of the space and how it is perceived should count on different and complementary analytical tools in order to describe light in a more complete, deep and interdisciplinary way.





## LIGHT PERCEPTION AS A CULTURAL PHENOMENON

In this work, lighting was explained both in a natural scientific way as well as described by the use of personal impressions as a tool of communication between my individual experience and the reader. Phenomenology was mentioned, and some paragraphs adopted the individual description as a tool, but it was not properly presented as a science or philosophy as it is. Therefore, as phenomenology is crossing this work in every chapter, it needs to be explained some relevant concepts should be discussed.



## FIRST OF ALL, WHAT IS PHENOMENOLOGY?

Phenomenology is an important area of philosophy that leads to primal concepts of perception, space and presence. In phenomenology, there are no small questions. When the space creator understands that lighting lies between science and art, it becomes inevitable to dive into an artistic state of mind and investigate the principles of philosophy and aesthetic. Phenomenology comes as the descriptive science of the unmeasurable, the non-tangible, the moments of silence and contemplation. Phenomenology describes what we feel when we are present in a space and are aware of it.

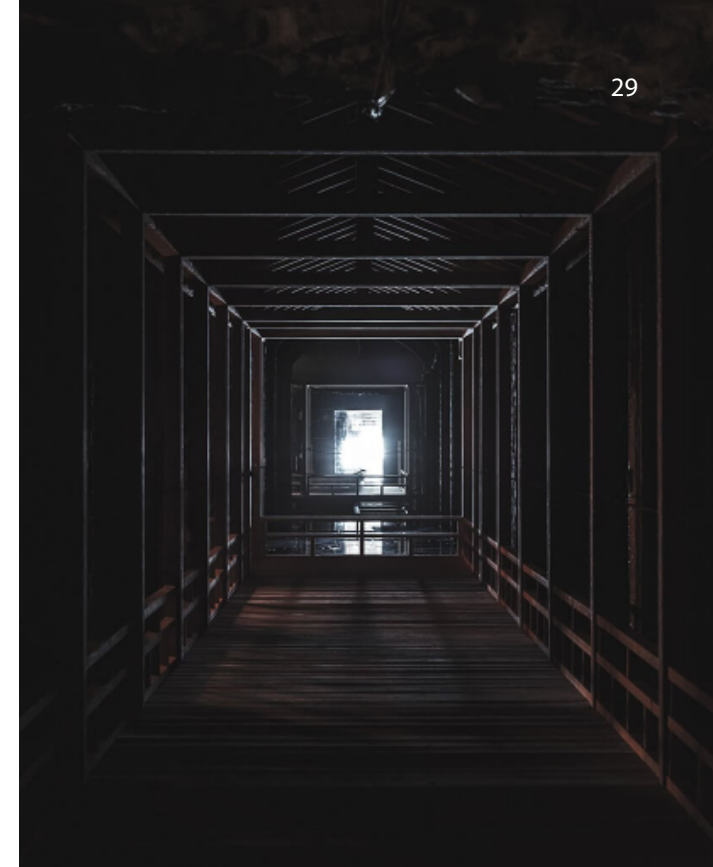
How should a science based perception in the human act? How can science explain the human perception in terms of feeling, space comprehension? How can science describe what we feel when we perceive our surroundings? If the perceived phenomenon is something internal and individual, how can we make a common science out of it? According to the philosopher Merleau Ponty, phenomenology can be identified as a manner of style of thinking, that is existed as a movement before arriving at complete awareness of itself as a philosophy. He states that the science of the phenomenon is the science of description of the real, not the analysis or explanation of it.(Merleau Ponty, 1962 p. VI)

Phenomenology, as a descriptive science, is seen and studied as one meaningful method of discussing, describing and exploring the field of architecture and space. The lighting designer, as well as the architect, needs to understand the user's presence in the space as an event, and, while creating and developing spaces, take the user's experience as the architecture's main criteria.

## THE REALITY AND OUR REDUCED PERCEPTION

What we perceive from the reality is just a limited fraction of it, and the difference between one (reality) and another (perceived phenomenon) is called *reduction* by Merleau Ponty.

The mind is able to absorb facts that are related to our notion of reality. We can only relate to what is known or possible according to our individual background. The writer and philosopher Aldous Huxley, in his book *The Doors of Perception*, argues that our languages filter our reality perception. He also calls this limitation reduced awareness:





*"Every individual is at once the beneficiary and the victim of the linguistic tradition into which he has been born - the beneficiary inasmuch as language gives access to the accumulated records of other people's experience, the victim in so far as it confirms him in the belief that reduced awareness is the only awareness and as it benefits his sense of reality, so that he is all too apt to take his concepts for data, his words for actual things."*  
(Huxley, 1954, p. 6)

Aware of this reduction, Merleau Ponty claims that our idea of the world also diminishes to a theme of discourse (Merleau Ponty, 1962 p. XV), and our idea of truth is based in this perception. We only perceive what we can explain and the language is the assumption path that our minds are used to follow. Moreover, the linguistic structure of the poetic imagination is acknowledged by Bachelard, in the Poetics of Space: *"By its novelty, a poetic image sets in motion the entire linguistic mechanism. The poetic image places us at the origin of the speaking being"* (Bachelard, 1958, p. 8)

If phenomenology states the existence of the reality reduction, constrained by our linguistic background, why are we not able to talk about visual reduction? If the linguistic background accumulated throughout our lives and inherited by our cultures enable this reduction in our perception, can we say the same about our viewed backgrounds that shape our visual assumptions? If light and contrast enable vision, aren't we used to see always in the same way when we live under the same kind of light during our visual background development?

For this reason, our understanding of lighting and the cultural visibility that we bring with us are editing the comprehension of the visible world and this, more than other aspects, influences the way we live and share the spatial events in our environment. Thus, our perception of the reality is reduced by our own cultures.

## MINDFUL PHYSICAL PRESENCE, CONSCIOUSNESS AND DWELLING: THOUGHTS ABOUT BEING

Gernot Böhme, in his essay *Atmosphere as Mindful Physical Presence in Space*, introduces the concept of an architecture based on *corporeality* (Böhme, 2013, p. 23) one architecture based not only in the volumes of a building, but in the perception of the user moving through the space. He describes the



“new architecture” as the space of the inverse of the buildings, as the emptiness between the wall when we are inside. When describing the different concepts of space along the history of architecture, he introduces the 17th-century philosopher René Descartes’ concept of *spatium*: the distance between bodies. Having bodies and distance as two unique parameters, the relation between bodies and the movement through the distances creates the space.

This objective space is perceived by the “sensitive” user. What he calls Mindful Physical Presence is the sensitivity of the user to its own condition inside the space. Atmosphere is the sensation of the mindful presence experienced in the space.

This awareness of the presence in the space was also explored by other phenomenological authors. Bachelard, in his book *The Flame of a candle*, describes in distinct ways the phenomenon of the “dreamer” whereas in the presence of a candle. According to him, the candle is an image operator, meaning that the candle has the power of provoking the imagination, bringing the “dreamer” different images and metaphors related to this mutual presence: the user existence aside the candle. He states that the candle’s presence generates the consciousness of the being, of the loneliness of the being. In this way, this lighting ancestral mechanism brings to the “dreamer” the consciousness of the own presence in the space.

The philosopher Martin Heidegger, in his text *Building, Dwelling, Thinking* develops the relation between the space and the being. In a very brief sum up of this text about the etymology of the word dwelling in the Germanic originated languages, it can be said that the word dwelling means being. In this way, the act of dwelling in the space is not just to live or have their homes, but where we inhabit, how we are in the spaces we occupy:

*“To be a human being means to be on the earth as a mortal. it means to dwell.” (..)Man’s relation to locations, and through locations to spaces, inheres in its dwelling. The relationship between man and space is none other than dwelling, strictly thought and spoken.” (Heidegger, 1971)*

Once more, phenomenologists build a determinant connection between the being and the space. We can conclude, by these thoughts, that the body is the parameter of the space, and that the perception is only possible by the sensibility, awareness or consciousness of the user’s presence.



## SEEING LIGHT: VISIBILITY AND ATMOSPHERE

Phenomenological concepts were developed and discussed, but what is the relation between phenomenology and light? What is the use of this science to the lighting designer? The connection between the phenomenon and its perception is clear but, when does lighting design become a protagonist in this territory?

The light is an elementary component for its obvious capacity of enabling vision. Böhme investigates the relation between light and vision and discusses that we only see things through light, but we only see light when it touches a medium. If we can't see light by itself, is light invisible? Even if we can't see light, the bodies reflecting it are our way to see the light phenomenon.

If light allows us to see the bodies and the distance between them, light allows us to see space, Descartes spatium. How is this space arranged, what is it saying? According to Böhme, the emotional tinge of a space: Atmosphere

*"The truth is that atmospheres are a typical intermediate phenomenon, something between subject and object. That makes them, as such, intangible, and means that – at least in the European cultural area – They have no secure ontological status. But for that very reason it is rewarding to approach them from two sides, from the side of subjects and from the side of objects, from the side of reception aesthetics and from the side of production aesthetics." (Böhme, 2013, p. 02)*

When we separate the object from the subject and understand that scenes can be created, we understand that the lighting designer can be an atmosphere inciter. In theater the separation between the scene and the audience is clear and the lighting designer creates a visual narrative, based on the imagination, in the nonexistent. Fantastic spaces can be created like new universes, what is called Phantastike Techne by the classical greek philosopher Plato. Böhme states that the designer truly doesn't create atmospheres, but establishes the conditions in which the phenomena can exist.



## ATMOSPHERES: WHEN LIGHT MEETS CULTURE

As already said before, atmosphere is created in the state between the object and the subject, between the space and the user. That means that the space creators, or lighting designers, have the power to provoke atmospheres in the user's perception. According to Böhme, theater lighting design is an example of the potential of creating these environments and to the audience induction to a state of mind that corroborate the narrative progression in a play.

In this case, atmospheres exist in between the one producing it or communicating an intention of a mood, or a feeling, inside a space, and the one who is receiving it. The construction of this feeling, thus, is made by the active part – the space creator- and the passive part – the space user. It is simpler if we use the example of the stage and the audience to make the clear difference between the creator and the user.

When we bring the term atmosphere to everyday life and the unconsciously created atmosphere that we have around us, it is inevitable to come back again to the concept of culture. Culture, in its basis, is about the communication inside a community, about shared values and facts. When an individual in a specific community is choosing for some lighting aspects in his or her house, this individual is visually communicating with the others.

*“Since atmospheres are engaged through a felt body, they are also resting on a culturally-shaped sensorium (cf. Classen, 1993; Howes, 1991), where social evaluation, anticipation and norms inform the particular shape of the atmosphere (Bille and Sørensen, 2007; Edensor, 2012). People do not simply become immersed in atmospheres on a blank slate but are inherently attuned by the norms of what to expect and by events that have occurred previously.” (Bille, 2015, p. 58)*

This work understands as atmosphere the specific feeling or mood of the user when inside a space. In different cultures and their inner immaterial territories, there is always a specific atmosphere caused by the way people learn to arrange the spaces and the light following their cultural background. Light, as an “atmosphere generator”, is one of the most powerful tools while changing a



space and its emotional apprehension. If every culture has its own lighting habits, has its own power of transforming the spaces. This people's power, conscious or not, is what we are naming here as *lighting culture*.

Hence, it is important to separate the term lighting culture from what is lighting design. In a way, what people do in their houses, what can be called as a lighting culture, is not the same as saying lighting design. The technical knowledge and the awareness of its requirements makes the discipline way more complex and technical than lighting as a cultural habit. These habits are shared and developed with an inherited and wise knowledge, but they don't explore and guarantee all technical and health complexity of the lighting design area.

The crucial concept of culture as a result of similar behaviors or aesthetical choices in the same community meets the concept of lighting, or lighting culture, in the act of arranging lighting sources in a space based on familiar knowledge and inherited visuality.



# 4 RESEARCH QUESTION

Based on the visual and cultural experience that I have had in Brasília, Copenhagen and Berlin and in the observations on daylight and artificial light in the three different cities, the research question is:

What is the influence of the natural light at a specific latitude on the visual perception and the artificial habits of a culture?



# 5 STUDY CASES

This work already presented the apprehension of light according to the physiology of the vision, to the phenomenological description of the spatial experience and presented what are the natural conditions of Brasília, Copenhagen and Berlin. Those aspects de-fine our perception conceptually and what kind of light is naturally “given” to people in different latitudes. Those concepts were introduced in pursuance of structuring the argument based on how we see, feel and perceive light depending on the cities we live, so until now this work was about the compulsory apprehension of light. The researcher Mikell Bille discuss the cultural aspect of lighting:

*But how do those different aspects lead to actual artificial lighting? What are the choic-es of people when they do lighting? The following study cases shape the main practical and analytical lighting section of this report, in which the artificial lighting differences between cultures will be documented, classified and discussed. As mentioned before, I do not aim to understand why every culture has preferences. The question of why people choose light the way they do would be more an anthropological research than an essay about lighting. Mikkel Billie, in one of his studies about lighting as a reflection of culture, affirms that lighting itself “is in one way or the other used in social life as a way of re-flecting notions of identity, cultural heritage, morality, securing possessions, and reveal-ing or concealing particular aspects of social life and so on.” (Bille, 2007, pg. 266)*

There-fore, this chapter objectively documents light settings in those different cultures. To establish analytical precision and propose an accurate analysis of practical lighting aspects, the scope of the study cases must be limited. This survey states methodologi-cal choices about the research field electing the space of the living room in private houses as it research object.



## WHY HOUSES?

*"With the house image we are in possession of a veritable principle of psychological integration. Descriptive psychology, depth psychology, psychoanalysis and phenomenology could constitute, with the house, the corpus of doctrines that I have designated by the name of topoanalysis. On whatever theoretical horizon we examine it, the house image would appear to have become the topography of our intimate being" (Bachelard, 1958, p. 20)*

The decision for private houses is due to the assumption that residential spaces act as a reflex of social preferences regarding intimacy, privacy, economic status and sociability representations. In the painter Hunderwassers theory of the five skins, he claims that the house as the third skin, as the middle skin between the social and the intimate spheres of the being. (Rand, 1993) The researcher Maíra Longhinott e Fellipe, in her essay House, a poetic of the third skin, argues about the house space as reflection of a society:

*"More than the projection of an image with evident paradise characteristics, the house is, most of all, a projection of the man, a reflex of its being. It gathers a conjunction of factors that it becomes a portrait of the inhabitant and its family. Through the house, the man reproduces his limits, his borders with the world. It reveals memories, desires, hopes, fears, rituals and personal rhythms and daily habits. Therefore, the habitation is also the portrait of an period and of a way of seeing the human relations. In this sense, the house exceeds the condition of mirror of the soul, enabling some kind of auto analysis, that leads to the re-valuation of the humanity itself. When the man see himself projected in the exterior, he becomes, potentially, a thinker of himself" (Fellipe, 2010, p. 301)<sup>5</sup>*

Instead of electing big projects designed by professional offices as study cases, this work decides for examining lighting habits. The understanding of how societies illuminate their houses is an analytic way of documenting the different cultures in their intimacy.

As a conclusion, houses were chosen based on the assumption that they are the space that better represent the lighting aesthetic that is made by people in the construction of their own cultural behavior framework.

<sup>5</sup> Essay wrtitten in Portuguese. The original version of the quote, in portugese, is in the appendix.





## WHY LIVING ROOMS?

The election of the living room among other residential typical rooms have both anthropological and practical reasons. By the anthropological aspect we assume that the living room is the social part of the house, where usually gathering happens, where the outsider people are invited to come in. More than that, the living room enables social interaction, and this is their main function. The practical aspect of this choice assumes that in the living rooms there are more variations of lighting settings and luminaire typologies, there is more available space and less practical limitations. Usually the lighting choices for these spaces are not only practical but have a strong aesthetical influence more than in the other rooms. The other reason for this choice is the facility to get access to living rooms rather than bedrooms or kitchens on people's houses. This is a survey made in three different countries and the intimacy values can vary, but it would always be easier to get pictures and physical access to the "social" areas of private houses.

## HOW TO ANALYZE THE LIGHTING IN LIVING ROOMS?

The settled method was established through the process of talking, visiting, receiving material and documenting living rooms in Brasília, Copenhagen and Berlin. When analyzing a space, what is important to document and investigate in a practical way? How do people describe the lighting conditions in their living rooms? What are the parameters that could be applied in the analysis of all the living rooms?

When interviews could be done, the interview method was the semi-structured review (Fontana, Andrea and James Frey. 1994), I would ask the users to describe the lighting conditions of their houses. The typical informal descriptions would begin with the daylight circumstances and how natural light behaves throughout the year in the inner spaces. That could be an object of study, but this work already analyzed the natural light conditions in a macro way.

After describing the sun and the daylight conditions, the user would describe the luminaires in the living room, their appearance and where they are placed. In other words, people described the type of luminaires, their fixation and the quality of the light. Following these repeated tendencies in the





answer of the users, the chosen method of documentation and analysis focused on the object of the luminaire and considered its election as a result of cultural lighting preferences.

