USERS' BEHAVIOUR MODELS FOR THE USE OF SHADINGS

IN RESIDENTIAL BUILDINGS

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ABSTRACT

The higher energy consumption in the building industry requires from current companies to developed nearly zero-energy buildings. To evaluate design options, the architects quite often use the simulations tools. However, they still need improvement in the area of the users' behaviour that currently is mimicked in a very static way (Hoes, Hensen, Loomans, De Vries, Bourgeois, 2009).

This project was provided by company Velux that seeks to improve their simulation programs. One of the important element in energy efficient design is shading – because according to the Dubois (1997) use of shading can affect power consumption by reducing solar gains and by modifying losses through the windows. Therefore, the company, to improve the tools, needs understand behaviour of individual household members.

The aim of this project is a closer examination of the inhabitant practices related to use of the shadings. Focusing on how the inhabitants adjusted their domestic thermal and visual environments by using the shadings to suit their needs and requirements.
The data for analyses was collected through different methods, such as an online survey, activity map and semi-structure interviews. Then, it was analysed through the Practice Theory that allows me to distinguish some common pattern of shading use, among users from Poland and Denmark.

KEY WORDS

Shadings, solar shadings, simulation tools, Velux company, Windows, Practice Theory, users' behaviour, Poland, Denamrk

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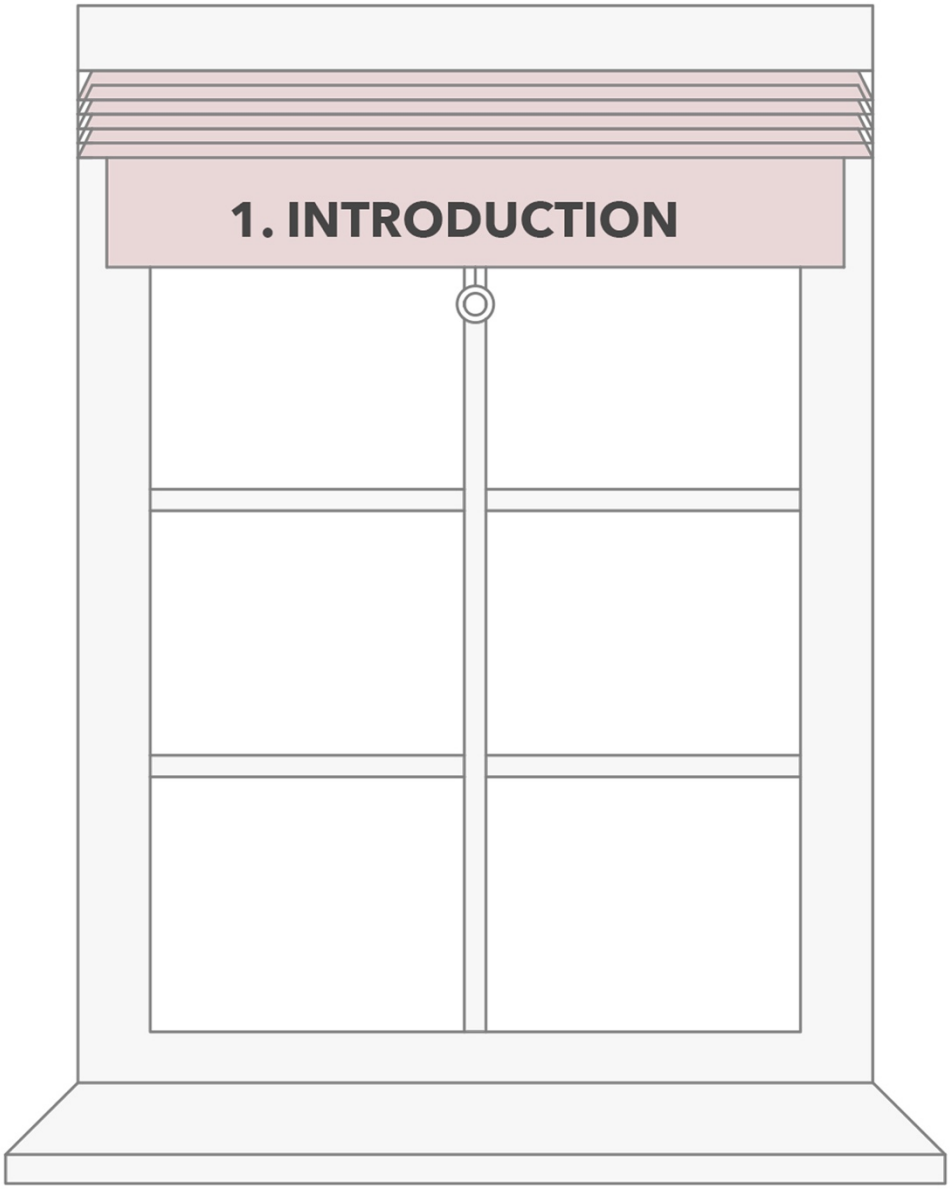

1. INTRODUCTION

1.1. MOTIVATION FOR THE PROJECT TOPIC – SHADING.

The current population growth and changing lifestyles in some countries, e.g. growing number of single occupant dwellings, contributes to increasing demand for building services, and therefore, to the higher consumption of energy in the construction industry (Pérez-Lombard, Ortiz, Pout, 2008). Besides the building's operational and space utilisation characteristics, the behaviour of the occupants strongly influences building energy use. Today, we spend up to 90% of our time inside buildings – living, working, learning and playing (The Velux Group, n.d.). Our presence, activities and the controls that aim to improve indoor environmental conditions such as air quality, thermal, light, noise - increase the power consumption (Hoes, Hensen, Loomans, De Vries, Bourgeois, 2009).

Furthermore, given that energy demand is likely to continue to increase in the future, energy-efficient buildings become the primary objective of energy policy at regional, national and international levels (Pérez-Lombard, Ortiz, Pout, 2008). There is a huge possibility and demand for developing a nearly zero-energy building (Nielsen, Svendsen & Jensen, 2011). This can be achieved by the systematic application of several principles, for example, improving the building envelope, changes in occupant behaviour, improved efficiency of energy systems, and an increased use of renewable energies (Lomanowski, 2008). Some of these principles can be accomplished in the early design stage when major decisions have the most impact on a building's performance.

Currently, many researchers, engineers, designers and architects use simulation tools to evaluate design options, and these consist of detailed assessments of energy consumption, comfort and indoor air quality. Moreover, simulations offer insights on the development of high-efficiency buildings in a fast and inexpensive way. Simulation tools are quite often used. However, they still need improvement, especially in the area of user behaviour that is mimicked in a very static way (Hoes, Hensen, Loomans, De Vries, Bourgeois, 2009).

This project seeks to provide empirical insights in one area – shading – because, according to Dubois (1997) use of shadings can affect power consumption by reducing solar gains and by modifying losses through the windows. Also, they can significantly influence the lighting conditions in the room and the view in/out. Shading is thus strongly related to energy use in buildings for heating, cooling and lighting. All of these aspects are usually controlled by occupants who seek to achieve the perfect visual and thermal comfort for themselves.

The topic of the project has been provided by company Velux that mainly manufactures roof windows and skylights. In addition to producing windows, the company is developing a number of projects that aim to improve the residential buildings' energy performance while at the same time providing healthier and more comfortable lives for the occupants.

1.2. PROBLEM AREA

Energy consumption in the buildings depends on many aspects that are related to each other and mostly depend on occupants' behaviour. One of the most significant elements responsible for the energy consumption in the building is windows. For example, by installing the bigger windows we can improve the interior lighting conditions, thus reduce the power use of artificial lighting, but also increase the heat gain, and therefore affect the energy demand for heating, ventilation and/or cooling (Nielsen, Svendsen, Jensen, 2011).
Windows are, however, great architectural devices that connect the indoor area with outdoors. In addition, they also have a lot of significant values to the occupants such as daylight and kinds of light, view out and view in, following the sun and others (Hauge, 2013).

Moreover, to minimise the energy waste through the windows, many designers, architects and engineers use in their design the solar shadings that become a common strategy, especially in energy-efficient buildings. They can affect the energy consumption by reducing solar gains and by changing thermal losses through windows (Dubois, 1997, p.9). However, they are very often affecting daylighting availability, thus, the use of electricity for lights.

Especially, in buildings that apply passive solar heating or daylighting, the energy consumption many times depend on well-designed shading devices (Prowler,2016). They are closely connected to the power use in the building for heating, cooling and lighting and with the occupants' visual and thermal comfort (Dubois, 1997).
Moreover, in the design of energy-efficient buildings, the use of energy simulations tools is becoming more popular. Thus, there is a clear need to model windows with shading devices to assess their impact on building performance (Lomanowski, 2008, p.3).