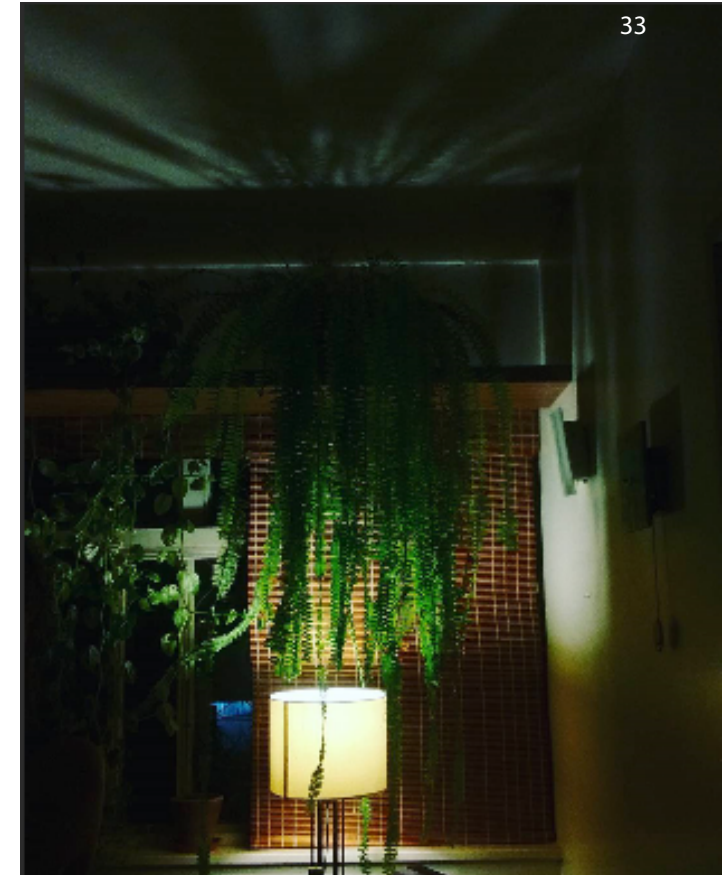
The material production and election of objects is called material culture, as stated by Mikkel Bille and Tim Flohr Sørensen, in the article *An Anthropology of Luminosity: The Agency of Light:*

*“The relationship between persons and things is at the heart of most material culture studies. Within the previous decades, one aim in these studies has been to understand how the sensation of things is inseparable from the meanings and sociality of things, and their production (see Howes, 1991, 2006)” (Bille, 2007, p. 264)*

The choice for diffused or directional light, one single downlight or several table lights with different sources or the height of a pendant could illustrate what a family wants to show or hide and what are the preferred places to be exposed, but that could be the object of another study. Again, the question of this work is not why, but how.

However, based on the choice of the luminaires as the way we all choose artificial lighting, the following documentation will be structured by luminaire types or, as called here, lighting typologies. These typologies were classified in a simplified way following the language used between clients and manufactures and known by the lighting designers in the professional practice. They follow a common terminology that could be applied in the survey and in the communication with the owners of the examined spaces.

The classification of the lighting typologies will follow the parameters of application, where they are installed and whether they are directional or diffused. Consequently, all the application types have the sub-typology of directional or diffuse, if they were found in the study cases. All the living rooms documented for this work will be classified under the following typologies:





## DOCUMENTATION METHOD

The research labor has always to count on the limitation of the tool and on practical issues. The body of this work includes the documentation of three different cities in three different countries and two different continents. To make possible that the information gathering could happen without my presence in both continents, a digital survey was spread for friends and known people in Brasilia, Copenhagen and Berlin. The survey intends to achieve ten different living rooms in each city, including the following information:

Furniture layout

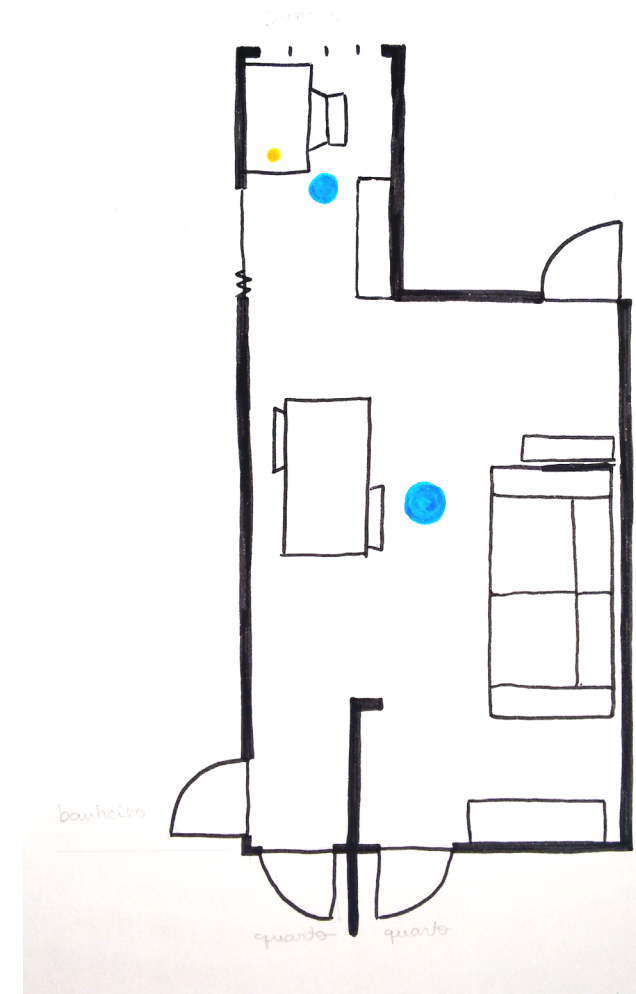
Luminaires position in the horizontal plan

Luminaires position on the vertical plan

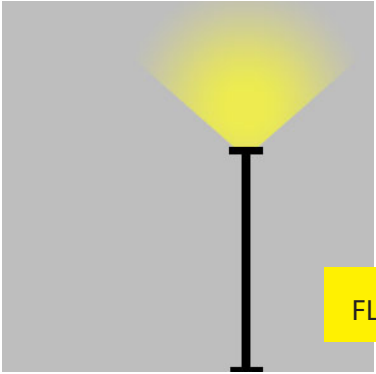
A daylight picture of the room.

This information was gathered using e-mail and phone calls when the visit was not possible, and the pictures, interviews and measurements were made by me in the cities in which the visit was possible. The received drawings were represented in diagrams without scale, due to the understanding that people that are not architects or designers would have some difficulty on making them on scale, drawing and representing it accurately. Because of that, all the visual documentation is without scale, but proportional.

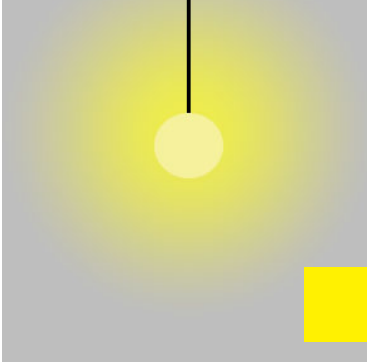
In the appendix, the classifications and visual schemes of all the living rooms are exposed. Not all the pictures or the original drawings are there, but the result of my work that intended to present the room documentation with some uniformity, pursuing the same parameters, visual representation and same kind of information are documented.



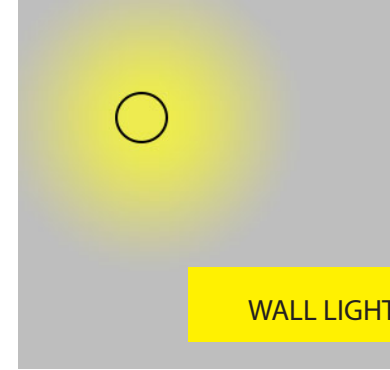




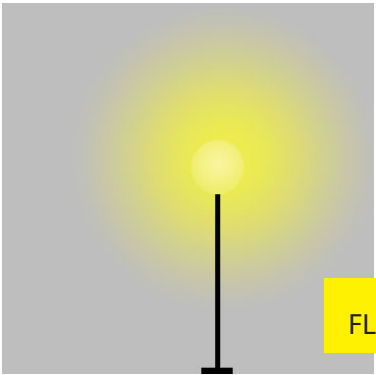
FLOOR LIGHT INDIRECT



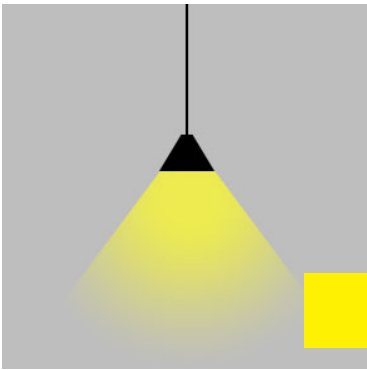
PENDANT DIFFUSED



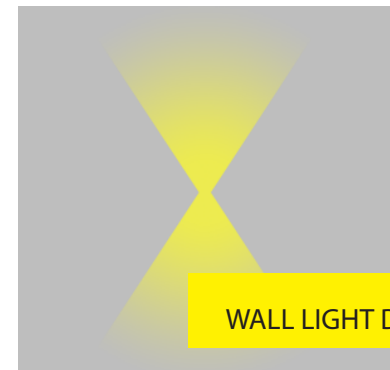
WALL LIGHT DIFFUSED



FLOOR LIGHT DIFFUSED



PENDANT DIRECT



WALL LIGHT DIRECTIONAL

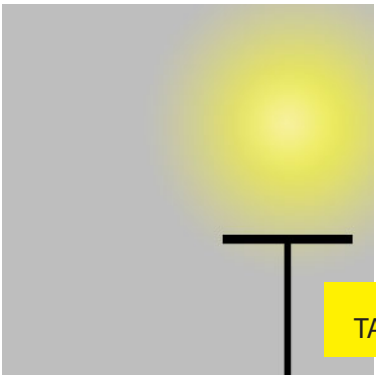
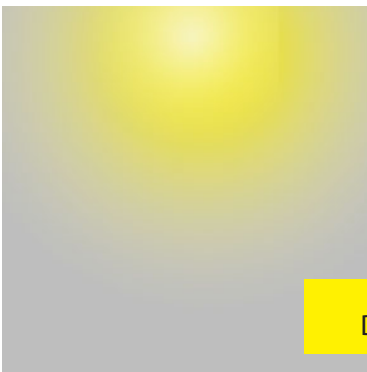
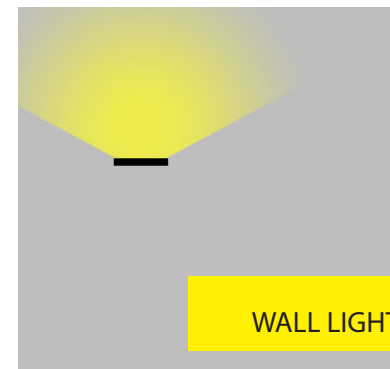


TABLE LAMP DIFFUSED



DOWNLIGHT DIFFUSED



WALL LIGHT INDIRECT

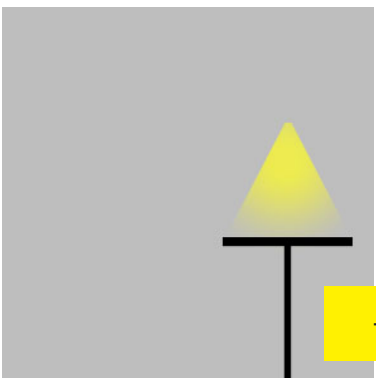
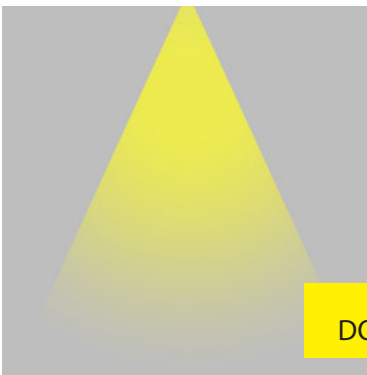
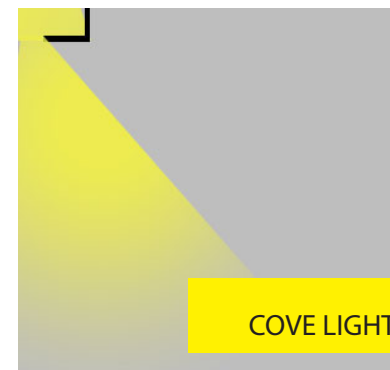


TABLE LAMP DRECT



DOWNLIGHT DIRECTIONAL



COVE LIGHT DIFFUSED



## ANALYTICAL METHOD

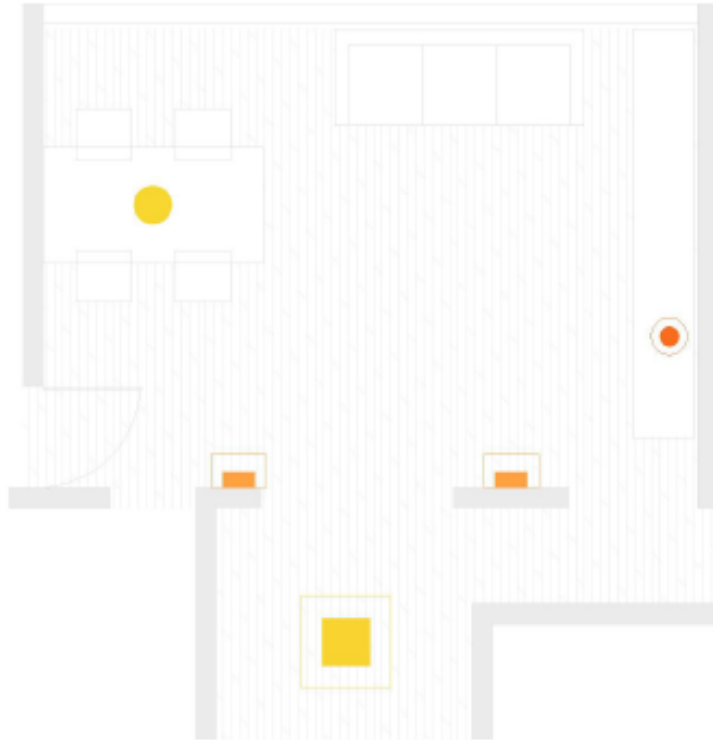
When talking to people about places, architecture, cultures, luminaires and about how light and atmospheres can be seen in every culture, there are some typical comments, stereotypes and beliefs that are constantly repeated and spread. These general assumptions exist not only between non-specialized people but also between lighting designers and architects. In my experience as a lighting designer I have always heard that in the southern countries, near the Ecuador, the artificial light would be always more intense, always in the ceiling, and with a specific color temperature because of the high sun incidence. In the other hand, northern countries would have the tendency of lower lighting levels, with a delicate and diffuse light and warmer color temperature. Both statements are based on the believe that the artificial light of a culture reproduces or follows characteristics of the natural light. I have heard many times, for example, that because of the lack of natural light in the winter time in Copenhagen, the artificial light plays the role of making a cozy atmosphere in the indoor spaces. These statements do not make part of a theoretical scope that is available in books or literature, but somehow, I was always curious if these allegations could be proved or not and if that relation between the natural light and the lighting habits of a society is so direct and predictable.

Once the living rooms of those three cities were documented and classified under lighting typologies, how can this documentation generate real content, avoiding assumptions that only would reinforce cultural stereotypes?

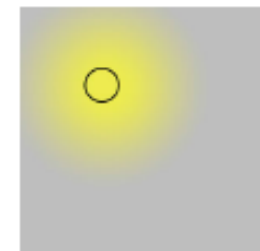
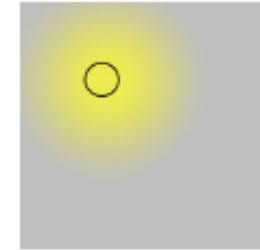
The following analysis uses these general beliefs as a tool. The established method will use benefits from these assumptions as hypotheses to be confirmed or contested. Some of the assumptions are shared by people in general, and some of them are my personal beliefs that were resultant from my experience in these places. I do not intend to prove those statements are right or wrong, but to go further in the discussion of them based in the collected data.

After presenting the main hypothesis, the result of the documentation analysis of the real lighting conditions will be presented and, at last, the hypothesis will be compared with the analysis result.





## Brasília



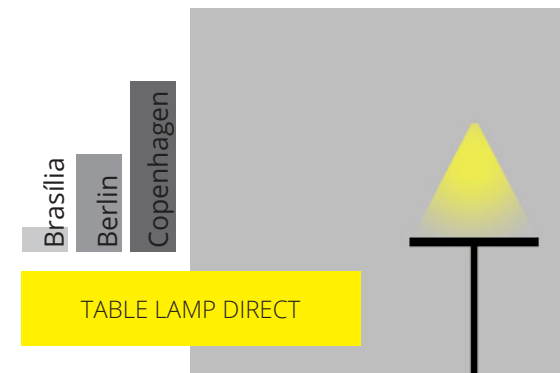
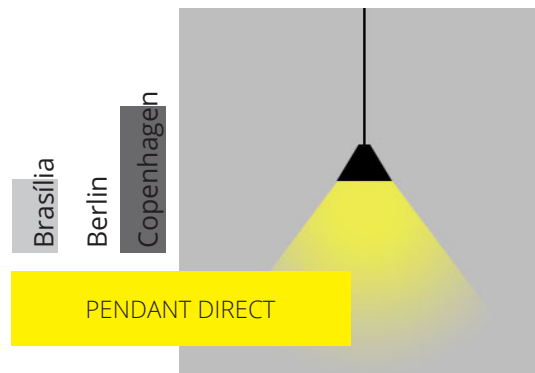
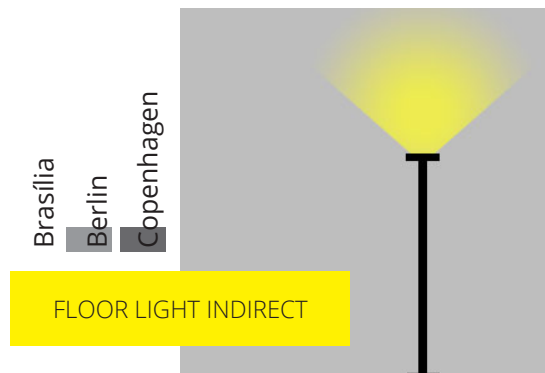
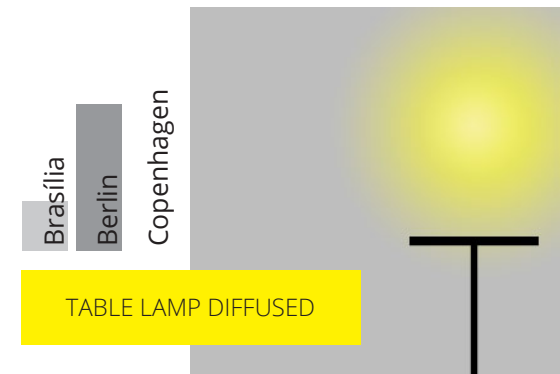
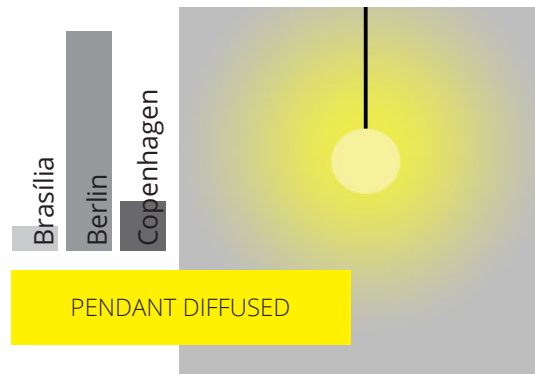
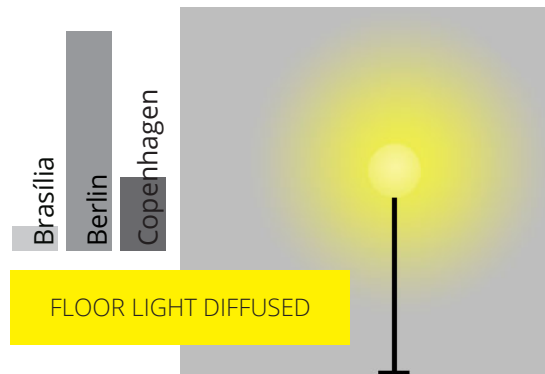
**Felipe e Nahira**

**33/29 years old**

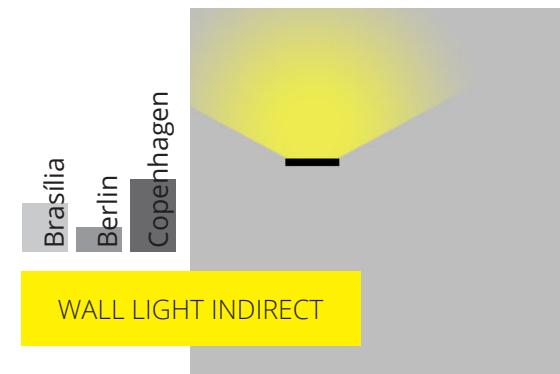
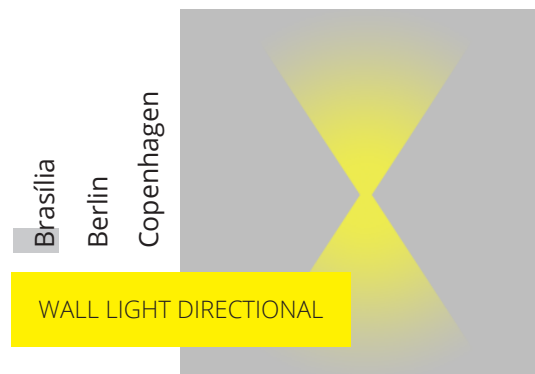
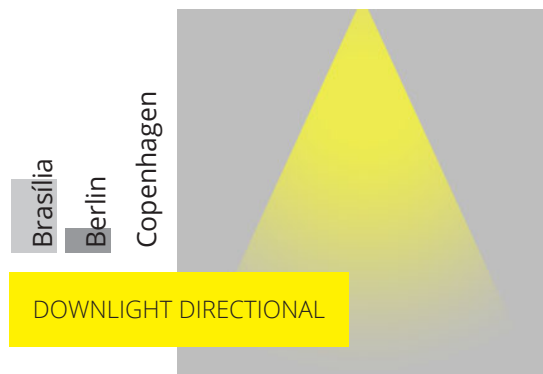
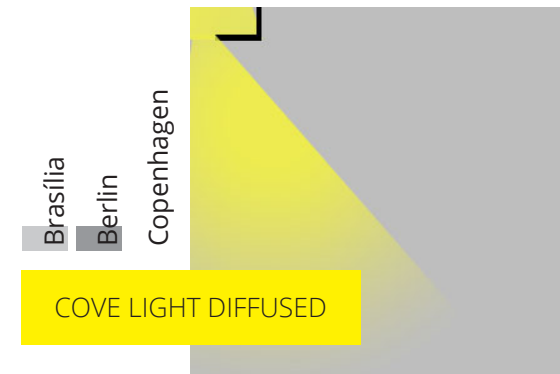
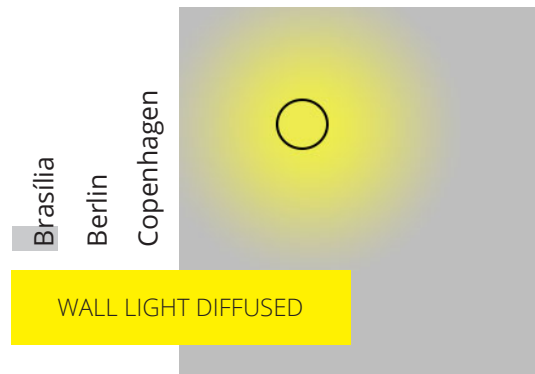
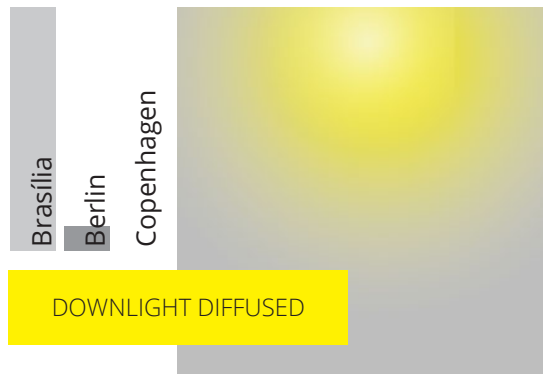
**3 inhabitants - Family**

**Apartment**











## HYPOTHESIS:

The Artificial Lighting in a culture reflects the conditions of the natural light of that latitude

At this point is important to establish an equivalence between the natural and artificial light to state the same lighting visual parameters. The possible parameters were light direction and contrast. These two parameters could be analyzed and compared both in the sun light and in the artificial light in living rooms. The direction parameter means the fixation (or location) of the luminaires in the living rooms and the contrast means the difference between directional and diffuse luminaires. The high contrast is represented by directional light and the diffuse have the analogue condition.

Based in that equivalence, sub hypotheses will be tested:

*1.a - As the natural conditions of Berlin and Copenhagen are extremely similar, the artificial light will follow this tendency.*

*1.b - The artificial light of Brasilia will be mostly from above, with no sidelight.*

*1.c - The artificial light of Brasília will be mostly focused, or with hard shadows.*

*1.d - The artificial light of Berlin and Copenhagen will be diffused with low contrast*

*1.e - The artificial light from Berlin and Copenhagen will be mostly from the side*



## RESULT OF THE ANALYSIS:

### BRASÍLIA

In Brasilia ten living rooms were analyzed, in which the users have an average age from thirty to forty years, mainly couples or young families. Only one of them is a shared apartment. The material from Brasília was all received by e-mail, but seven of them were visited by me in previous opportunities.

In Brasilia all the apartments have the main light source in the middle of the room as a construction standard, but the users declared that not all of them are used on a daily basis. In three of them, the diffuse downlight is used every day as the main light source. In the other seven, the other sources are used more frequently.

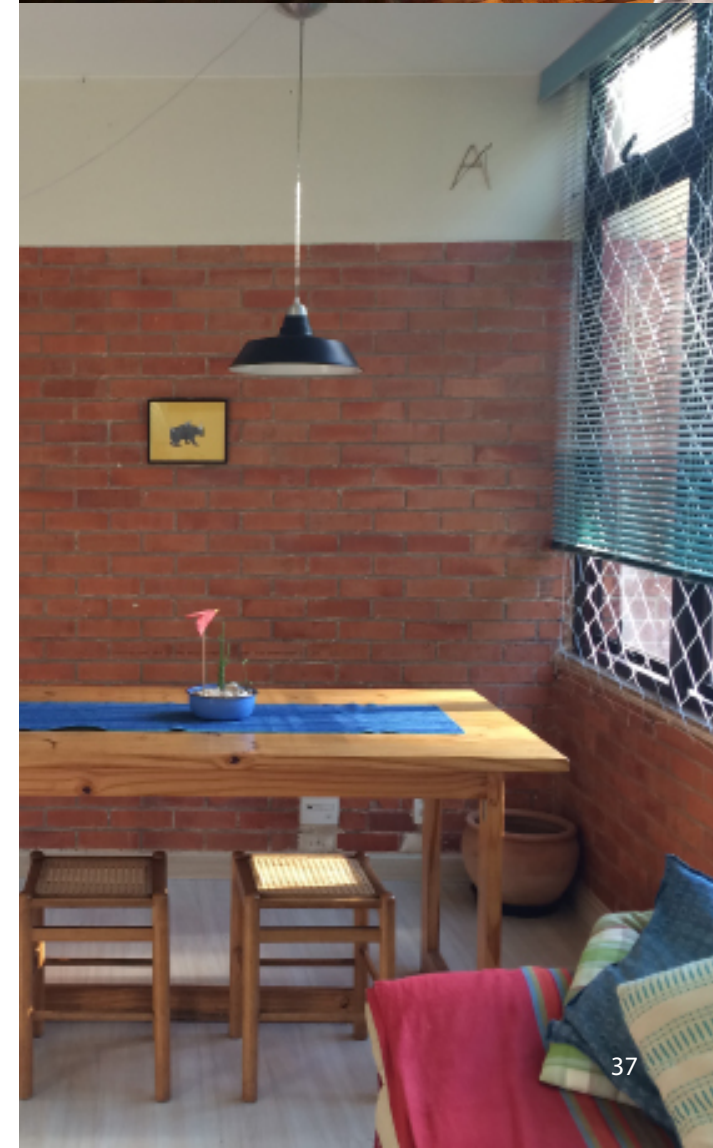
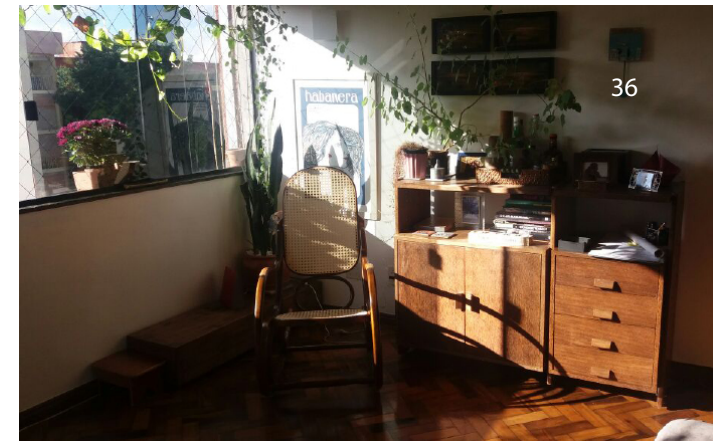
The surface mounted diffuse luminaires used in the ceiling in Brasília are not common in the other two cities. It is clearly a regional use of one kind of luminaire that in the other countries is used only in commercial environments.

From the 10 apartments, only three use directional downlight. Or else near the walls, illuminating artworks or in the small bar used to highlight the surface of the bar (see Giselle, Vania e Lorena in the appendix) . In the other seven apartments, the downlight is mainly diffuse and not used so often. In one apartment, the central point in the center of the room is frequently used but the luminaire is a source of indirect light.

Another feature that is present is the wall light. Four apartments make a constant use of this source, and from these four, only one use the focused light. There is one example with diffuse light and the other two use indirect wall light, what is called here as diffuse light.

In Brasilia, the use of pendants is mainly for the dining tables. The pendants are not so frequent as in the other cities, there are pendants in five of the 10 living rooms. From these five, four are used for the dining table.

The use of table diffuse light was found in two out of ten apartments. One of the living rooms have more than one, in one of the study cases it is used in a study table. Only one diffuse floor lamp is used in the collected material of Brasília.







## COPENHAGEN

In Copenhagen it was only possible to document seven living rooms. The age of the users was between twenty four and sixty two years old. No shared rooms were registered, only one single person apartment, the others were couples or families. Three of the above mentioned living rooms were visited. The other material was sent by e-mail.

The characteristic of the main light source in the middle of the room is not so frequent in Copenhagen. When it happens, there is a wire that changes the location of it in order to produce the pendant light over the table. In these apartments, the pendants are usually over the table as in Brasília, except for two rooms. In the mentioned two rooms, there was a diffuse pendent in the middle of the room.

In Copenhagen there is no mounted surface downlight with diffuse light.



Wall indirect lights were found in two apartments.

In the apartments and houses of Copenhagen there was a repeated use of pendants over the table with a lower height of them, closer to the table than in Brasília.

Different from the other cities, the living rooms of Copenhagen usually do not have a main source of light but other small sources, like table lights and floor lamps. There were found five sources of directional light and three floor lamps, two diffuse and one indirect. These are located all over the space, but usually focused to the next horizontal plane. These table lights were generally found in side tables and, most of all, in the base of the window. It was also possible to see candle holders in the base of the window, that could be reallocated in the dining table in some specific social events.





# BERLIN

In Berlin eight apartments were studied, in which the age of the users goes from twenty nine to sixty two years. The living conditions of the study cases in Berlin are quite different from Brasilia, and way more diverse between themselves. In the beginning of the research process it was a hard task to find shared apartments with living rooms. In this city or specifically in the environment that this research could have access to, it is common to transform the living room into a bedroom, and the social part of the house becomes the kitchen. From the documented samples, some part was made by people living alone (four samples), three were owned by couples and two shared apartments were analyzed. I personally visited five of them and the others were registered by the owners and shared with me by e-mail.

As in Brasília, the living rooms in Berlin follow a construction standard and have the main light source (in some cases more than one) in the room ceiling. Those ceiling luminaires were found in all the study cases. In seven of them these luminaires were diffuse pen-



dants, at one there is an example of surface mounted diffuse light, and, as an exception, there was one room with many focused downlights. One important aspect of the location of the pendants in this city is that they are not placed over the tables. So, differently from Brasilia and Copenhagen, the pendants are used as a source of general diffuse light, not only to illuminate the dining table.

In Berlin it was registered the use of focused downlights in one room and only one wall light with indirect light was registered.

The diffuse light produced by the pendants is usually complemented by table lights or floor lamps. In the material collected, there were 7 living rooms with the use of diffuse floor lamp and five used table lights. In three of them, the table light was focused on a table and in three of them there was one sample of diffuse table light.



## DISCUSSION

The discussion about the documented living rooms compared to the hypothesis will begin from the comparison of the artificial lighting conditions of Berlin and Copenhagen. If the artificial light of a culture reflects the atmosphere and the conditions of the natural light of the same latitude, the artificial light of Berlin and Copenhagen should be, if not the same, clearly similar. As presented above, the election for luminaires and their location is not as similar as the natural light conditions. Needless to say, the correspondence between the hypothesis and the collected data is not true, and other aspects should be analyzed when comparing the light of the two cities.

If the light in Brasília would follow the sun usual conditions, the hypothesis that there will be more sources from above would be true. As it was shown by the collected material, in Brasilia there is another kind of luminaire that is more frequently used in the ceiling but the quality of light, diffuse, is the same of the pendants in Berlin. Thus, the quality of the light is the same, but the typology of the luminaires is different. That could be explained by manufactures, marketing trends, economical influences, aesthetic preferences or other reasons that don't make part of the scope of this work, but the hypothesis is wrong.

The other aspect of the reproduction of the natural light of Brasília would be the absence of side light. As it was explained, 40% of the analyzed living rooms had wall lights with diffused or focused light.

One important aspect that was shown by the result of the analysis was the presence of focused light in Brasilia. It does not appear in most of the samples, but it appears as focused downlight in two apartments and as focused wall light in another living room. In the other cities these kind of fixtures were not found. But in its majority the artificial light of living rooms in Brasília was diffuse.

The discussion about diffuse light in Copenhagen and Berlin is a little bit more complex. In Berlin, the presence of a main diffuse light with other small diffuse sources was clear, so it confirms the hypoth-



esis of the analogy between the natural and the artificial light. In this specific case, the hypothesis would be correct if the analysis of Copenhagen would confirm it, but that was not the case.

The study of the living rooms in Copenhagen showed that there is an extensive use of table lights or floor lamps. Still, what is important to emphasize here is that these lamps are usually in the windows base, over side tables or near the corners. These light sources are not often diffuse but used in a directional way. That produces a low spill light that gives a very specific atmosphere, but that light cannot be classified as diffuse and is not similar to the diffuse quality of the light in Berlin or Brasilia.

In Berlin and Copenhagen, where the sun path produces a constant side light, it was only found three examples of side light, or luminaires fixated in the walls. That means that there are not enough samples to confirm that the side light also is present in the artificial lighting.

In the other hand, the discussion could go in the opposite direction and it could be asked if the artificial lighting does not do the opposite role, if the artificial lighting could be compensating the daylight and climate aspects and have the opposite characteristics. In the case of Copenhagen, for example, the artificial light has the opposite “typologies” of the natural one. Instead of the cold diffuse light, the artificial lighting is focused on horizontal surfaces and with warm color. But even that this hypothesis could be stated, the comparison with Berlin would have the same result. The artificial light is diffuse and general, pendant from the ceiling, with a colder color temperature. In this case, the difference between the lighting settings would prove that the relation with the natural light is not direct, even if in the opposite direction.

These compared examples were practical tools, based on established equivalences, to prove that the relation between the natural environment and cultural production should not be reproduced or used as a base for design choices. What is stated here is that, if we cannot explain the behavior of a population by its weather or latitude to avoid to be simplistic and determinist, aesthetical determinism should as well be avoided.



# 6 CONCLUSION

## **VISUAL PERCEPTION AND LIGHTING HABITS: A CULTURAL PHENOMENON**

Light as a natural, cultural and visual phenomenon was described under different areas of science and was also described using personal description as a tool. In the presented work many questions were made, hypotheses were stated in the pursuance of stating parallels between our physical perception of light, the individual apprehension of the space and its relationship with the natural environment. In the last chapter, the respective cultural visual background and how they influence the production of artificial lighting in the compared cities was studied.

The presented thesis follows the narrative of the process of investigation. At first, the connection between the vision, the natural light and the lighting production of the cultures was clear, but in the development of each subject and the investigation of each example of living room transformed the work less and less deterministic, natural conditions progressively were shown to be less important than the cultural preferences that lead to the way people make lighting in their houses.

What is the influence of the natural light at a specific latitude in the visual perception and artificial lighting habits of a culture?

This question raises a complex discussion that should be treated carefully. First, it is crucial to separate what is the perception of light and space from what is the lighting production of a culture.

As stated many times, the lighting perception is an individual process that is influenced by our constructed visual background. This visual background is shaped by our natural conditions but also by our cultural aesthetical characteristics. It is impossible to separate the natural environment from the



cultural influences in our visual perception, but the relevance of the culture is unquestionable.