Also, recently it has been recognised that the user behaviour has a strong influence on building energy performance (Hoes, Hensen, Loomans, De Vries, Bourgeois, 2009). Nevertheless, many of the current building simulation tools, also the ones that Velux uses, are taking users actions into consideration only on a general level.

This approach can provide incorrect results of the building's performance. Thus, more precise and detailed studies of the users' behaviour for specific buildings need to be conducted to give a better picture of how user behaviour affects building energy performance. Implementation of more actual users' behaviour models might allow optimising the use of energy for the particular building (Hoes, Hensen, Loomans, De Vries, Bourgeois, 2009).
Moreover, in residential buildings, the shading devices are very often manual, so the use of them will strongly depend on inhabitants who by enabling/disabling windows' covering can affect energy consumption.

Therefore, the aim of this project is a closer examination of the inhabitant practices related to use of the shadings. Focusing on how the inhabitants adjusted their domestic thermal and visual environments by using the shadings to suit their needs and requirements.

1.3. Problem formulation

Today, residential buildings consume significant amounts of energy, and this is likely to increase in the near future. Moreover, the power consumption is determined not only by the efficiency of the equipment but also by inhabitants' use (Gram-Hanssen, 2010, p.175). The development of the technology leads to change of the everyday life' practices, thus to higher energy consumption (Gram-Hanssen, 2011).

Use of solar shadings shows greater potential to decrease power consumption and improve indoor climate conditions, thus creating a healthy environment for occupants of the buildings.
However, without a better understanding of users' practice related to use of shading, the simulation tools would not provide an adequate illustration of building performance since, in current programs, the user behaviour is accounted for in a very static way (Hoes, Hensen, Loomans, De Vries, Bourgeois, 2009).

Based on the research outlined in the previous pages, the project's problem definition is as follows:

How do people use the shadings to control the quality of their indoor environment in terms of visual and thermal conditions?

Are the cultural and climate differences influencing the practice of using the shading?

1.4. Research approach

To answer these questions, the practice theory will be applied. This approach, in which I will be studying the use of shading practices, allowed me to understand how routine everyday activities can be socially structured. Moreover, it provides me with more collective aspects of various individual's behaviours related to use of shading with an understanding of different social, cultural and material structures (Gram-Hanssen, 2010).
The data for the analyses will be collected in Poland and Denmark by using three methods: online survey, activity map and semi-structure interviews. The online survey will provide me with the quantitative data to better understand general information's related to using of shading what will be a foundation for more detailed future research, those being the activity map and semi-structure interview. Those will provide me with the qualitative data of various individual users that will be analysed through the practice theory to distinguish some common patterns among the users.

Moreover, the studies will be conducted in two countries Denmark and Poland as they are one of the main targets for the company and there is a need to understand users behaviour related to use of shading in these countries.
Also, the choice of two different places aims to check if the slightly different weather conditions and culture will significantly influence the practice.

Finally, the analysed data will be a foundation for preparing new user models to improve the simulation tools, thus contributing to the improvement of buildings' design and reducing the energy consumption.

1.5. Outline of the report structure

The report is structured as follows: starting with the chapter Introduction where the motivation of the topic – shading, is presented. Afterwards, I investigated a problem area that led me to the following problem statement: *How do people use the shadings to control the quality of their indoor environment in terms of visual and thermal conditions? Are the cultural and climate differences influencing the practice of using the shading?*
To answer the problem formulation research approach was described in the following sub-chapter.

In the next chapter – Background, the information related to the topic was further investigated. Starting with the description of sustainability focusing on the building industry in Poland and Denmark. Followed by the sub-chapter about the Velux company and its approach – healthy homes and their simulation tools. Finally ended with the sub-chapters about energy efficient buildings and the users' behaviour in which I also described the relation between people and windows, and general information about solar shadings.

Then, in the chapter Theoretical Approach, I described the framework – Practice Theory, that I used to analyse the people's practices related to window's shadings. To collect the data for analysis three methods were used. They are described in the next chapter – Methodology.

Subsequently, in the chapter Analysis with the use of theory, the collected data was analysed. First, I presented the outcome of the online survey, separately from each country. Then, I summarised it in the following sub-chapter. Second, I described the information collected from activity maps and interviews in the same way.

The analyses through the practice helped me to distinguish some common social constructions that would be presented in the next chapter - User behaviour models for the use of shading.

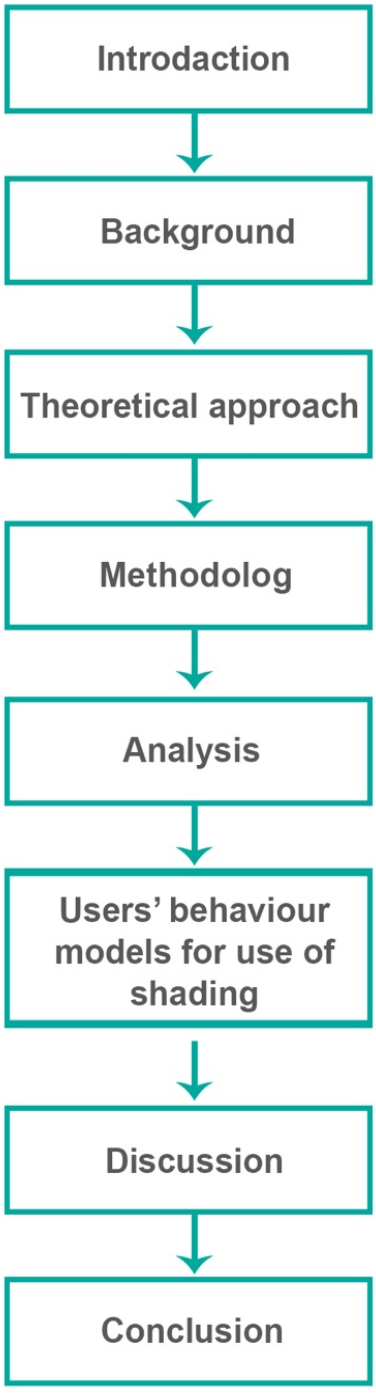

Figure 1 - Schema of the report

In the penultimate chapter of the report – Discussion, I discussed the outcome of the analysis, and I reflect upon the choices I have made in this project.
Finally, the report ends with a Conclusion chapter were my problem statement based on our analysis, discussion and solution are answered.
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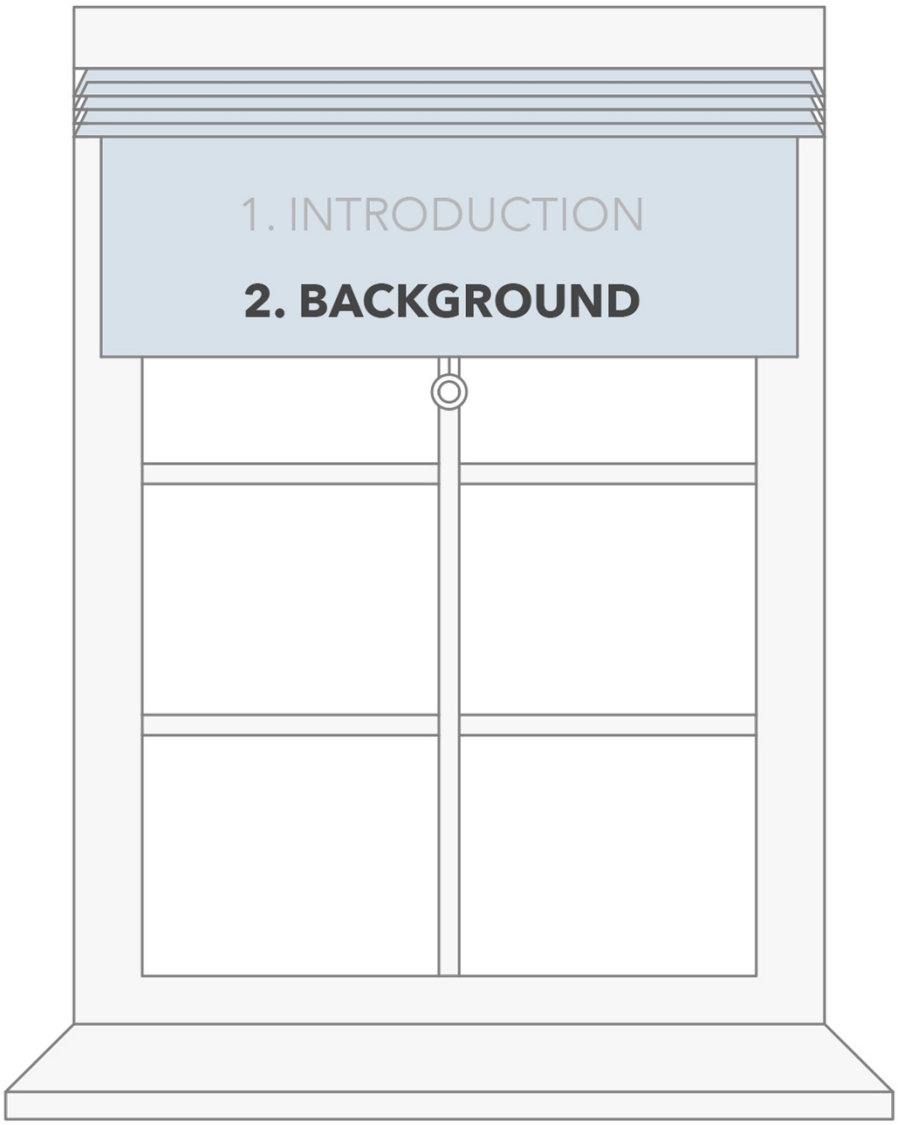