The other part of the research question is the influence of the natural environment in the lighting habits and conditions. The natural circumstances shape our architecture, the available material we have, the kind of isolation of our buildings, the costs of one material or another, and by all means it influences our cultural aesthetical characteristics. Thus, when it refers to lighting conditions, weather and sun path, this influence is not as proportional. The fact that the sun map of Berlin and Copenhagen is so similar, and the artificial lighting production is clearly divergent proves that, more than the environmental circumstances, the cultural inherited preferences for the material culture is infinitely more important than the other aspects.

Another important conclusion of this work, present in the chapter about the description of the daylight conditions in the three capitals and the personal impressions about it, is that the perception and description of light itself as an isolated aspect is an close to impossible task to handle. To describe the lighting conditions of a space as a phenomenon is also to describe atmospheres and the space of the city. As concluded before, the light shapes the space and the space shapes our perception of light. This is due to the intrinsic aspect of light of being visible only when touching a material. It can seem like an obvious conclusion, but the difference between the light perception of Berlin and Copenhagen is more due to the architectural aspects of both cities than to the natural light itself. Once more, when the sun path of the respective cities is analyzed, there are more similarities than differences, but when you are present in the space the appearance and atmosphere is completely different. The conclusion is that the analysis of light is also the analysis of the space, and it should be treated as a spatial analysis.

Light stands between art and science and this is the most important characteristic of the lighting field. Therefore, it should be analyzed under different aspects and areas of knowledge. The adopted methodology of overlaying different areas of science to analyze, compare the results and use different types of information makes the work more holistic, complete and respectful with all areas. The measurable information together with the unmeasurable and the personal impressions enables a more complex comprehension of lighting, spaces and urban environments. It results in a more complete and less deterministic discussion.



The use of study cases allied with a theoretical approach makes the research closer to reality and easier to visualize. The study cases were a successful tool to evaluate the hypothesis and general beliefs and to understand the lighting habits of a culture.

Concepts as beauty, elegance, intimacy and comfort are all constructed culturally. If, for example, the concept of atmosphere exists between the space and the user, the background of the user is a determinant part of the creation of the mood, because this visual background built the image framework of that user. It cannot be denied that the natural light perceived by these cultures over the centuries also shapes the spatial perception, but, as proved by the study cases, it is not as determinant as culture.

As cultural beings, everything that we do is caused by our social surroundings and made in a collective experience. Light, as the shared phenomenon of all the days, is perceived in different ways, depending on our visual background, shaped by the spaces we have experienced. But lighting, a social tool of communication, celebration and information about what we are and what we want to see, is made collectively. It is inherited, organic, reinvented every day. Just like culture.



## FURTHER DEVELOPMENTS

This work intended to cover different areas of the lighting research, from the vision to cultural lighting habits passing through phenomenology and a sun path analysis of Brasília, Copenhagen and Berlin. As these different areas were explored, the research could not look further into several aspects, but some were clearly seen in the process of the research.

Concerning the measurable aspects of the study cases: The illuminance of the living rooms could be measured to compare the light intensities. As it was not possible to visit all the three cities during the development of the study cases, the illuminance could not be settled as a parameter. In the initial phase of the analysis in which the vision was the study focus, the fact that the contrast enabled vision, led to the consideration of measuring the contrast in the visited places. This index could be a valuable measuring tool of the usual contrast in the spaces to compare these values in natural and artificial lighting. Another index that could be generated in further analysis of the study cases would refer to an average of luminaires per square meters. The quantity of luminaires between the living rooms in the three cities could not be a comparison parameter because of the measurement impossibility. That parameter could bring a more accurate notion of number of light sources per room as well.

In the unmeasurable part of the work, deeper developments could seek for behavior registers, or ethnographies itself. To understand how societies deal with light, when the lights are on, when candles are used, how society sees light as a common habit could also bring more depth into the analysis of the why. To understand why people do lighting the way they do would be a long and careful work of researching behavior cultural habits, intimacy rules and their consequences in the lighting choices and visual preferences. That would be an anthropological study of lighting, and it could have a wide and important presence in the preliminary studies for lighting projects.



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Sambuichi Interview: Building with Sun, Water and Air <https://vimeo.com/220431980>, made by the Louisiana Channel

## 8 Images

Image Cover: Picture from the exhibition DESTUDO, work of the artist Samantha Canovas, 2013. Picture by oBarco Estúdio

Fig 1: The Labirinth made of light painting by the Transdisciplinary Laboratory of Scenography. 2012. Picture took by the author

Fig 2: Test process in the semester project at Aalborg University. 2017. Picture by Laurence Bourghol

Fig 3: Eye physiology: Fovea and Retina. Source: <http://bonlacfoods.com/worksheet/structure-of-the-human-eye-worksheet-0.html>

Fig 4: Image of the eye: Rods and Cones: <https://www.sciencenews.org/article/how-rewire-eye>

Fig 5: Image Signal comparison: Drawing made by the author inspired in a scheme from Liljefors, Anders, "Light, Visually and Physically",

Fig 5A: Cornsweet Illusion: [https://commons.wikimedia.org/wiki/File:Cornsweet\\_illusion\\_explanation.svg](https://commons.wikimedia.org/wiki/File:Cornsweet_illusion_explanation.svg)

Fig 6: Sun Path Brasília Top View: <http://andrewmarsh.com/apps/staging/sunpath3d.html>

Fig 7: Sun Path Brasília Side View: <http://andrewmarsh.com/apps/staging/sunpath3d.html>

Fig 8 : Day length Brasília: <http://andrewmarsh.com/apps/staging/sunpath3d.html>

Fig 9: The inevitable light or Brasília, The Brazilian Museum of Republic. Author: Gabriela Cerqueira

Fig 10: The red on the dry season. Author: Gabriela Cerqueira



Fig 11: The heavy clouds of the stom. Brasília. Author: Marília Panits.

Fig 12: The orange clouds and the sodium street lights. Author: Bruna Neiva

Fig 13: Image Sun Path Copenhagen Top View: <http://andrewmarsh.com/apps/staging/sunpath3d.html>

Fig 14: Image Sun Path Copenhagen Side View: <http://andrewmarsh.com/apps/staging/sunpath3d.html>

Fig 15 : Image Day length Copenhagen: <http://andrewmarsh.com/apps/staging/sunpath3d.html>

Fig 16: Copenhagen's façades. Author: Raquel Rosildete

Fig 17: Window in the copenhagen winter:. Author: Raquel Rosildete

Fig 18: Copenhagen Summer. Author: Raquel Rosildete

Fig 19 Copenhagen side light in the summer. 20hs. Author: Raquel Rosildete

Fig 20: Sun Path Berlin Top View: <http://andrewmarsh.com/apps/staging/sunpath3d.html>

Fig 21: Daylenght Berlin: <http://andrewmarsh.com/apps/staging/sunpath3d.html>

Fig 22: Sun Path Berlin Side View:: <http://andrewmarsh.com/apps/staging/sunpath3d.html>

Fig 23: The Skyline of Berlin: Author: Raquel Rosildete

Fig 24 : The purple skyof Berlin. Author: Hugo Carvalho

Fig 25: mage of the exhiton of Hiroshi Sambuichi, at the cisternene, Copenhagen. Autor: Rasmus Hjortshoj. Source: <https://www.designboom.com/art/hiroshi-sambuichi-cisternerne-installation-water-copenhagen-rasmus-hjortshoj-07-31-2017/>

Fig 26: Frame from the documentary: Sambuichi Interview: Building with Sun, Water and Air <https://vimeo.com/220431980>, made by the Louisiana Channel

Fig 27: The modernist face of Berlin. Author: Raquel Rosildete

Fig 28: The modersnm of Brasilia. Author: Alice Carvalho

Fig 29: Image of the exhiton of Hiroshi Sambuichi, at the cisternene, Copenhagen. Autor: Rasmus Hjortshoj. Source: <https://www.designboom.com/art/hiroshi-sambuichi-cisternerne-installation-water-copenhagen-rasmus-hjortshoj-07-31-2017/>

Fig 30: Sun pattern inside a living room in Brasília. Author: Raquel Rosildete

Fig 31: Window looking at garden in Amager, Copenhagen. Author: Raquel Rosildete

Fig 32: Living Room in Copenhagen. Author: Raquel Rosildete

Fig 33: Table light in Living Room in Brasilia. Author: Raquel Rosildete

Fig 34: Sketch received by e-mail with the asked information. Author: Vanessa Cavalcante

Fig 35: Scheme with example of the analysis of the living rooms. All the ohter rooms are in the appendix.

Fig 36: Living Room in Brasília. Author: Marina Lima

Fig 37: Living Room in Brasília. Author: Nahira Salgado

Fig 38: Living Room in Copenhagen. Author: Mette Hvass

Fig 39: Living Room in Copenhagen. Author: Mads

Fig 40: Living Room in Berlin. Author: Raquel Rosildete

Fig 41: Living Room in Berlin. Author: Raquel Rosildete



# 9 Appendix

Original Version from Paulo Barnabé, p.25

*“Algumas das relações percebidas com a experiência de luz são universais, imagens arquetípicas que a humanidade compartilha; certos significados são culturais, absorvidos por rituais ou atitudes perante a vida; outros são pessoais, associados aos eventos específicos vividos. Assim como se pode escolher uma roupa para se usar ou não usar, por causa de certas associações, de modo específico, padrões de luz lembram de um lugar, permitem fazer correlações com outros lugares, possibilitam vivências acumulativas multifacetadas.”*

Original Version from Paulo Barnabé, p. 37

*“Mas o processo de ver depende também da mente que interpreta os estímulos luminosos, porque o ser humano olha o tempo todo, mas realmente vê somente aquilo que sua mente está interessada em assimilar. Sua experiência de vida, desejos e aversões influenciam no ato de visualizar o que o rodeia. Disso decorre, então, ser capaz de projetar ambientes visualmente confortáveis dependendo do modo pelo qual estuda esses problemas.”*

Original Version Clarice Linspector about Brasília, p. 27

*“Brasília é construída na linha do horizonte. Brasília é artificial. Tão artificial como deveria ter sido o mundo quando foi criado. Quando o mundo foi criado foi preciso criar um homem especialmente para aquele mundo. Nós somos todos deformados pela adaptação à liberdade de Deus. Não sabemos como seríamos se tivéssemos sido criados em primeiro lugar, e depois o mundo deformado às nossas necessidades. Brasília ainda não tem o homem de Brasília. Se eu dissesse que Brasília é bonita, veriam imediatamente que gostei da cidade. Mas se digo que Brasília é a imagem de minha insônia, vêem nisso uma acusação; mas minha insônia não é bonita nem feia, minha insônia sou eu, é vivida, é o meu espanto. Os dois arquitetos não pensaram em construir beleza, seria fácil; eles ergueram o espanto deles, e deixaram o espanto inexplicado. A criação não é uma compreensão, é um novo mistério”*

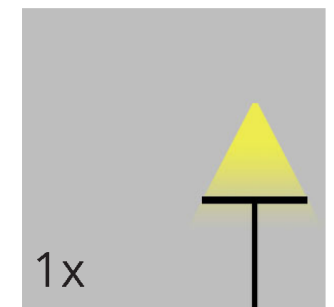
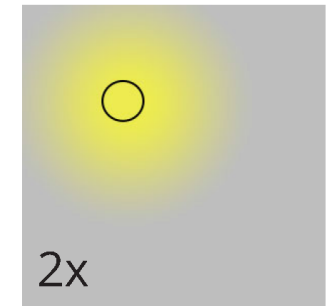
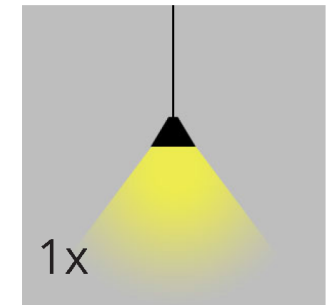
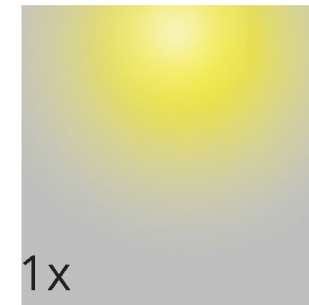
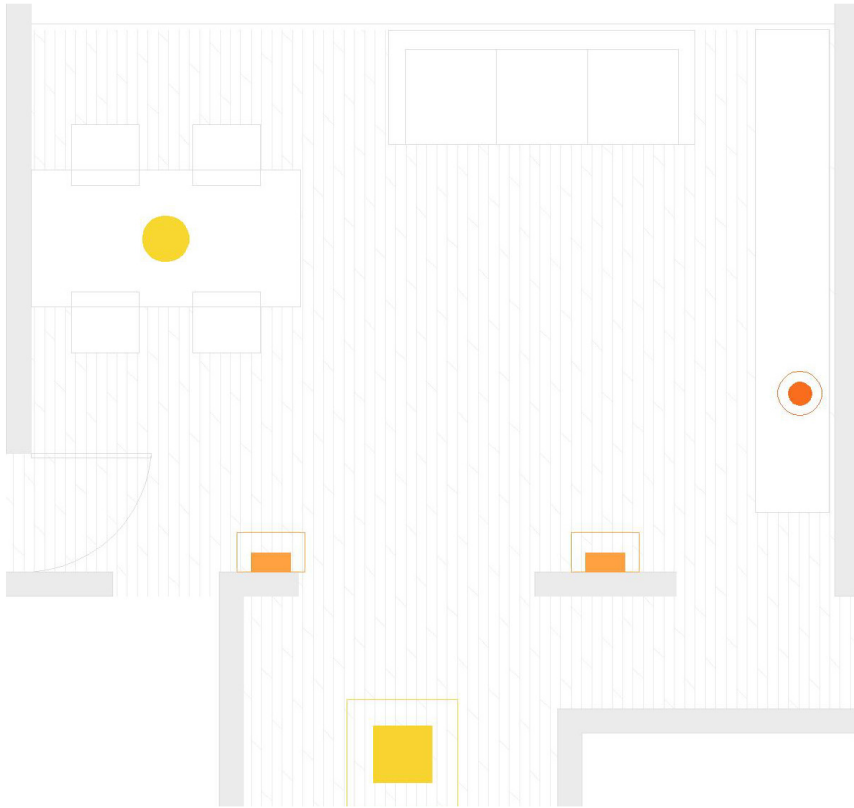


Original text of Fellipe, Maíra, p. 47

*“Mais que a projeção de uma imagem com evidentes características paradisíacas, a casa é, sobretudo, uma projeção do próprio homem, um reflexo de seu ser. Congrega um conjunto de fatores que a tornam um retrato do morador e da família. Através dela, o homem reproduz seus limites, suas fronteiras com o mundo. Revelam-se memórias, desejos, esperanças, medos, rituais, ritmos pessoais e hábitos cotidianos. Por isso, a habitação é também o retrato de uma época e de sua maneira de enxergar as relações humanas. Nesse sentido, a casa ultrapassa a condição de espelho da alma, possibilitando uma espécie de autoanálise que leva à revalorização da própria humanidade. Quando o homem se vê projetado no exterior, torna-se, potencialmente, um pensador de si mesmo.”*



# Brasília



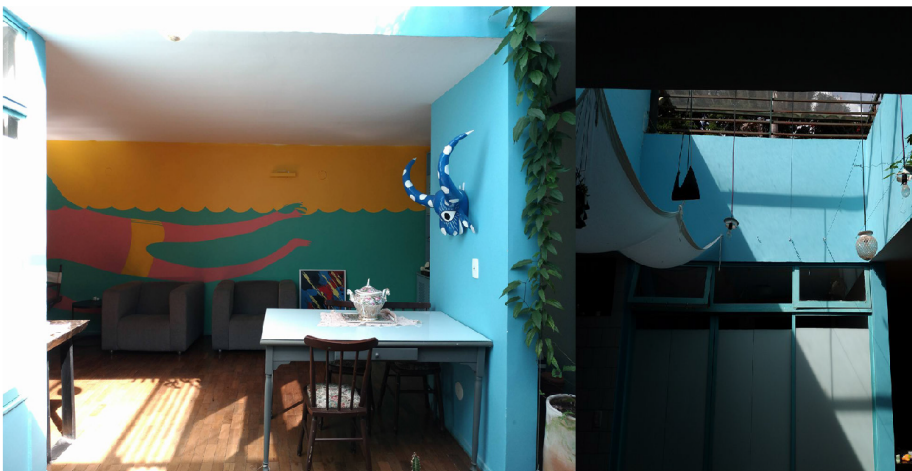
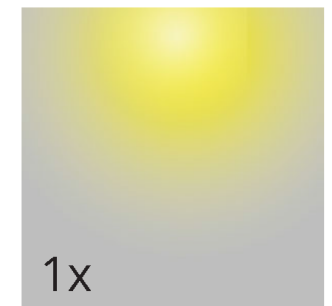
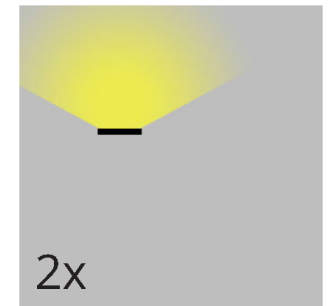
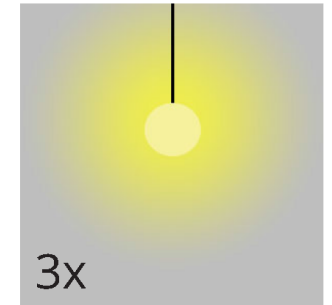
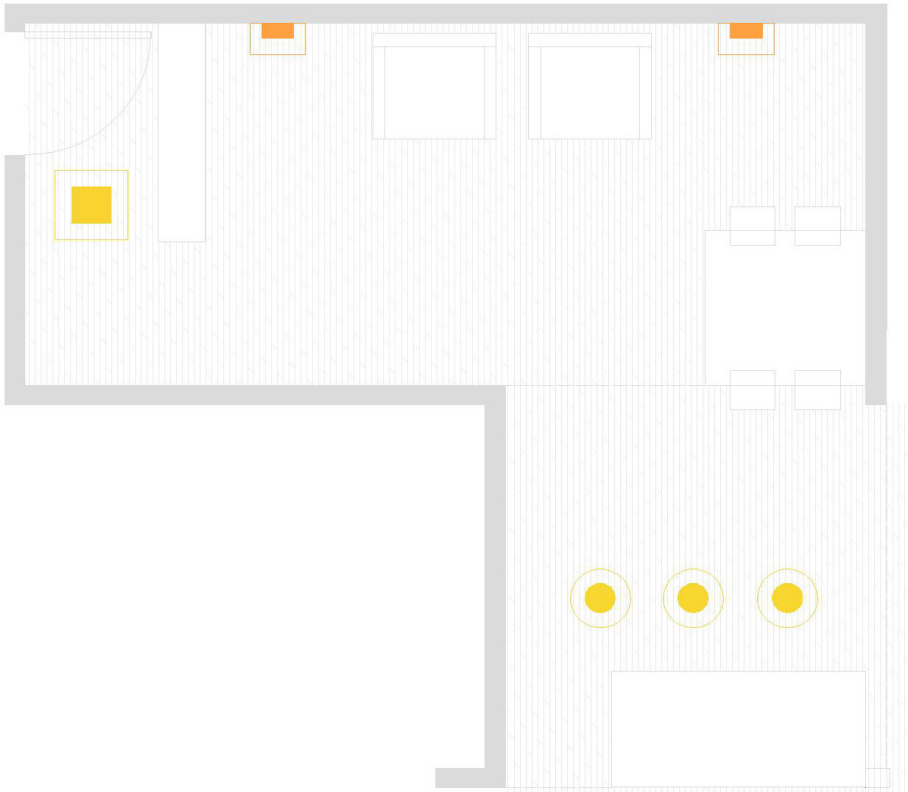
Nahira

28 years old

3 inhabitants -  
family apartment



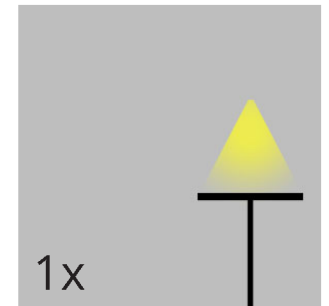
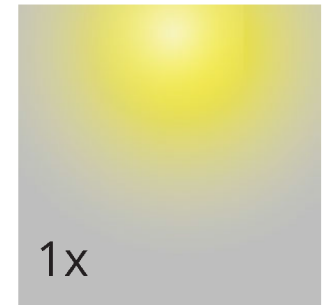
# Brasília



Fabiana  
36 years old  
2 inhabitants - couple  
couple house



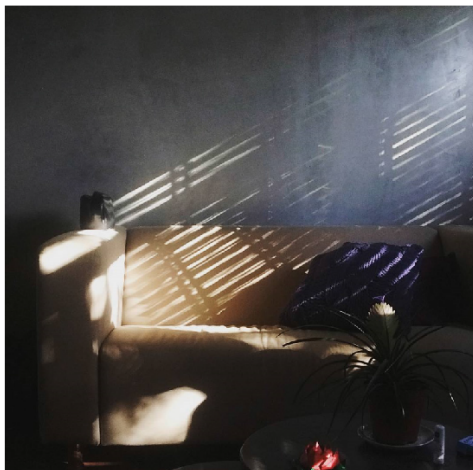
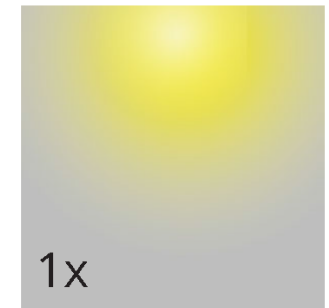
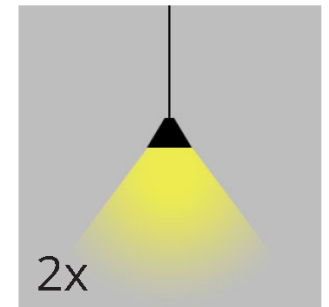
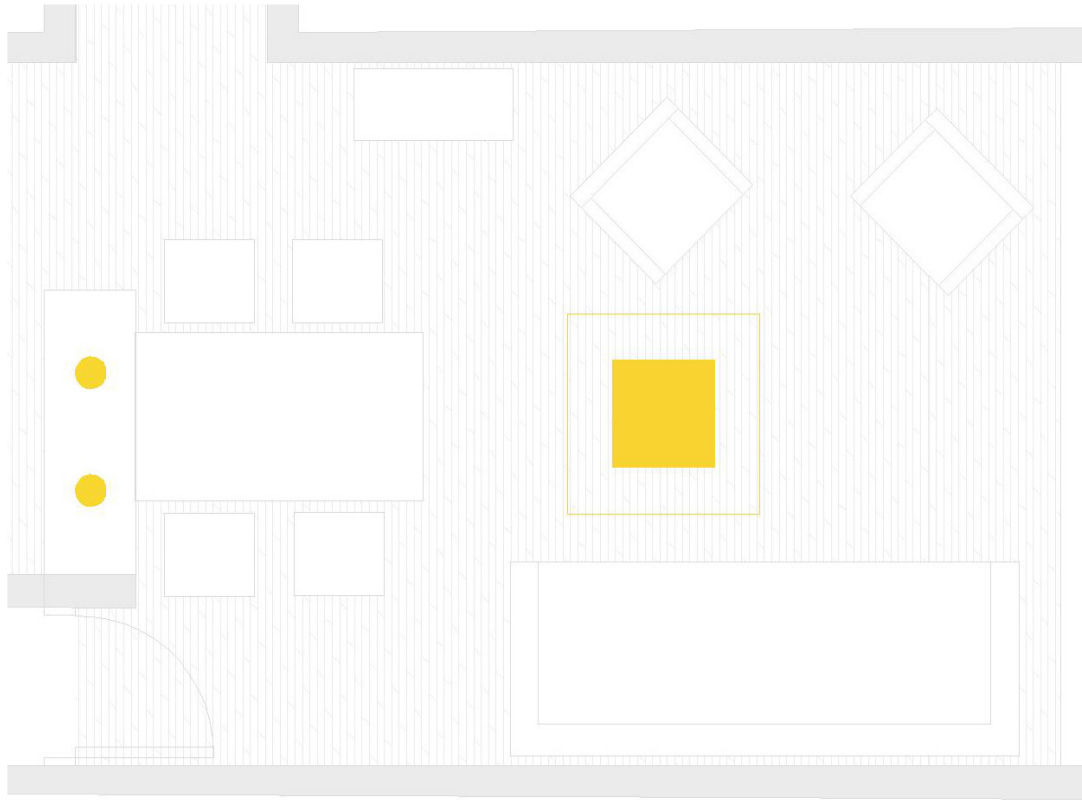
# Brasília



Vanessa  
35 years old  
2 inhabitants  
shared spartment



# Brasília



Bruna

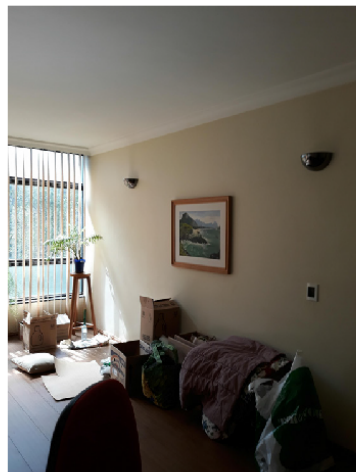
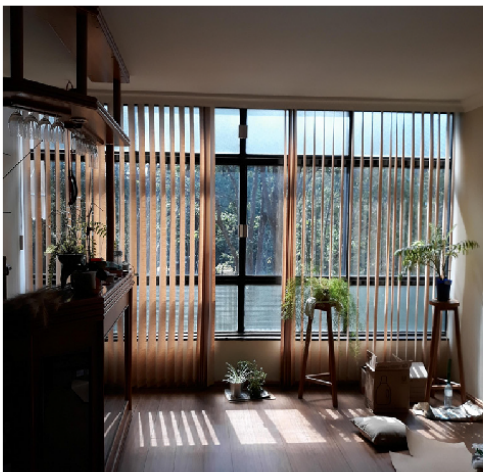
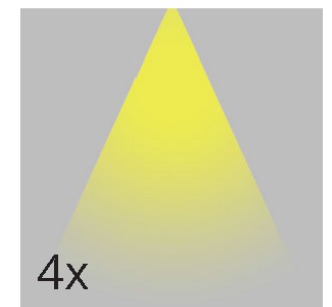
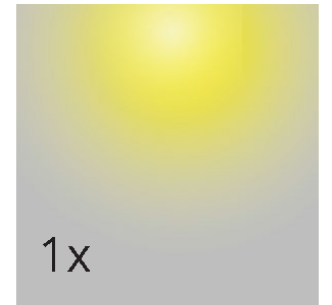
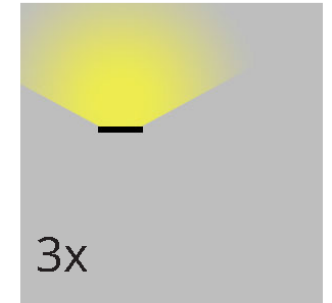
31 years old

2 inhabitants

couple apartment



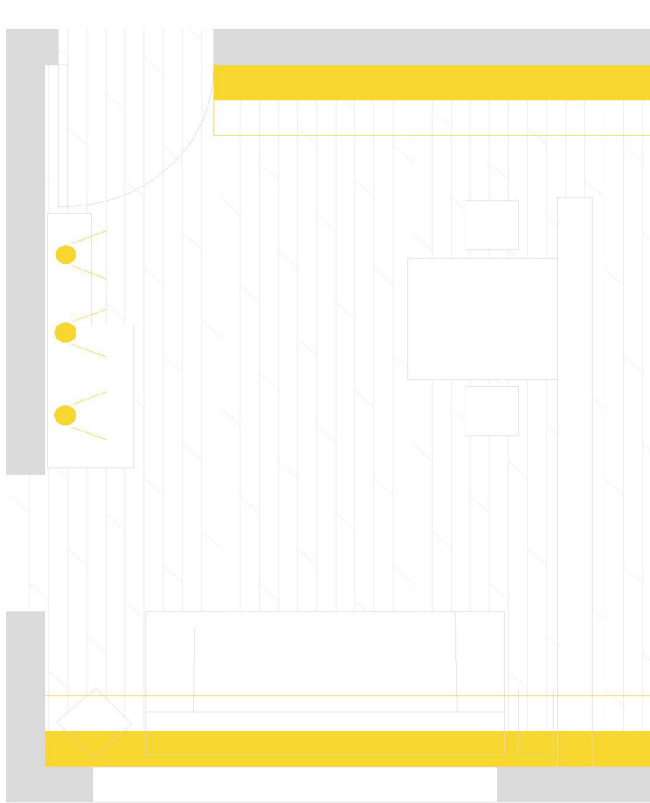
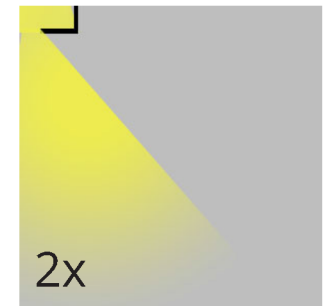
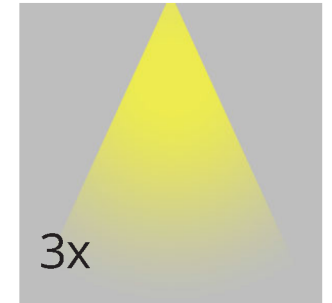
# Brasília



Giselle  
33 years old  
1 inhabitants  
single apartment



# Brasília



Lorena

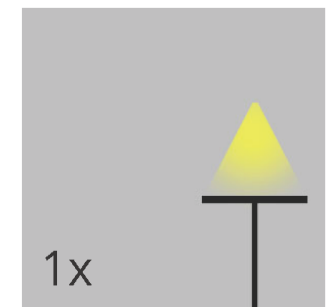
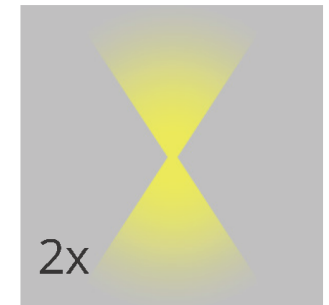
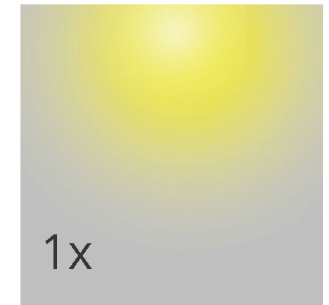
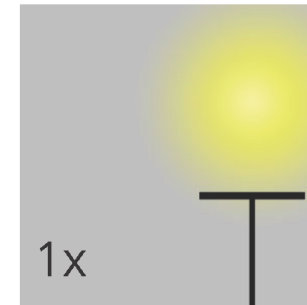
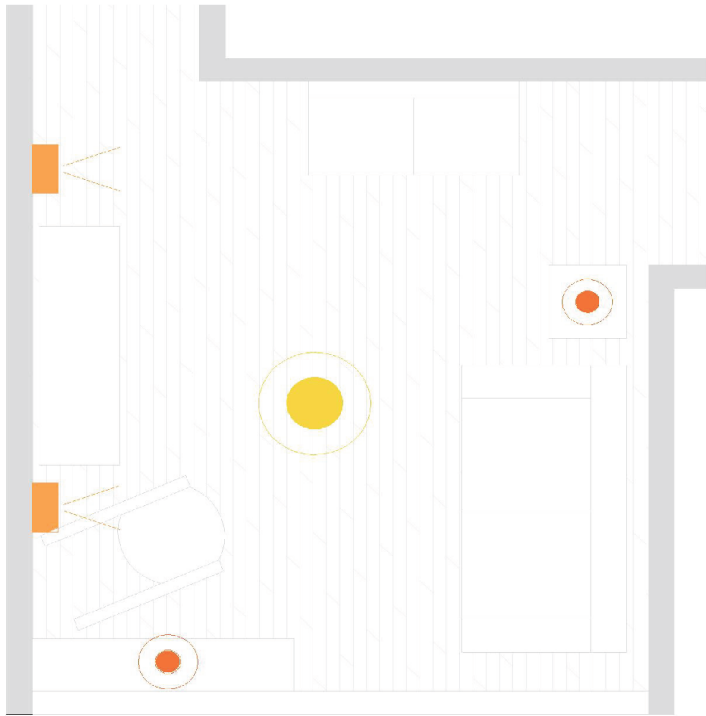
33 years old

2 inhabitants

House



# Brasília



Marina

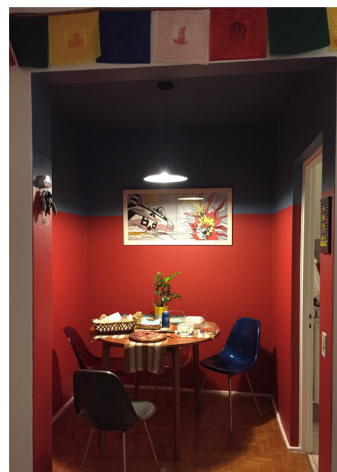
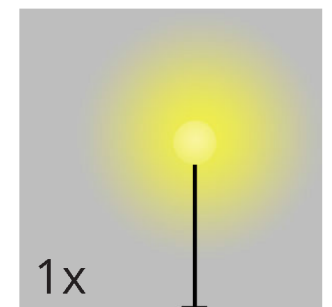
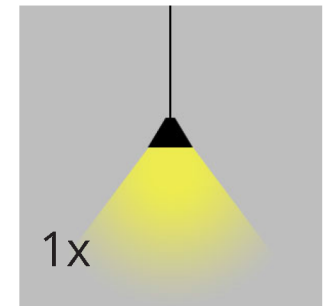
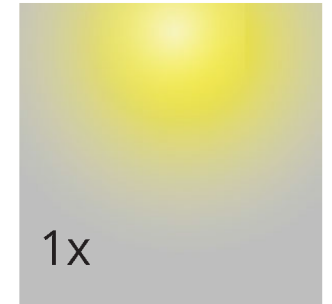
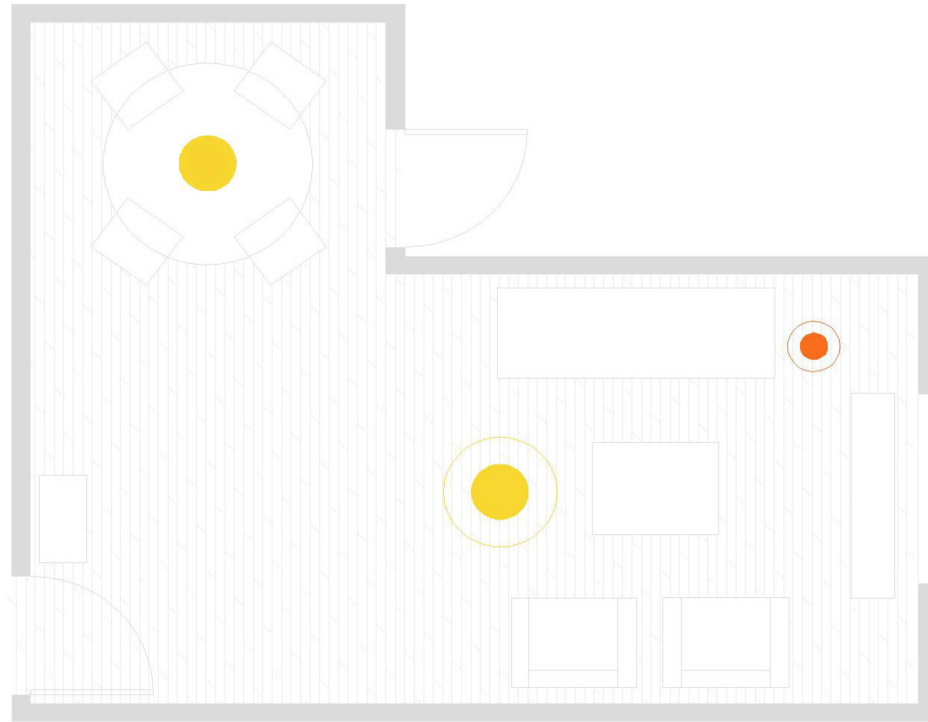
32 years old