1. INTRODUCTION
2. BACKGROUND

2.1. Sustainability in Poland and Denmark

The research is carried out in two different countries since the practices might be performed differently by people in various places. Also, the sustainability focus of the countries can significantly influence the users' behaviour, thus impact of shading on energy consumption. Especially, according to Gram-Hanssen (2011), the change in technology leads to change in practices.

In the twenty-first century, more sustainable development becomes a global challenge. Governments, companies and many other institutions and people have to ensure that developed solutions, for the problems that we are facing, need to be much more aligned with the environmental, societal, and economic problems.
However, a significant number of case studies of sustainable development that exist are mainly from countries with well-established market economies, such as Denmark (Kronenberg, Bergier, 2012).

Regarding Poland, it has only recently undergone a transition from a centrally planned to a market economy. As such, it may be difficult to apply best practices for sustainability that are developed, for example, in Denmark to a different economic and social context like that in Poland (Kronenberg, Bergier, 2012).
Even though sustainability in Poland has become a popular phrase, it is still a new idea, and its practice is adopted by an only small amount of the people. Also, Polish companies are less eager to engage in sustainability what has roots in history (Kronenberg, Bergier, 2012).
Moreover, the factors such as little social capital and trust, lower environmental awareness of citizens and decision makers, a lack of sustainability 'know how' in Polish organisations, and few known examples of Polish good practice negatively influence the promotion of the sustainable development in the country (Kronenberg, Bergier, 2012).

However, on the other hand, over the previous two decades, Poland has made significant progress, and there are a lot of good examples of awareness raising and action being taken within the country regarding sustainability.
One of the examples is the Polish Green Building Council (PLGBC) that is dedicated to promoting sustainable design, construction and operations in the entire

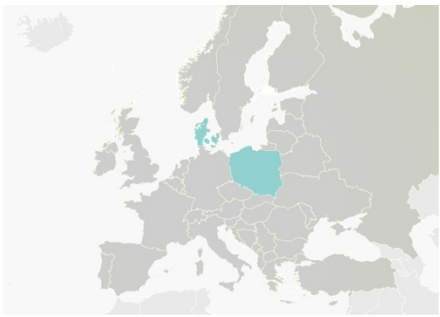


Figure 2 - Poland and Denmark in Europe

country, which in the future can importantly change the practice of using the shadings that are one of the principle elements of energy efficient buildings.

While Poland is just at the beginning of putting sustainability into practice, Denmark is very well-known as a country with a strong sustainability focus for many years. Sustainability development began when in the 1970s, Denmark had been severely affected by the oil crises. The country decided to find a more environmentally friendly way to meet growing energy needs. As a result, Danes strongly focus on green issues, such as energy efficiency, renewables, waste and resource management, clean air and water and sustainable cities (The history behind Denmark's green transition | State of Green, n.d.).
By 1980, Denmark had become a global leader in the development of new sustainable technologies and solutions (The history behind Denmark's green transition | State of Green, n.d.), leading to new practice patterns.

Today, creating a green and sustainable society is one of the key goals for Denmark. For example, as the first country in the world, they decided that in 2050 the energy used in the country will come 100% from renewable energy sources (The history behind Denmark's green transition | State of Green, n.d.).

Moreover, since long ago, authorities and organisations tried to influence practice through influencing engagement as well as knowledge, as we also see today in campaigns for saving energy (Gram-Hanssen, 2011, p.67).
Moreover, according to Robeco SAM Country Sustainability Ranking from October 2016, Denmark is in the 8th position while Poland on the 26th which shows the significant differences in those countries' sustainability performance (3. J., 2017).

The sustainable development can positively influence the people's practices in all the countries. However, the environmental and cultural differences have to be taken into account individually to achieve successful results.

2.2. VELUX COMPANY

The topic for this project was provided by the Velux company which manufactures roof windows, skylights and many types of decoration and sun screening, roller shutters, installation products, products for remote control and thermal solar panels for installation in roofs.

Figure 3 - Velux comany logo

Since 1999, the company has focused strongly on sustainable living in buildings with the aim of improving their window solutions both regarding comfort for the people and energy efficiency, at the equal level. Their goal is to make a design in which concern for the environment never precedes concerns for the health and well-being of humans. (Rasmussen, n.d.). Moreover, the Velux Group is focusing on the enormous potential of solar energy, striving to create the buildings that can connect the modern demands for daylight and ventilation with much higher use of solar energy for free lighting and heating (The Velux Group, n.d., p.6).

In one of their projects, called “Active House”, the Velux Group built six full-scale experimental demo-houses across Europe, between 2009-2011. The aim of it was to show that it is possible to build sustainably with products, processes and technologies that are already available. The project was based on three fundamental principles of buildings that can create healthier and more comfortable lives for their occupants without impacting negatively on the climate (The Velux Group, n.d.).

As the first principle, the company goal is to create the indoor climate that focuses on an environment that promotes health, comfort and sense of well-being. To achieve these three aspects, several things are taken into account: good daylight conditions, comfortable room temperatures and high-quality indoor air (The Velux Group, n.d.).

The second principle aims to create a building that is energy sufficient and easy to operate. The energy in the houses is provided from a variety of renewable and CO2 neutral sources that are integrated into the overall design of the house. Moreover, the buildings are equipped with sustainable systems, such as, thermal collectors, mechanical ventilation and a wood-burning stove, that helps to reduce energy consumption (The Velux Group, n.d.).

The last principle’s goal is to create buildings that exert the minimum impact on the environment. Using local materials with high recycled content or that are recyclable or re-usable can positively contribute to lower ecological damage. Moreover, the houses are equipped with water saving fittings on the shower and sink to reduce the water consumption (The Velux Group, n.d.).

The description and specification gained during the project of an Active House become a vision of how to create sustainable building anywhere in the world. The company provides the guideline that seeks innovative technical approaches which

combine energy efficiency with specific attention to the user health and comfort, indoor climate and the environment (The Velux Group – Active House, 2016, p.4). The Active Houses are only a small percentage of the building mass in most countries. Therefore, it is interesting to investigate what the company is planning to do in regards to existing buildings.

Velux's next step is to start the renovation project in existing housing since 90% of the buildings stock that we will be using in 2050 has already been built. The new project will be based on principles of an Active House described briefly above. The aim of this project is to develop a sustainable and affordable renovation concept suitable for large-scale renovation and modernization of the buildings that will require it in the near future (The Velux Group, n.d.).

The Velux company has a strong focus on improvement of connection between environmental sustainability and comfortable human dwelling since current modern buildings have not always met human requirements on an eye-to-eye level which can negatively impact on our well-being and health (The Velux Group, n.d., p.75). Therefore, one of their goals is to investigate users' behaviour in dwellings in regards to creating indoor climate by using various systems, among others - shading.

2.2.1. Healthy homes

The home has a significant impact on human health and wellbeing, but also on society's energy consumption and sustainable development. Because of the growing concern for global climate change, it becomes crucial and challenging for many companies to provide energy efficient building with a healthy and pleasant indoor environment.
Many Europeans connect their home to their health, even more than good diet or doing sports (Rassmusen, 2016, p.2). The Velux company described "healthy home" as the place that has "as little environmental impact as possible and is as much energy efficient as possible", while on the other side, it is providing "healthy and comfortable surrounding for its occupants" (Rassmusen, 2016, p.4).