3 inhabitants

family apartment



# Brasília



Nadine

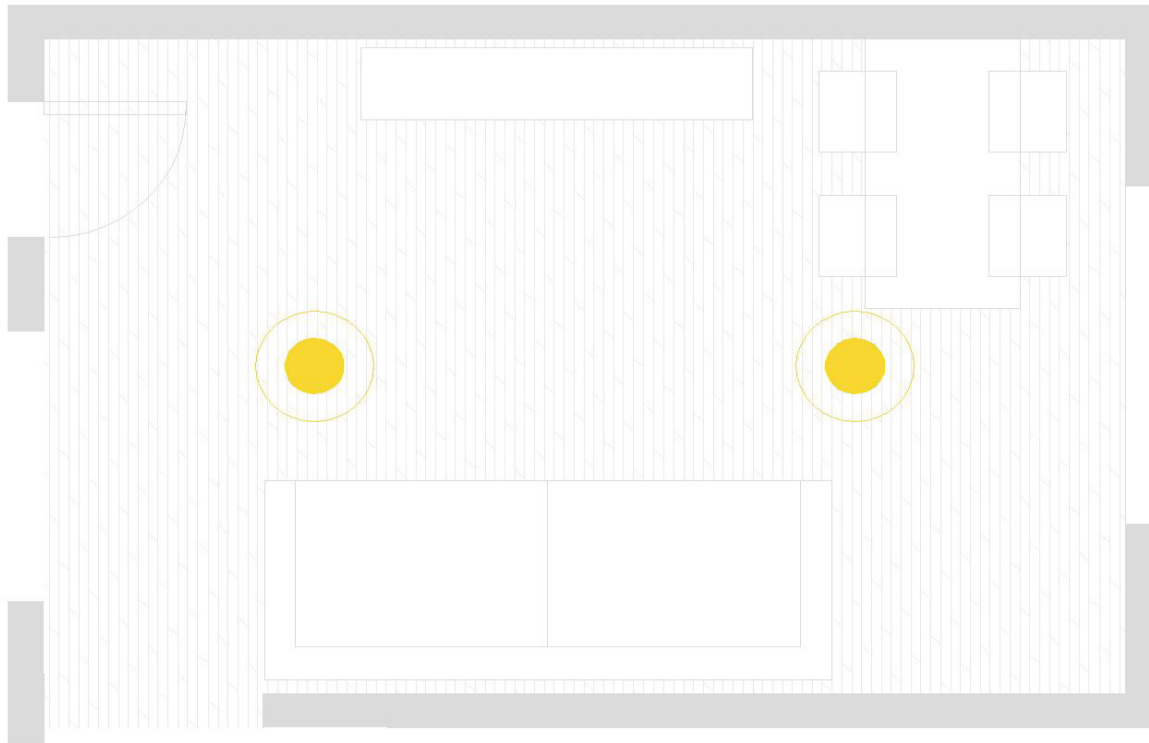
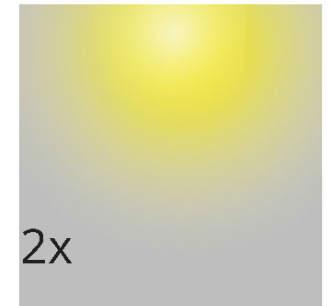
33 years old

2 inhabitants

couple apartment



# Brasília



Nena

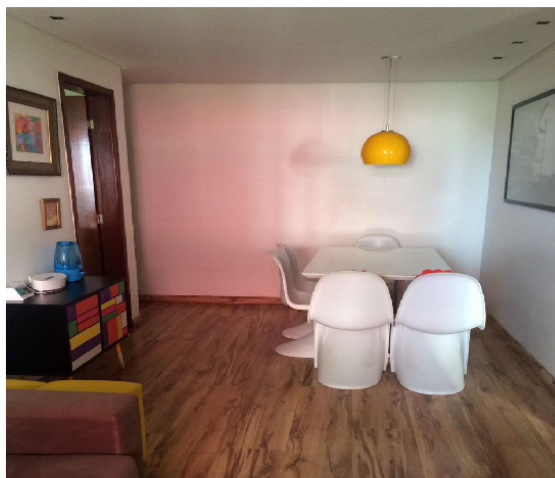
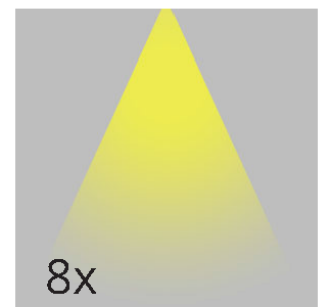
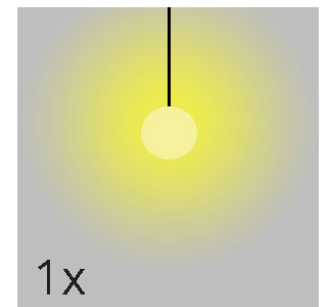
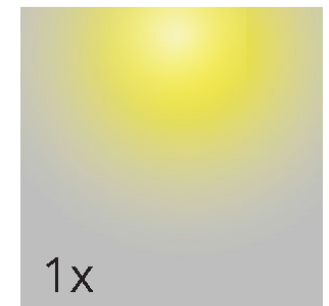
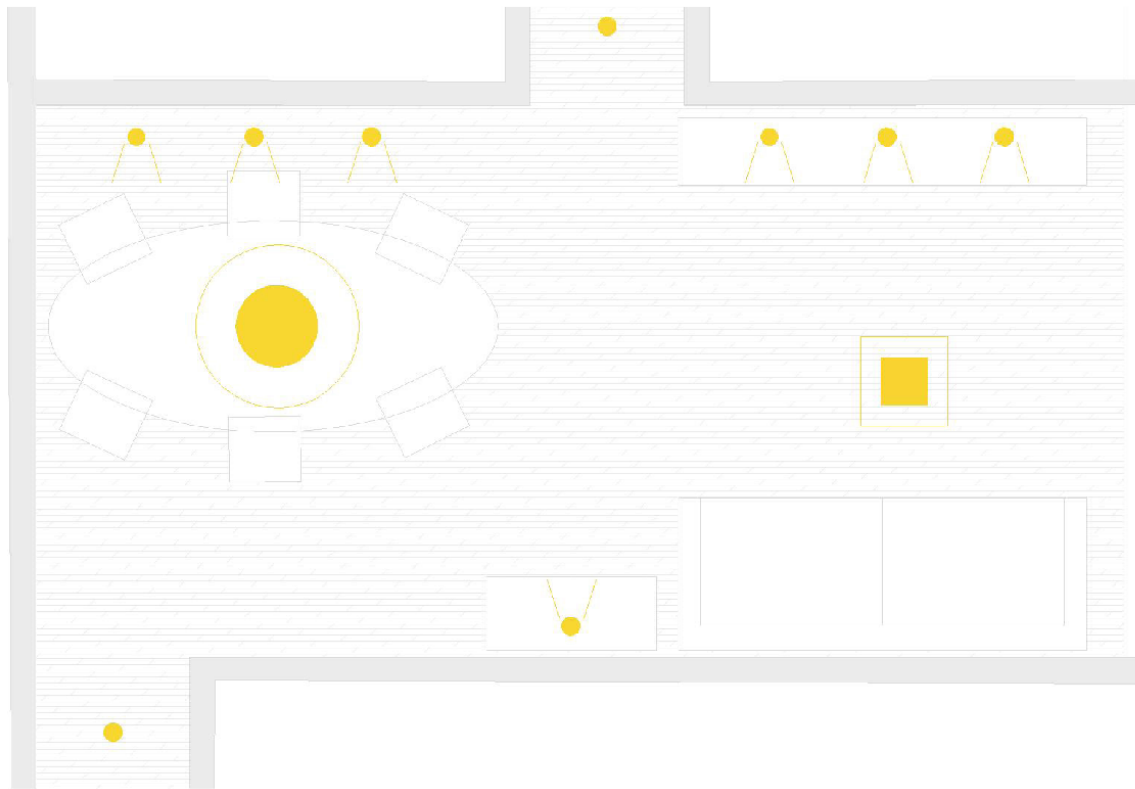
28 years old

3 inhabitants

family apartment



# Brasília



Vania

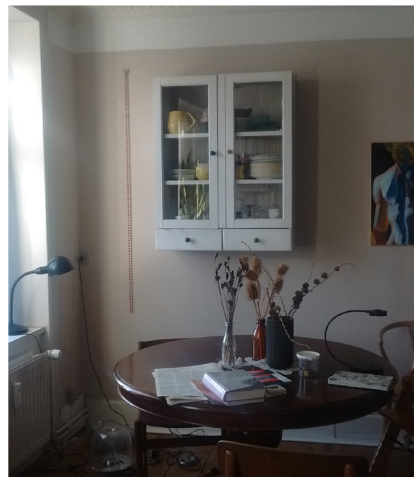
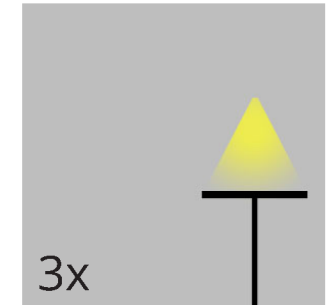
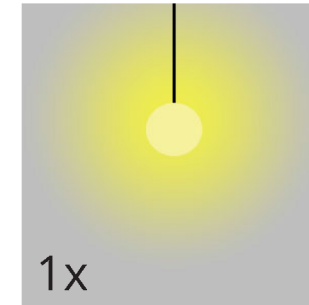
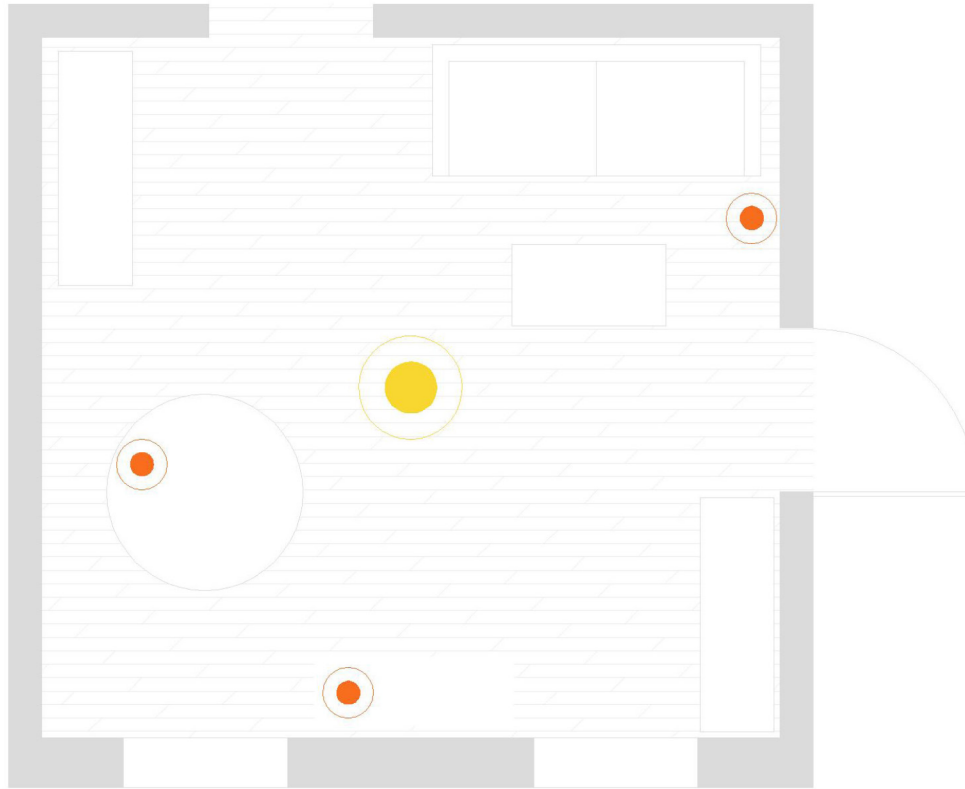
39 years old

4 inhabitants

family apartment



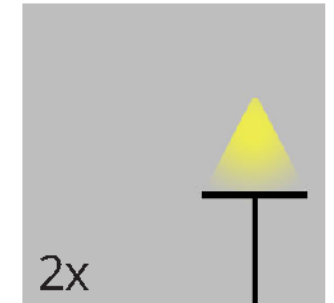
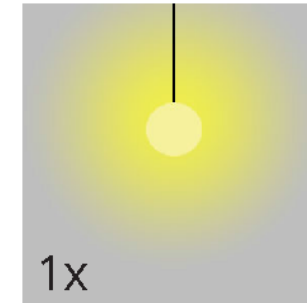
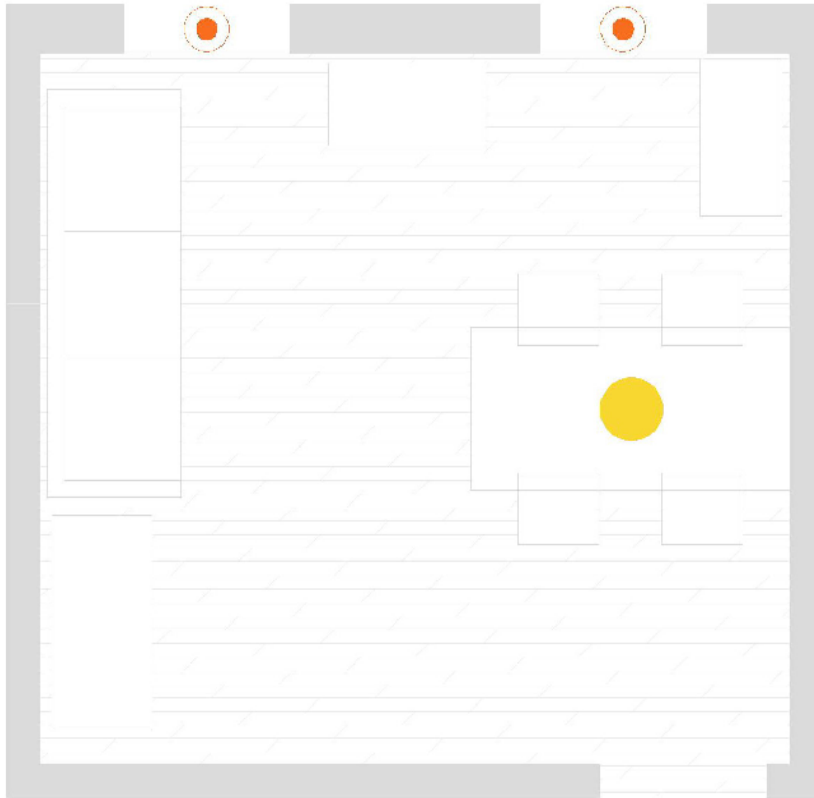
# Copenhagen



Chris  
57 years old  
2 inhabitants  
Family apartment



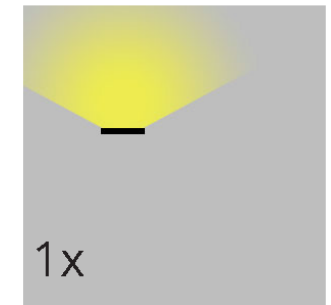
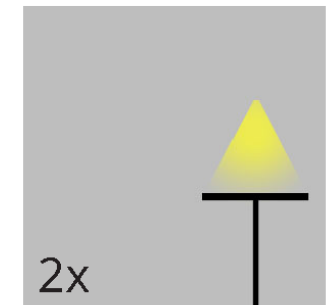
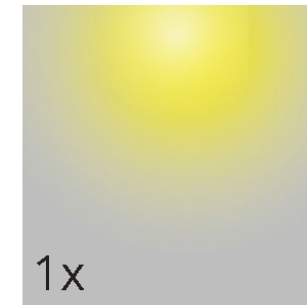
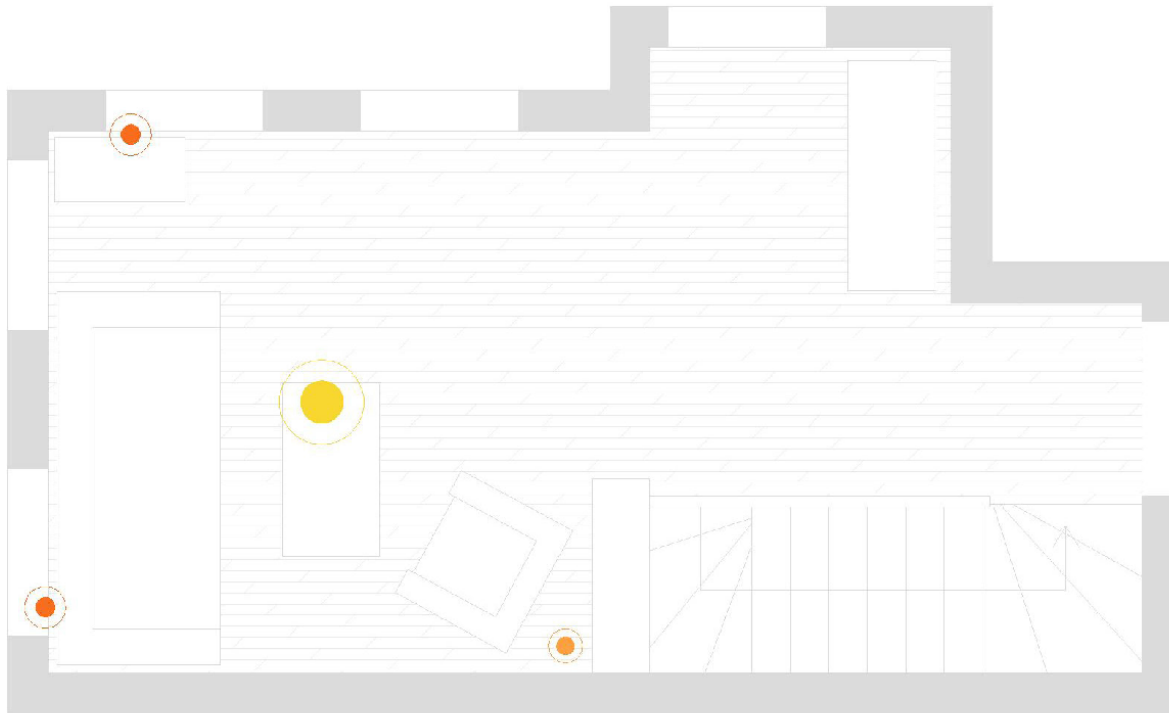
# Copenhagen



Mads  
50 years old  
4 inhabitants  
family apartment



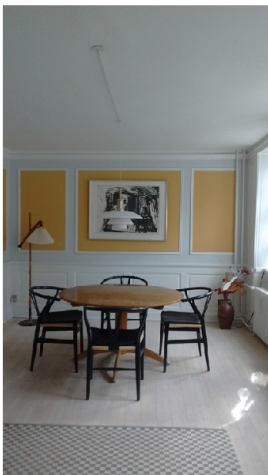
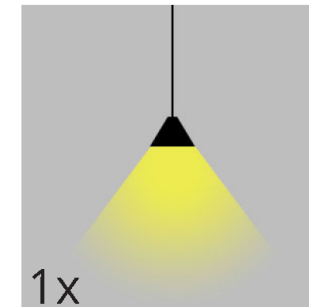
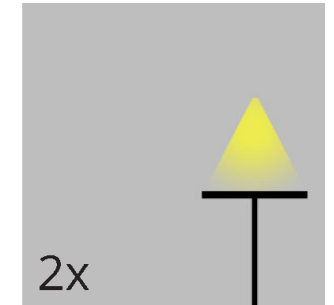
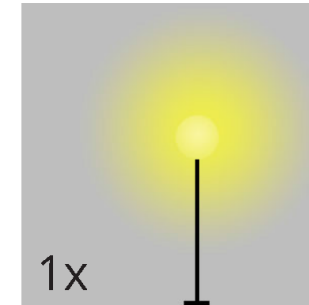
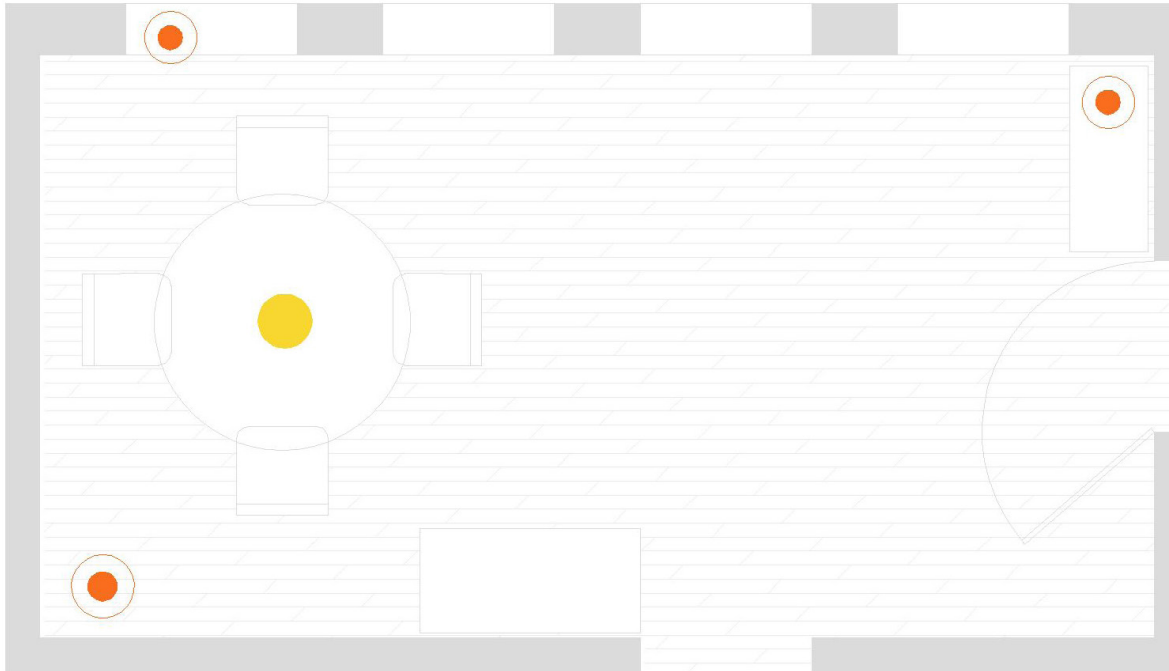
# Copenhagen



Mette  
50 years old  
4 inhabitants  
family apartment



# Copenhagen



Nilza

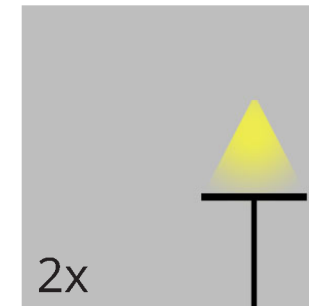
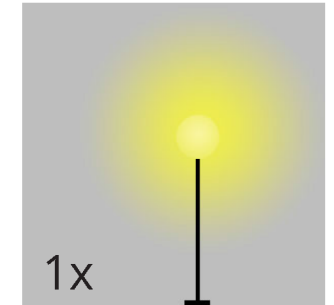
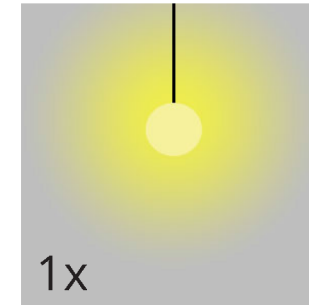
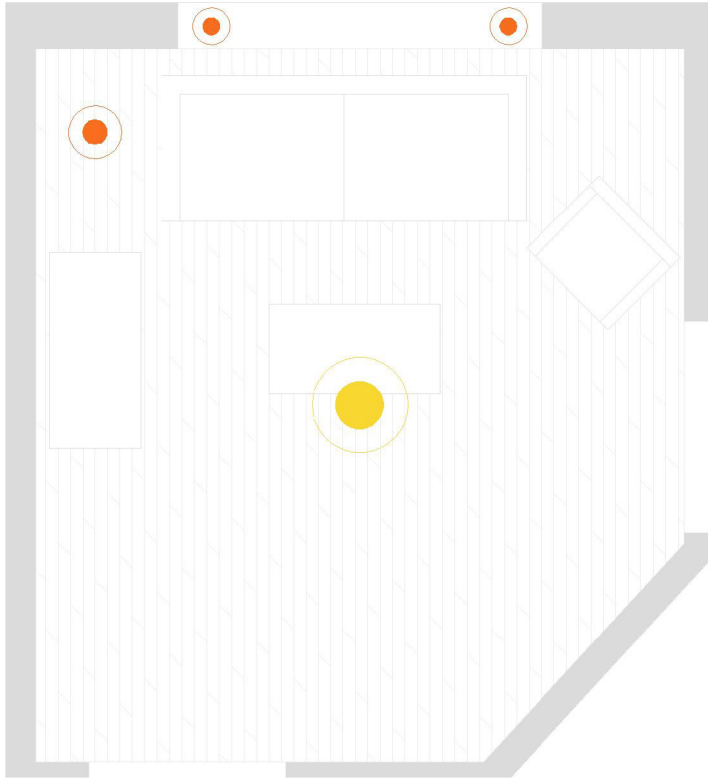
62 years old

2 inhabitants

couple apartment



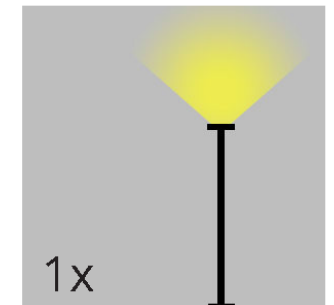
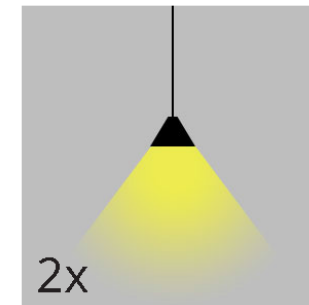
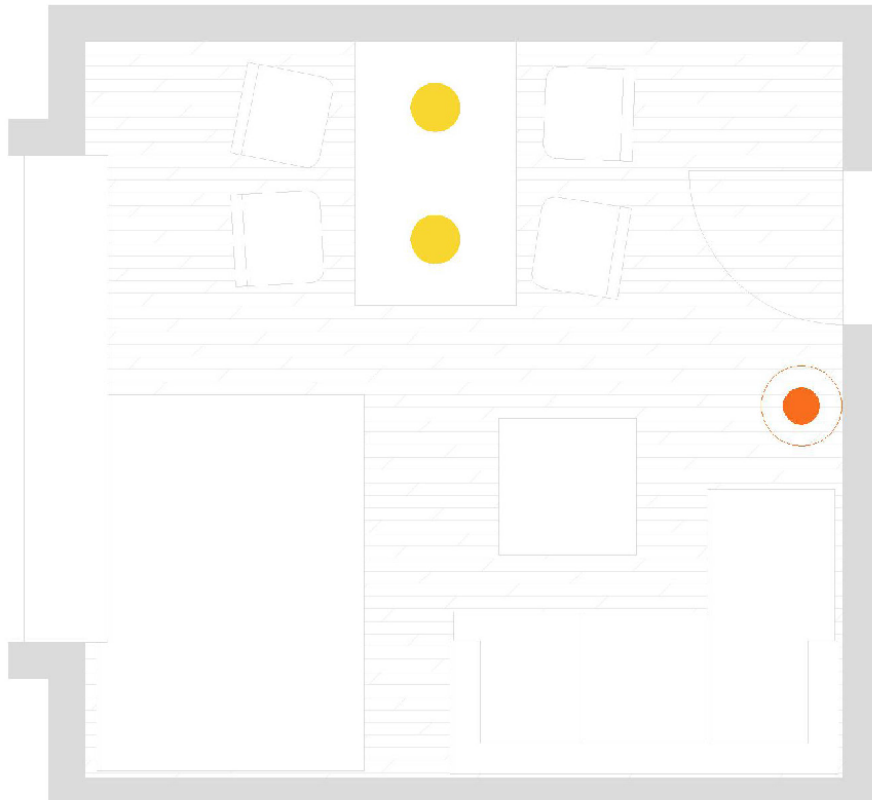
# Copenhagen



Ôssi  
50 years old  
4 inhabitants  
family apartment



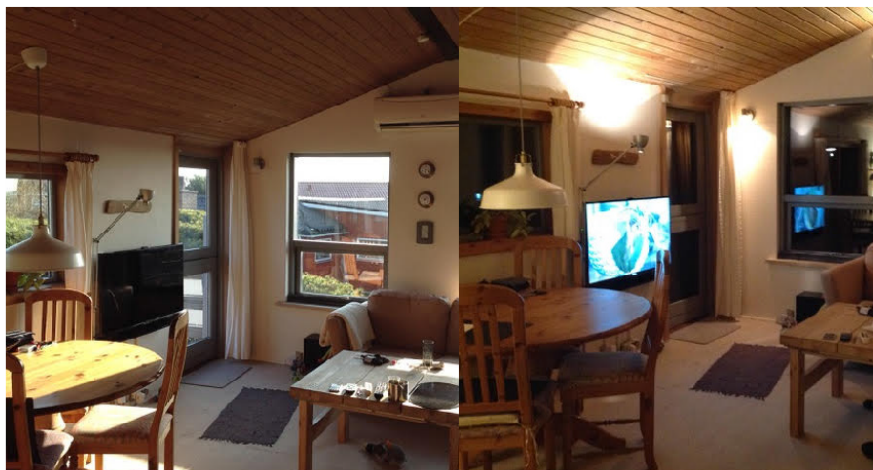
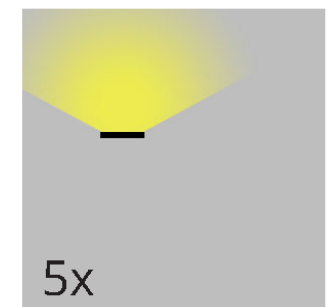
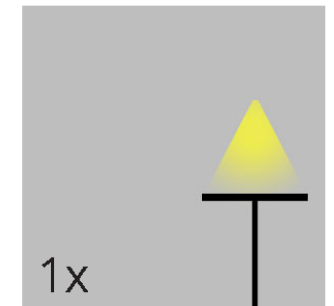
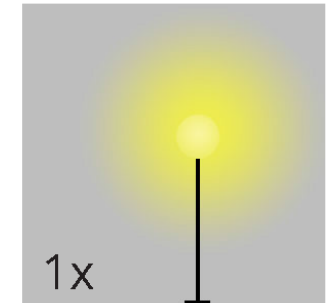
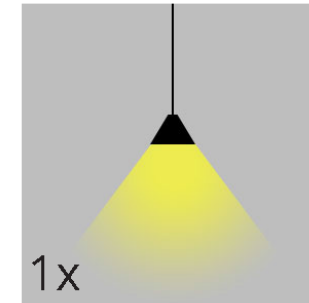
# Copenhagen



Philip  
24 years old  
1 inhabitant  
single apartment



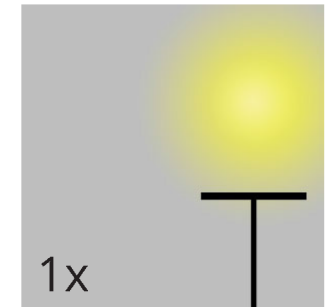
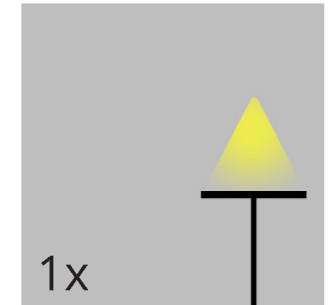
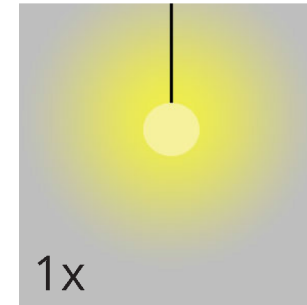
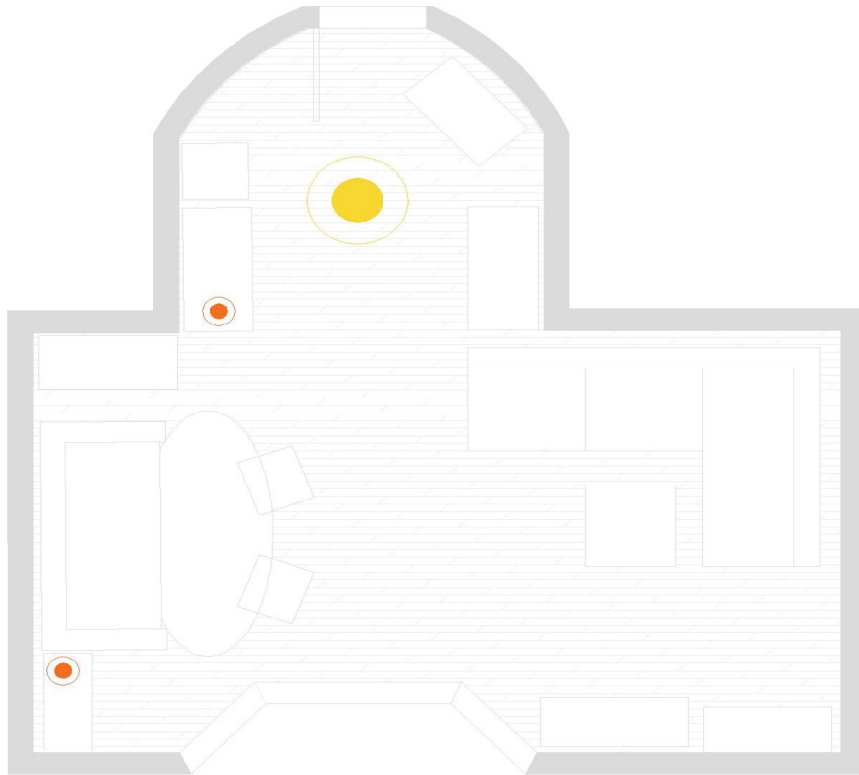
# Copenhagen



Karin  
52 years old  
2 inhabitants  
couple apartment



# Berlin



Janine

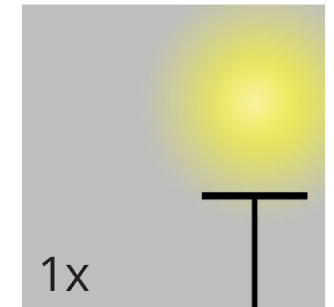
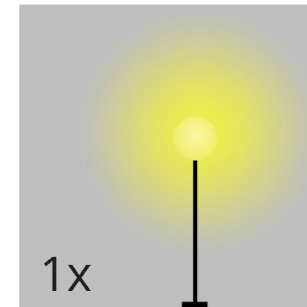
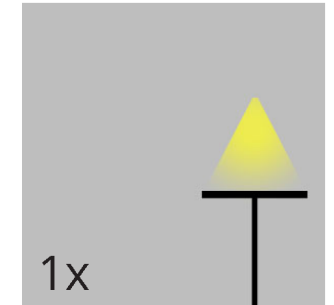
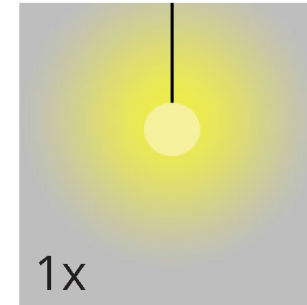
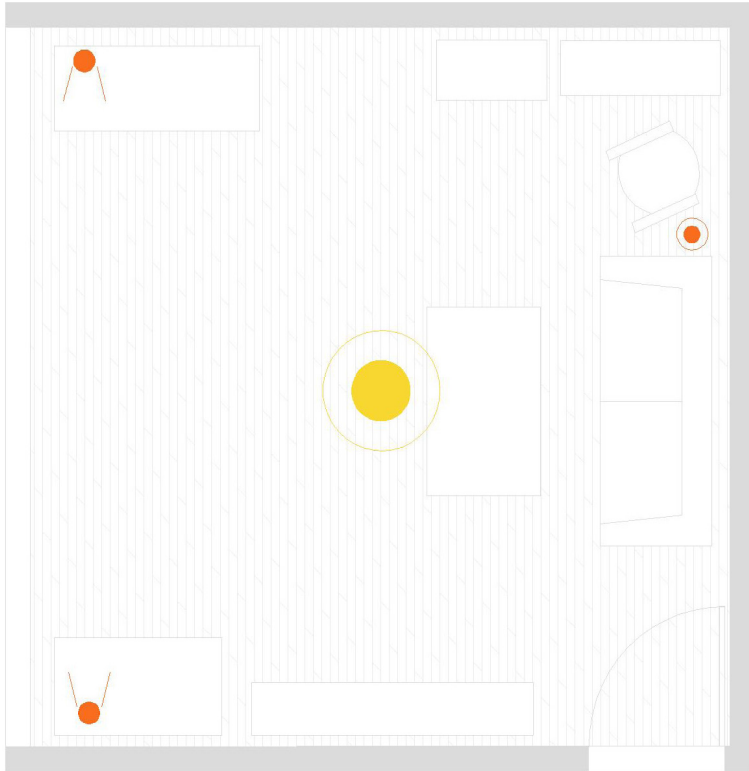
29/34 years old