To understand the importance of "healthy home" for people, the company investigate what inhabitants perceive as being most valuable regarding home satisfaction and wellbeing. The questionnaire was answered by 14,000 people from 14 European countries (Rassmusen, 2016, p.4). As a result, they distinguish five aspects of the healthy home.

Most important characteristic for Europeans is to have good sleeping conditions. If we sleep well at night, we feel more energised, and we are more resistant to infections. Moreover, poor sleep negatively affects our job performance in physical and mental areas. For instance, we are more exposed to work accidents, or we do not have enough ability to make the right decisions (Rassmusen, 2016).
As the second factor of "healthy home", people prioritised comfortable indoor temperatures. Many of the Europeans have a significant problem with low temperature during the winter and an overheating issue during the summer. Inadequate temperature can cause different nose and throat infections, but also has an adverse impact on our sleeping conditions. Extremely cold climate can even cause death from cardiovascular diseases (Rassmusen, 2016, p.12).
Another important aspect is fresh air in our home. For instance, people feel more energised if their house is aired out several times per day compared to those who never do it. Incorrectly ventilated rooms have a higher risk of having high humidity conditions that can increase susceptibility to diseases, for example, asthma (Rassmusen, 2016, p.12).
The last two characteristics are satisfactory daylight levels and appropriate humidity levels. Good lighting conditions can positively impact our mood and productivity that can increase by up to 15 %. Moreover, the lack of daylight can cause sleep disturbance that contributes to tiredness during the day, susceptibility to stress and obesity (Rassmusen, 2016, p.12). Regarding the humidity, too high levels of damp can lead to mould or even more dangerous problems.

An excellent condition of all the characteristics described above can contribute to a better economic situation in the country. For example, UK Office for National Statistic present that in UK minor illnesses were the number one cause of absence from work in 2013 what contribute to 1,8 billion pounds of lost national income (Rassmusen, 2016, p.13). A possibility of living in a healthy environment will decrease numbers of diseases among people, thus fewer absences at work. Moreover, almost all of those aspects are strongly related with our energy level that gives us the motivation to live active lives (Rassmusen, 2016).

2.2.2 VELUX'S SIMULATION TOOLS

The company Velux provides building simulation tools to facilitate the design and construction of sustainable buildings. There are two available programs: VELUX Daylight Visualizer and VELUX Energy and Indoor Climate Visualizer.

The first program is a professional lighting simulation tool for the analysis of daylight conditions in buildings (see Figure 4). It is important to do such an examination in the early stages of the project's design process as it can significantly contribute to the energy consumption of the house when it is built. Good daylight conditions can replace electric light during daytime, but also influence both heating and cooling loads. Moreover, it also provides a variety of health and comfort benefits for occupants.

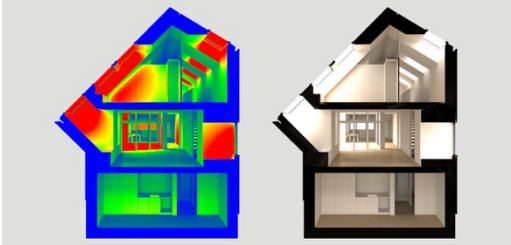


Figure 4- Daylight Visualizer

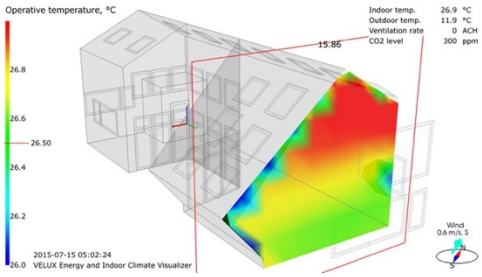


Figure 5 - Energy and Indoor Climate Visualize

The second program evaluates the performance of single-family houses concerning energy, ventilation and indoor climate (see Figure 5). The visualizer focuses on how the windows and solar shadings effects on the indoor climate and the energy consumption for heating, ventilation, cooling and electrical lighting. It can be used for new-built projects as well as for modernization of already existing buildings.

Both programs can be used to compare results between identical building geometries and different choices of windows, panels and solar shadings. However, we have to be always aware of various user interaction with those elements as the program's guidance does not always reveal the reality.

2.3. ENERGY EFFICIENT BUILDINGS AND THE USERS' BEHAVIOUR

Today, reducing the use of energy, especially in the built environment becomes a significant contributor to a sustainable environment in many countries (Hoes, Hensen, Loomans, De Vries, Bourgeois, 2009). In 2014 in the European Union, the households' consumption accounts for about 24.8% of the total energy use, and it is a third dominant category right after transport and industry (Consumption of energy, 2016).

Usually, the high energy consumption is caused by creating an optimal indoor environment for the occupants of buildings concerning good ventilation, comfortable temperatures and sufficient light (Brunsgaard, Heiselberg, Knudstrup, Larsen, 2012).

Many engineers try to develop the design of buildings that leads to significant energy reduction (Hoes, Hensen, Loomans, De Vries, Bourgeois, 2009). Over the last decade, the main focus has been to improve the energy efficiency of specific building elements such as the building envelope, including its walls, roofs and windows, and building equipment such as heating, ventilation, air handling cooling equipment and lighting (Heiselberg, 2006). For example, one of existing low energy building concepts is the "Passive Building" which is a very well insulated building that has most of the windows are orientated towards the sun, and it has a has a ventilation system with very efficient heat recovery (Brunsgaard, Heiselberg, Knudstrup, Larsen, 2012).

Even though there is a significant improvement in energy reduction and current building simulation tools provides us wide possibilities to improve the design, there is still place for improvement. The amount of used energy for creating the high-quality indoor environment depends on four factors; building fabric, outdoor temperature, indoor temperature and duration of heating. Two of these elements are controlled by the occupants, highlighting the large impact that users can have on power consumption (Combe, Way, 2011, p.2).

In current building simulation tools, user behaviour is modelled in a very static way that corresponds poorly with actual user behaviour which usually is much more complex. Energy consumption not only depends on building design and climate but also on users' habits and preferences. For example, in the article written by Brunsgaard, Heiselberg, Knudstrup and Larsen (2012), the house was designed according to existing standards with regards to the indoor temperature. However, decisions made by inhabitants resulted in high indoor temperatures. The users argued that they could not keep the doors and/or windows open when they are not at home as was suggested by the architect. Then, occupant also expressed a feeling of the negative pressure in the house due to wrong understanding how to use the skylights. They were keeping them open, but they did not open the windows on the lower level, so there was not the proper circulation of the air (Brunsgaard, Heiselberg, Knudstrup and Larsen, 2012, p.438). The incorrect design of the house which do not allow inhabitants to ventilate their home when the house empty effected in uncomfortable indoor climate. The solution to this problem could be the windows that can stay open and at the same time provide security when the house in not occupied (Brunsgaard, Heiselberg, Knudstrup and Larsen, 2012).

The situation described above shows that 'wrong' occupant behaviour and poor design can bring unexpected results. If the designs do not match with the psychological or social behaviour of the occupants, then, the wanted effect will be

unreachable. Sometimes the lack of knowledge of the users, habits or limited available information on how to use system 'correctly' will have a negative impact.

Moreover, the internal heat gains from various sources, such as, central heating, fireplace, the sun, has a direct relation with the behaviour of inhabitants since they are the ones who control the temperature, ventilation, solar shadings and lighting according to their preferences and current outdoor condition. For example, they open/close windows, turn on/off heating, switch on/off air-conditioning or enable/disenable the shadings. Therefore, it is assumed that user behaviour is one of the most significant input parameters influencing the results of building performance simulations. Unreliable assumptions regarding user behaviour may have large implications for such assessments and impact negatively on the indoor climate and the energy use (Hoes, Hensen, Loomans, De Vries, Bourgeois, 2009).

Another very important indicator that can influence the energy consumption and it is strongly related to user behaviour and the change of behaviour over time is the lifespan of buildings and systems installed. In the preliminary phase of building a lifetime, they can provide expected results, however, over time they can become less efficient and require more maintenance from users (Hoes, Hensen, Loomans, De Vries, Bourgeois, 2009). Thus, if inhabitants will not provide the proper conservation, the performance of the building might change negatively over time.

Concluding, the user-behavior and everyday practice of the occupants are of great significance in the performance of the indoor climate, and they are not adequately taken into account in today's practice of building simulation industry (Heiselberg, 2006). Therefore, more detail studies on user behaviour need to be conducted to decrease an energy consumption and improve the indoor environment.

Moreover, the application of user behaviour models with higher complexity will improve the understanding of the relation between building, user and building performance (Hoes, Hensen, Loomans, De Vries, Bourgeois, 2009). A better understanding of those aspects can lead to improved assessments of energy performance after that reduce power consumption.

2.3.1 Windows and people

Windows are significantly essential elements in the building design, but they also have a high-value role in people's life more than just tool only used to air out the home. Studies conducted by Bettina Hauge (2013) manifestly present that there is a strong relationship between residents and the windows in their homes, and that this relationship involves daylight but also other qualities (Hauge, 2017).

The highest priority people give to the influx of daylight since it contributes directly to our "well-being". *"It can influence our energy, joy of life and inspiration, but also it gives us a daily and seasonal rhythm by being able to follow developments in the immediate surroundings because of the provision of daylight"* (Hauge, 2013, p.2). Besides this, it also gives a character to the form and colour of the room (Hauge, 2017).

Moreover, the windows give people visual access to the external surroundings so they can stay in touch with the social life and the course of nature. This relationship with the sun and daylight - and thereby also the window - anchors people in the world they inhabit as powerful human beings engaged in constant interaction with their environment (Hauge, 2013 p.2). On the other hand, the window can be seen as a barrier between the internal and external world which we can control depending on how much interaction we would like to have with outside.

Another important aspect related to the window is its appearance. First of all, windows play a significant role in the design of the buildings, the shape, the colour of the frame and other characteristics might influence building's appearance, after that, peoples' opinion if they like it or not, both from inside and outside. Moreover, they are a characteristic part of the house which many people decorate with certain curtains, plants, decoration on festive occasions, etc.

Furthermore, in some cases, windows are associated with certain risks, for example, they can be seen as easy access to the house for burglars, or they allow to people from outside to easily see what is happening in our home.
Moreover, like all the other parts of the house, windows require maintenance, such as cleaning and painting, and they have a particularly high priority on the households' 'things-to-do' list (Hauge, 2013).

All the factors described above and others, such as ventilation, provision of glare, exclusion of rainfall, exclusion of dust, noises, pollution and insects and exclusion of solar radiation can be controlled by the window itself. Moreover, also by the elements which it might to contains, such as, shadings, mosquito net, metal grid, etc.

2.3.2 SHADINGS

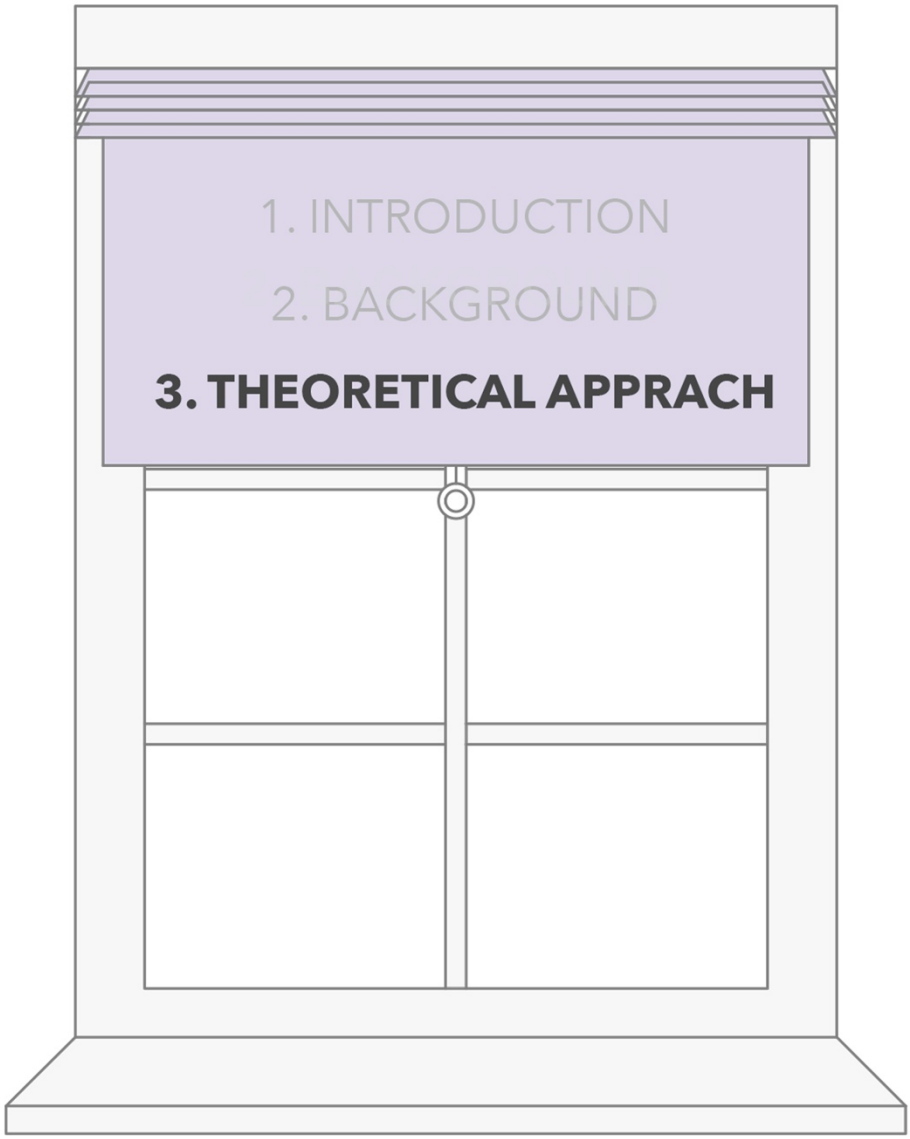
There are several reasons why people want to control the amount of sunlight and solar heat that is entering the buildings, but also their privacy. Moreover, the use of the shading is an important aspect of many energy-efficient building design strategies. Well-designed sun control devices can prevent from the overheating, improve the user visual comfort by controlling glare and reducing contrast ratios that lead to increased satisfaction and productivity of inhabitants (Prowler,2016).

The use of solar shading in a case of the sun protection will mostly depend on the window orientation. However, in some of the circumstances, it might be used for the other reason, e.g. privacy, lighting, decoration, and this mainly will be a choice of the users.

There is a broad range of devices that can protect from the sun, some of them will also be used in other cases that I mentioned above. Firstly, we can use natural landscape features, such as trees or hedgerows. Then, we have several exteriors and interior elements that can distinguish between horizontal and vertical. The first ones are overhangs and light shelves, while the second ones are usually vertical fins, curtains, indoor and outdoor blinds, shutters (Prowler,2016). Some of those elements are controlled by humans, or they can have an automatic system. Moreover, they are usually in different colours, materials and shape, depending on the choice of architect or householders.

Furthermore, the various design of shading enables them to function in several ways, for example, some of the indoor blinds can be enabled completely, just half window or have a different angle of elements which shading device is made of what can partly allow access for the sun.

Figure 6 - Various shading types


1. INTRODUCTION
2. BACKGROUND
3. THEORETICAL APPRACH

To better understand the users' behaviour related to use of shading, I chosen to apply the practice theory that is a fragmented body of theories that embraces questions about what role things and technologies should have in the understanding of practices (Gram-Hanssen, 2010, p.176). It also helps to understand the relationships between materials, images, and competencies in the practices, and provide a better understanding of the user's role towards the product itself. Moreover, practice theory allows seeing the reproduction of routinized behaviour performed by individuals as social structures of society what would be significantly important to create the users' behaviour models.

3.1 Practice Theory

To illustrate various users' behaviour models for the use of shadings, it is fundamental to investigate people's practices related to window's shadings.
The practice of using solar shadings is strongly related to the practice of window use and can be seen as part of it or as a part another bigger practice, such as everyday life practice. For example, every day when we are going to sleep, some of us enable shading to do not be disturbed with the daylight in the morning.

However, in my project, I will investigate it as an individual practice where everyday life actions and other things are the factors influencing it.

Since the project focuses on the manual type of solar shading, I will be analysing the practice of enabling/disabling them by the inhabitants of the house. The investigation of this practice will give me a better understanding of what is the reason for people to use the solar shading on their windows in various situations, and how does it influence the thermal and visual conditions in their room.
Moreover, the better understanding of the people practice related to use of solar shadings can help to create the users' behaviour models that will improve the simulation programs for lighting and indoor climate that aim to support the architects in designing more energy sufficient buildings.

The practice theory had been described differently by various authors. According to Reckwitz (2002: 249), a 'practice' is a routinized type of behaviour that appears at different locales and at different points of time and is carried out by various body/minds. On the other hand, Schatzki says that practices are coordinated entities that are temporally unfolded and a spatially dispersed nexus of doings and sayings (1996: 89). Both of the authors focus attention on the collective aspect of practices. Since the practice forms a nexus that means there are know for certain elements holding it together; however, in the work of Schatzki, Reckwitz, Warde and

Shove/Pantzar, there are slightly different descriptions of the things holding a practice together (Gram-Hanssen, 2011, p.62).