2 inhabitants

Couple apartment



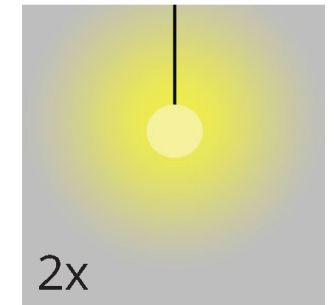
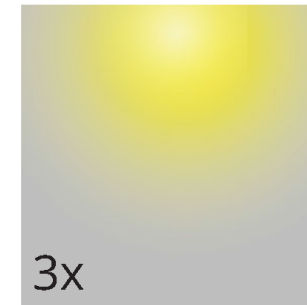
# Berlin



Miriam  
37 years old  
1 inhabitants  
Single apartment



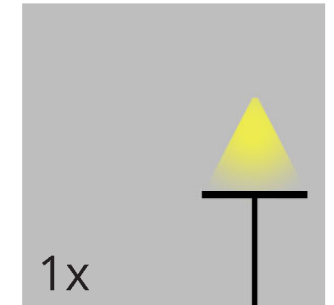
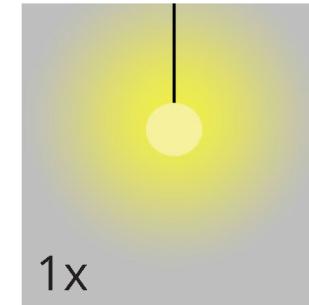
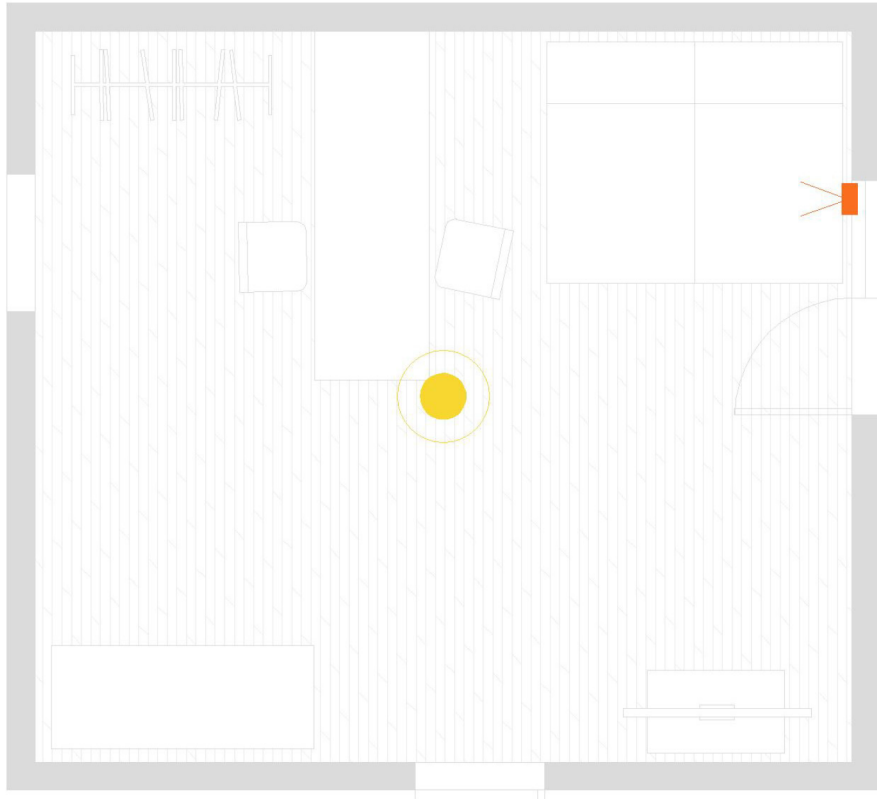
# Berlin



Fleming  
62 years old  
1 inhabitant  
single apartment



# Berlin



Lilly

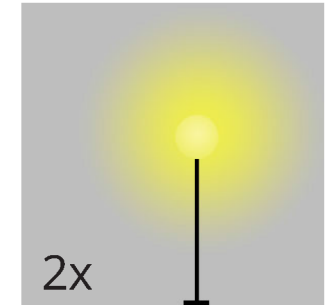
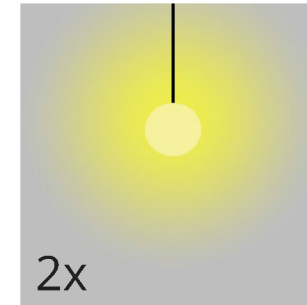
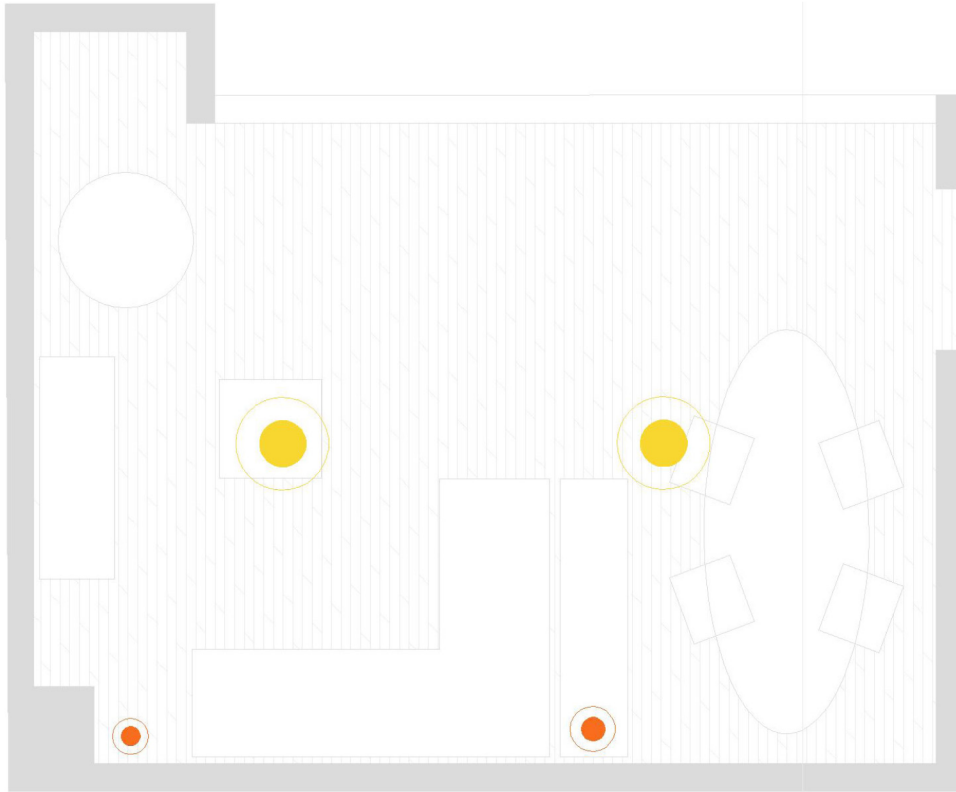
25 years old

2 inhabitants

couple apartment



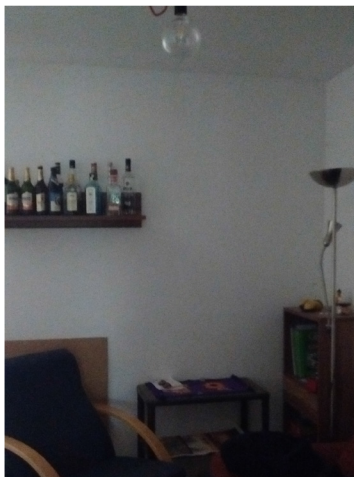
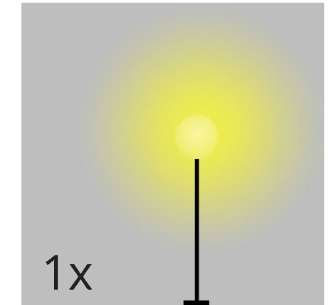
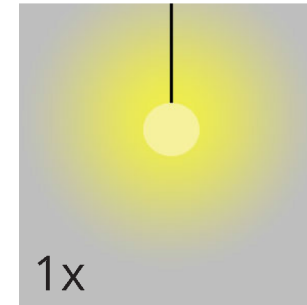
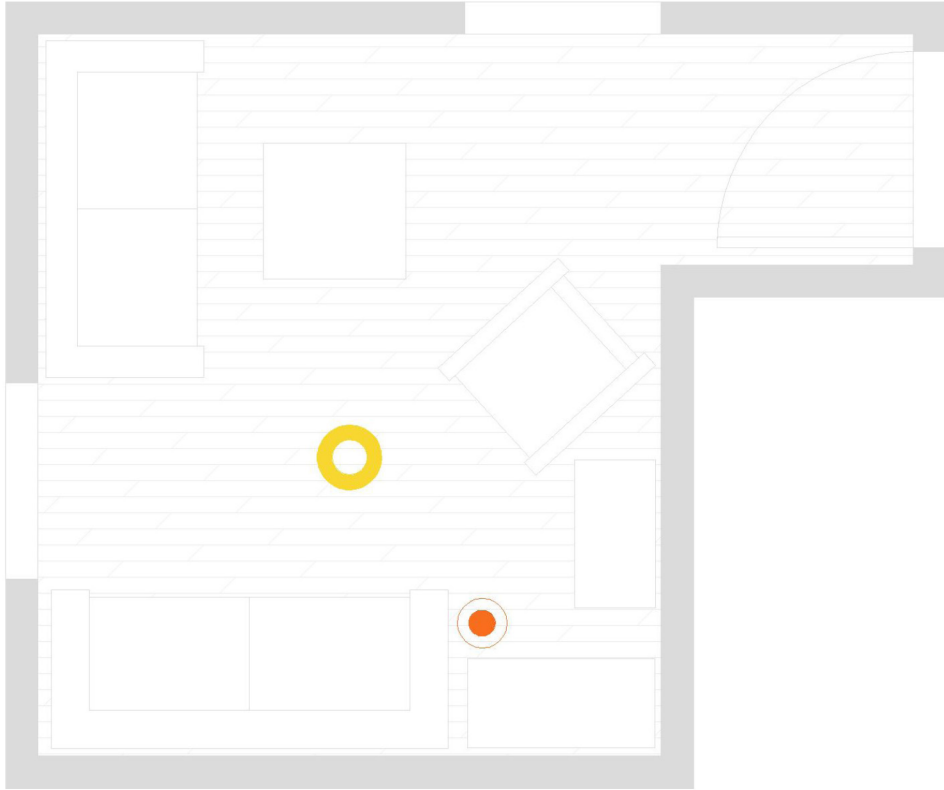
# Berlin



Marten  
29 years old  
2 inhabitants  
couple apartment



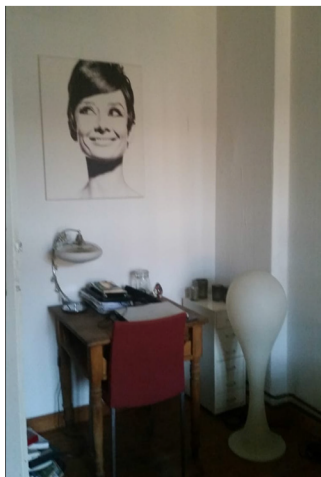
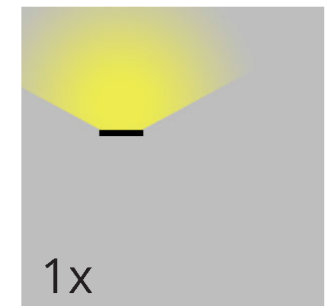
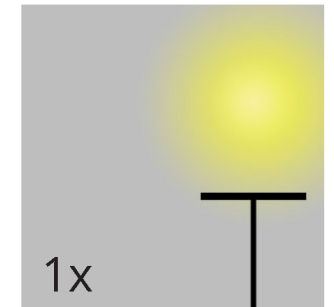
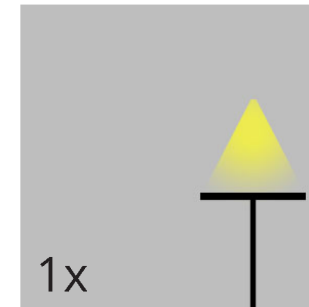
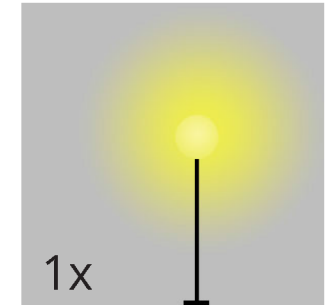
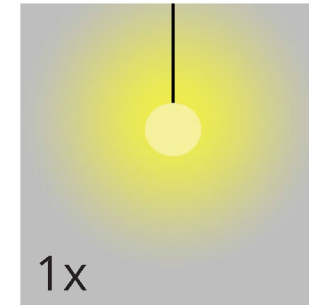
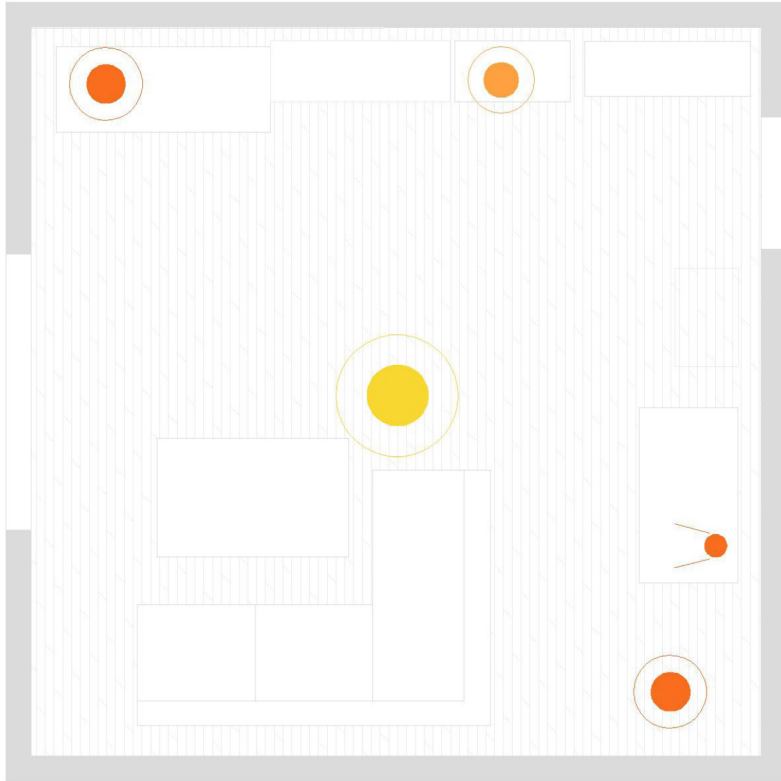
# Berlin



Nora  
32 years old  
4 inhabitants  
shared apartment



# Berlin



Sonja

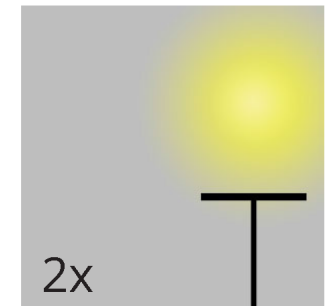
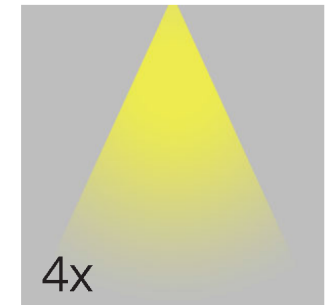
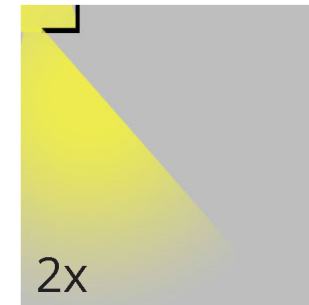
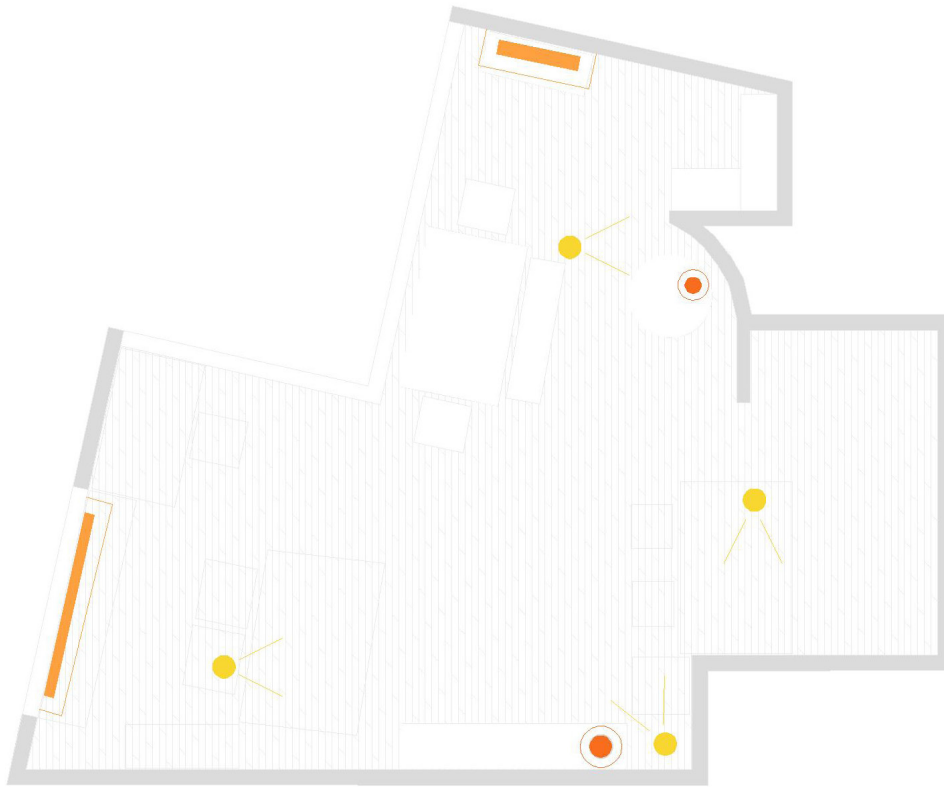
40 years old

1 inhabitant

single apartment



# Berlin



Rijo

35 years old

1 inhabitant

single apartment