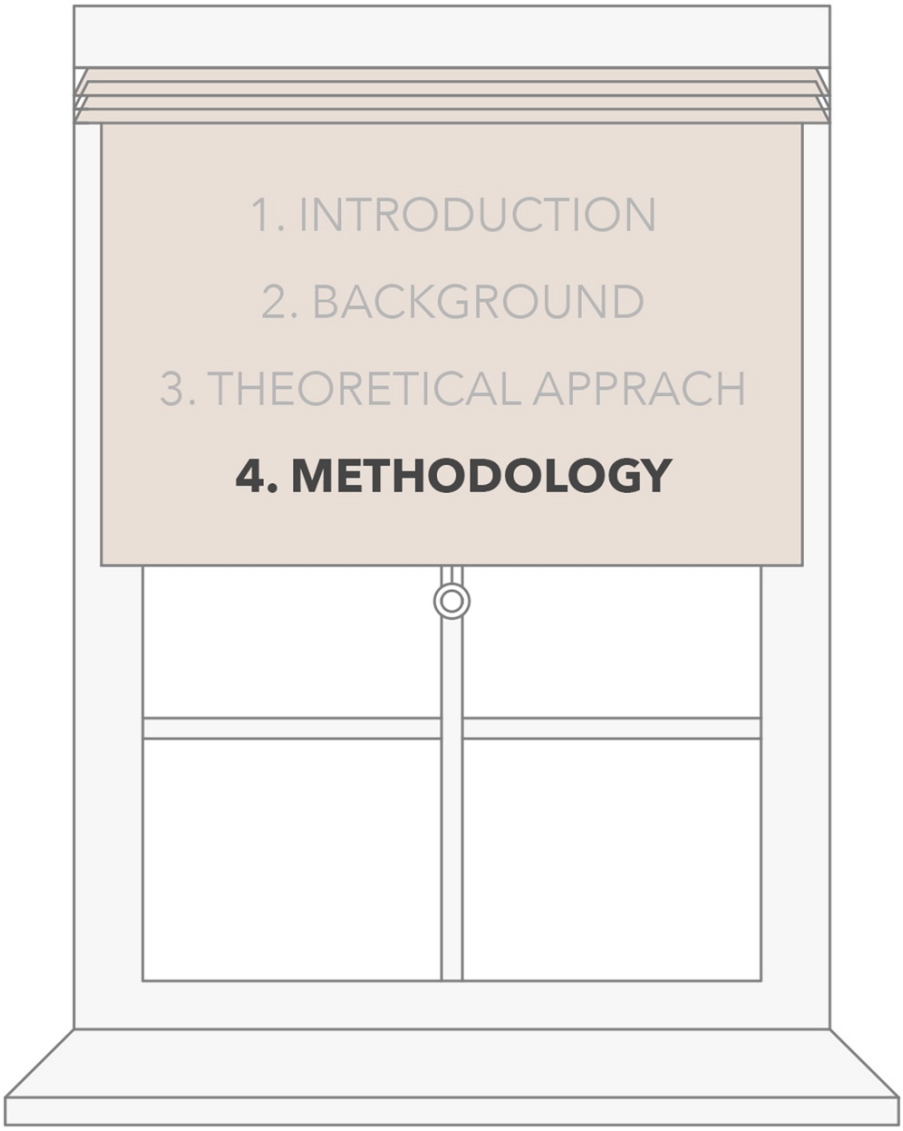
In our everyday life, we are engaged in various practices, such as working, eating, cooking, etc. All those activities consist several elements that are interconnected to each other, and they can be performed by various people in different ways (Warde, 2005, p.133). Some of the practices can be carried out by individuals while the other can be accomplished only in the group of people, for example, playing football.
However, to bring practice to existence it has to be performed and shared by a large group of individuals in a society (Røpke, 2009). It means that the activities performed individuals, such as reading and showering, need to be carried out by other people as well to become the practice.
Moreover, all practices are changing over time since they often involve elements that are unstable, such as, materials, meanings, competences. If some of that component, human and non-human occur, disappear or change, the new practices might emerge, and others die out when practitioners can no longer be recruited (Røpke, 2009, p. 2494).

According to Reckwitz technologies are an essential element in holding practices together, while for the Schatzki, technologies are products of practices. In my project, technology will be seen as an important part of bringing changes into practices.

In the paper by Røpke (2009, p.2492), those parts are divided into three overlapping groups: material, meaning, and competence — or in other terms, equipment, images, and skills. In the same way, I would conduct my analysis.
The first component - materials include the objects, equipment, and bodies (or body parts) that are involved in the practice preformation. Then, there is a meaning element that includes the ideas of what the activities are good for, the emotions related to the activities, the beliefs and understandings. The images are often varying in between different social groups, sometimes incomprehensible in between them. The last component- competence is related to the skills and the knowledge which are required to carry out the practice and usually are learned by experience or training. Some of them may be more specialised limited by formal rules, principles, precepts and instructions, but also some of them may be used in several practices, such as the ability to read and write (Røpke, 2009).

Described above components are strictly connected to each other, for that reason, if one of them is also modified the other two are consequently affected. Moreover, those parts are usually shared between more than one practice. Therefore, they act as links among them.

Summarising, to analyse practice we have to be aware of setting the boundaries between the elements considered to be constitutive for the practice and the context in which the practice unfolds (2009, p.2494). Since many practices can be seen as a group of different activities that can be considered as sub-practices. For example, using the solar shading could be a sub-practice of using the window practice.
Furthermore, as described in the article by Warde (2005), most of the practices require and entail consumption. In my project, the practice of enabling/disenabling solar shading seem to do not involve it. However, if we look at this activity as a sub-practice of another practice, such as using electric lights, then it will include consumption of energy.


1. INTRODUCTION
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To get an overview of the problem and issues related to it and to collected the date for the analyses with the Practice Theory, I have applied four different methods, starting with online survey followed by activity map and semi-structure interviews. The use of several methods allowed me to collect information at various levels from general one to more personalised one.

4.1. ONLINE SURVEY

As the first method to collect the date, I have chosen online survey (see Appendix A). It allowed me to gather the preliminary information about the use of shadings to better understand the user's practice. The gained data gave me the general overview on where and why, and what type of solar shading people use in their houses.
Moreover, it provides me information about common people's knowledge related to shadings use.

The questionnaire was dedicated to people who lives in Denmark and Poland, and it was made available in both languages. The data was collected separately from individuals who live in Denmark and from people who live in Poland to see the cultural and climate differences on how people use solar shadings in those countries. The survey consists two parts, the first one with 18 questions in which some were yes/no questions, some were multiple choice, and some were open-ended questions and the second with five questions, only for the people who have roof windows.

To collect information survey was posted for one month on several social media, such as Facebook, LinkedIn, etc., by me, my friends and Velux company. Even though it was available in many places, it has been difficult to gain people attention since currently, there are many surveys posted by other students.
Also, to obtain more answers from the people I have been using a picture of the "cute" cat. It proved to be an excellent choice to make more people respond to the questionnaire.

Summarising, the online survey has been a useful method to collect the information about general users' experience with the product. By using this method, I was able to easily gather the data from many people in different locations in a relatively short period without exposure to additional costs. Moreover, it helped me to reduce my research time and effort thanks to automated data collection (Sincero, 2012).

However, even though, the online survey seems to be a very useful tool to collect the data for my project, it also has many disadvantages.
The wrong design survey may provide the provide meaningless or, even more, inaccurate information. Some of the people who are filling up the survey may do not take it seriously and fill it up sloppily or do it for money, not with a desire to contribute to the advancement of the study. Moreover, it mostly excludes the seniors and people who reside in remote areas as they usual has limited accesses to the internet (Sincero, 2012).
To avoid these disadvantages, I also collected data by using other methods which provided me more true information since I talked to users in person. Moreover, to include as many as possible seniors, I post my survey in Facebook's group for pensioners.

4.2. Activity Map

The activity map (see Appendix D) was used to understand the daily interaction between a user and shadings better. Unfortunately, personal observations were impossible in this project since I could not spend several days in people's houses.
The activity map was a great solution to collect information from various people at the same time by filling up the form individually by each of the participants.

As the first step in activity map, the participant was required to write down some information about themselves and about the type of room, windows location and type of solar shadings which usage will be described below in timelines. The whole task consisted three days' timeline in which each of participants needs to answer four question, related to each other, about the use of shading in the chosen room. Also, they need to describe the weather for the particular day and select if it was working or free day for them.

The exercise was conducted in both countries Poland and Denmark, the first time in March and second time in May with the same participants. In each place, there I had chosen 1-3 people in three different age group below 35, between 35-65 and above 65.
The different country and period aimed to see the differences in behaviour according to the climate and culture, while the various age group goal was to see if everyday activities related to our age influencing our choices. For example, younger people usually have a less stable schedule, especially when they are studying what can reflect on how they use solar shadings.

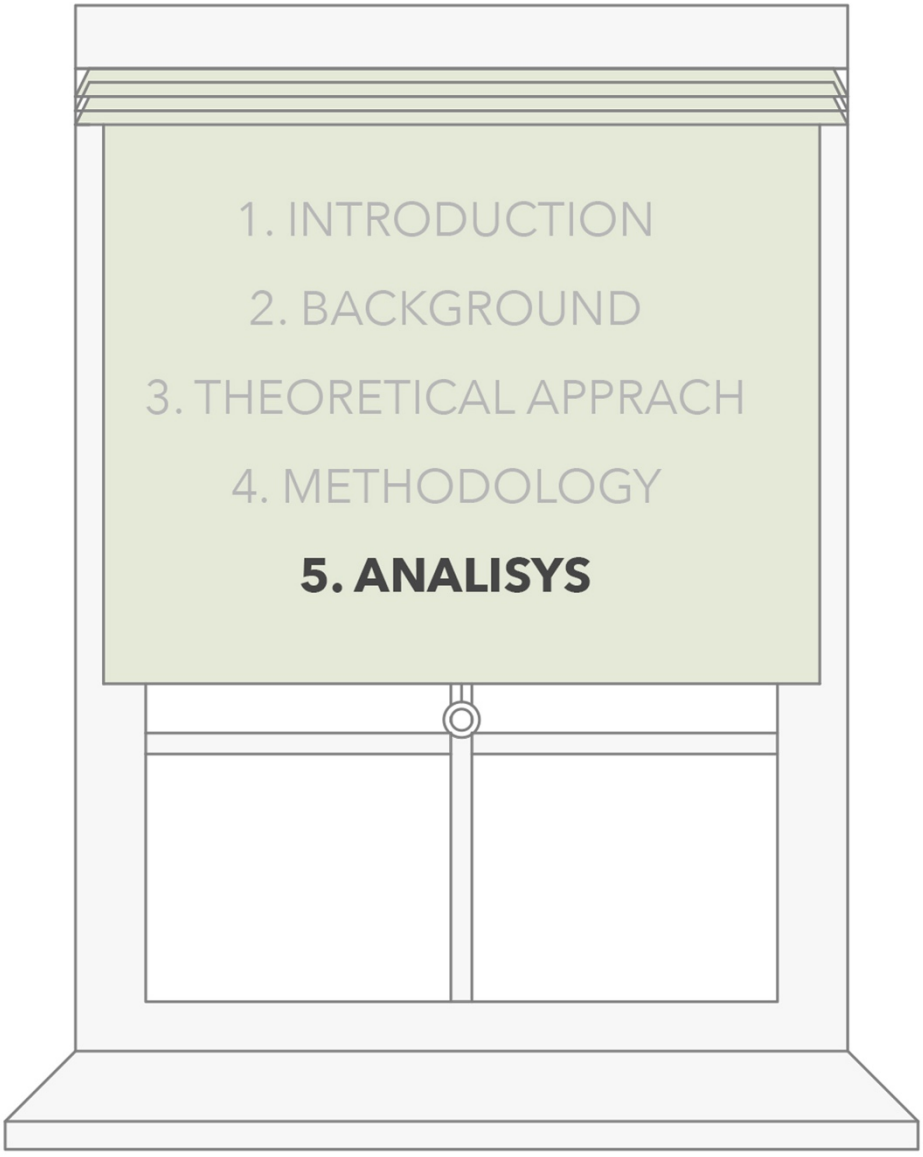
Moreover, the activity map was used as the based to construct some of the questions for semi-structure interviews afterwards with the same group of people.

4.3. SEMI-STRUCTURE INTERVIEWS

Interviews are one of the most common methods for understanding the user behaviour. In this project, I conducted fourteen interviews (see Appendix F and G) with open-ended questions which were based on the online survey results and activity maps filled up by participants previously. The aim of them was to understand better the choices made by each of user regarding the use of shading in their home. I used the semi-structured type of the interview that provided me with both qualitative and quantitative data since the interviewer has a guide with a set of questions to ask, but it is possible to deviate from the order and ask additional things if needed (Baxter, Courage & Caine, 2015).
Moreover, in comparison to the online survey, participants had an opportunity to explain each answer precisely.

For the interviews, I selected various people in different ranges of age and lifestyles. Each of the interviews took approximately 15 min, and he or she were recorded by an electronic device. In Poland, the interviews were carried out mostly in the place of living of the participants, while in Denmark in public places, such as the University. Conducting them in place of the user was fairly beneficial since I could easily relate my questions to the surrounding, thus participants' windows and shadings.

The guide for interview contained 14 questions (see Appendix E) which were related to three components of practice theory: materials, competencies and meanings. The questions in the material part were related to the type of shading and its location. In the competences part, the participants had to share their information about skills and knowledge on how they use their shading. Finally, in the last part- meaning, the questions were connected to the reason of using the shadings and personal understanding on how the use of them contribute to their indoor climate qualities and their well-being.


1. INTRODUCTION
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5. ANALISYS

The practice I am going to analyse in this chapter is how people use the shadings, more precisely when and why they enable/disable them in their home or whether they use the shading to control their indoor environment and individual comfort. It will be investigated from the user point of view since they are the ones who chose and monitor the shadings according to their requirements. The data used for analyses was collected by three different methods – an online survey, activity mapping and interviews.

The first part of the analysis focuses on the general information related to use of shading in Poland and Denmark. The data was collected in both countries, separately, using the online survey that was in total answered by 435 people, 54% from Poland and 46% from Denmark.
The sub-sections will provide an overview of individuals' shading practices using quantitative, general information and it is reported separately from each country. Then, similarities and differences between Poland and Denmark will be summarised together in the last sub-section.

In the second part the analysis, the qualitative data from the activity maps and interviews will be presented. They will focus on three elements - material arrangement, competencies and meanings. The data was collected from eight people in Poland and six in Denmark by using activity map and semi-structure interviews. All of the participants live in various types of buildings and locations. Moreover, they are a different age, and they have various lifestyles.
This part will start with a presentation of main practice activity and general elements in the material arrangement in both countries. Afterwards, in four sub-sections, which are time and reason of using the shading, materials involved in the use of shading, competencies involved in the use of shading and meanings related to use of shading, the information will be analysed, separately from both countries.
The second part of analyses will also finish with sub-section where presented data from Poland and Denmark will be concluded, showing similarities and differences between these countries.

5.1 Analysis of the survey – quantitative data

5.1.1 Understanding the use of shading in Poland

The questionnaire in Poland was answered by 236 people (78% female and 22% male), and of whom stated that they have shindigs in their homes. On these respondents 85% were below 35 years old, 11% between 35 to 65 years' old and just 4% above 65 years' old.

A large number of young respondents, i.e. below 35 years' old, can presumably be attributed to my posting of the survey on social media. Today, the greater amount of social media users are usually young people rather than people above 65 years' old. (Social Media Fact Sheet, 2017). Moreover, my age (26 years old) probably also strongly affected the respondent's group, since many of them were in the group of my friends that are my age.

The use of shading is strongly related to the features of the windows that are the inseparable part of residential buildings. The type of building, its shape, location and surroundings of it, might influence the way that people use the shadings. Thus, the investigation of people's place of living was essential.

The respondents from Poland live mainly in flats (66%). Approximately a third live in houses (32%) and just a few in other types of accommodation, such as student house (2%). Regarding the multi-dwelling housing, the floor level that people live on should also be taken into consideration as it can influence the inhabitants' practices. As mentioned in the studies conducted by Bettina Hauge (2013), the windows allow us to view in and out. However, the extent to which others can "view in" depends on what floor the flat is located and how closely located other apartments' building are. For example, people living on the ground floor, they are more likely to have people passing by and looking in than people living on the other floors. On the other hand, individuals who live on the higher floors usually have windows that are more exposed to the sun, whereas the trees more likely shade windows situated on the lower stories or they are shade from another block of flats located nearby. Most of the participants of my survey live lower than the 5th floor, especially first and second and just a few of them in the higher stories up to 11th floor (see Appendix B).

Furthermore, the practice of using shading is strongly related to the type of window and its orientation. Depending on the building the windows can be located on one, two, three, or even four directions. According to the survey, there is not world direction in which participants' homes windows would be mostly oriented. However, it can be noticed that they are turned slightly more into south and west (see Appendix B).

The type of the window can influence the kind of shading, e.g. roller blinds, shutters, curtains, etc. that can be installed. However, its world orientation would have more significant impact on shading practices, particularly, if the use of shading is aimed at protecting from overheating. Even though Poland is not considered as a country with constantly high temperatures, during the summer, the temperature rises to 35 degrees and many people use fans and/or air conditioning to cool their homes. For example, in 2015 in southern Poland, summer temperatures were very high, and

people bought so many fans that the shops run out of them (Fakt24, 11 August 2015).

Regarding the type of shading that people have in Poland, the survey shows that there are various kinds in different rooms or even a combination of two on the same window. For example, in many Polish homes, people use net curtains permanently. However, since this type of curtain does not provide 100% privacy or light protection, additional curtains or blinds are needed. The combination of different kinds of shadings is also reflected in the survey results. The most common form of shading in Poland is indoor roller blinds (59%) which can have different colours and patterns. Secondly, many people have curtains (42%), and many have net curtains (35%). Both of the types of shading have countless colours, patterns and shapes. Fewer respondents have indoor blinds (19%) and outdoor blinds (15%) the latter of which are used in houses rather than flats. Very few respondents (2%) have shutters (see Appendix B). These are not common in Poland, even though, they very often occur in hot countries, such as Italy or Spain.

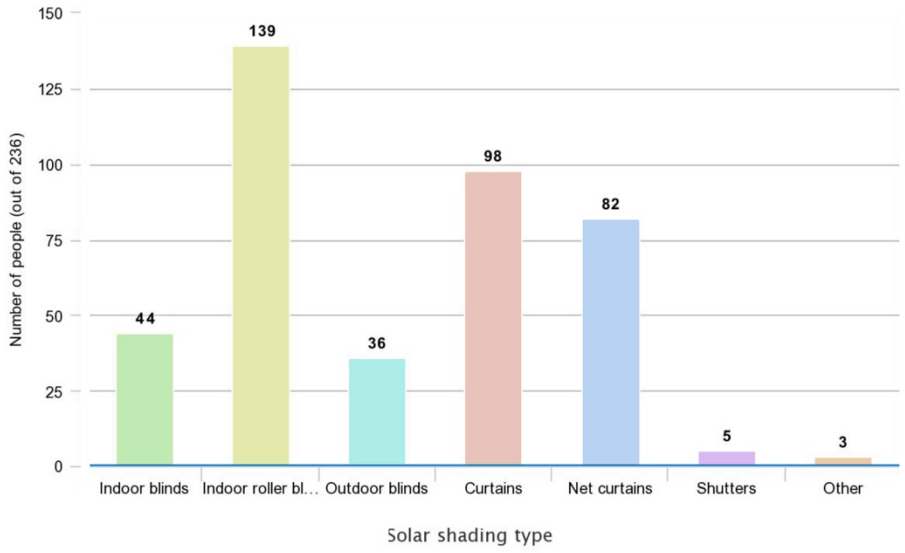


Figure 7 - Types if shading in Polish homes.

The shading is an additional system that can be installed on the window. Therefore, it does not always occur in every window in the home. Mostly the choice of the room where shading is installed depends on the reason why people have them.
Two most common rooms where Polish people have shadings are a bedroom (80%) and living room (79%). Then, almost half of the respondents have shading in their kitchens (49%). Also, quite many of them have it in the dining room (27%). Although not everyone has a separate dining room since very often, it is a part of the kitchen

or living room. Regarding the bathroom, 21% of respondents reported having the shading there. It is a quite significant number since bathrooms quite rarely have windows in Poland.
Moreover, it is fairly common to have a home office where according to respondents, 14% have shadings. Besides all mentioned above rooms, 7% of the answer were another type of room, for example, studio flat (see Appendix B).

The use of shadings can be attributed to many aspects of our lives that influence the practice. According to the survey, the most common reason, people use shadings in Poland is for privacy reasons (73%). This presumably is related to the answers on which floor people live. Since they mostly live on lower floors, e.g. first and second, a quite large number of respondents indicate that they use shading to protect their privacy rather than to protect their rooms from overheating.
Moreover, many of the people also added comment that to protect their privacy, they do not disable shading when is not longer needed for other purposes.
The second and third most common reasons for using shading was to decrease glare (53%) and to provide light protection (49%). The second reason is usually related to peoples' sleeping practice. For example, one the respondent who works at night uses shading during the day, when he sleeps so as not to be disturbed by the sunlight (see Appendix B).

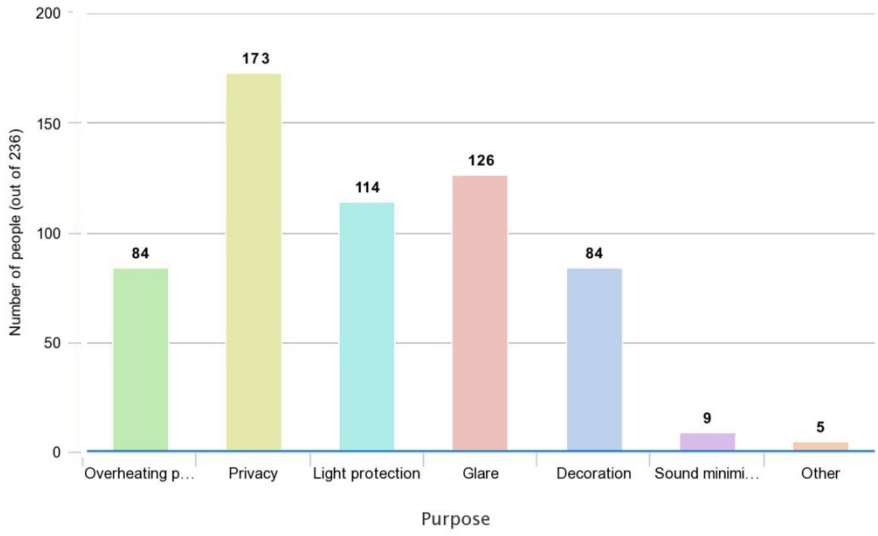


Figure 8 - Reason of using the shading in Polish homes.

Furthermore, in many countries shadings are used as protection from solar heating. In Poland, high temperatures occur only during the summer months, and over a third of respondents (36%) noted that they use shading as overheating protection. However, it appears that shading can also be used to protect against heat loss. One respondent said that one of the most important factors for why he decided to buy

outdoor blinds was to prevent the temperature from dropping in his house on cold days (see Appendix B).
For some of the users (36%), shadings are part of the decoration. As respondent noted: “I prefer to watch my curtains than the view that is behind my window”. Another characteristic feature of some types of shading is that it can be used for sound minimization, particularly, if they are outdoor blinds. These are usually very massive and tight. However, only a fraction (9 out of 236) have indicated that this is the reason for their choice of shading (see Appendix B).

The use of shading is quite often related to a use of the electric light. Therefore, it was important to understand if enabling the shading for the other reason than daylight protection, during the day would not limit the access of it. For example, using the shading that completely blocks the influx of the light to the room for solar heating protection would necessitate the use of electrical light in the room to perform some activities. Moreover, the daylight is one of the most important aspects that window provides to the people (Hauge,2015) and it affects our well-being and health positively. Thus, use of some types of shading during the day would have a negative impact on human being and energy consumption.

According to the survey, during the sunny days, 74% would have sufficient lighting conditions, even though they use their shading. 15% said that it would depend if shadings are completely enabled and nearly 10% would have to use electric light (see Appendix B).
The situation changes if people use shading on cloudy days, then only 31% consider that they would have sufficient light. 25% do not need to use artificial lighting if the shading is not enabled entirely and 40% will require an additional light (see Appendix B).

The practice of using the shading was difficult to foretell since it is influenced by many unpredictable aspects, such as the weather, building features, but also, especially, in the residential buildings, people’s needs and individual choices. For instance, the public buildings and offices increasingly have solar shadings that are automated, particularly, if the building has a lot of glazed surfaces to protect from overheating efficiently. Even though, there is still many places with manual solar shading the way of using it might depend on a group of people, for example sharing the office room so that it will become a less individual choice.

Regarding the individual choices, almost 50% of respondents stated hat they will not disable their shading when is not longer needed (see Figure 9). They are different

reasons for this: laziness (24%), obliviousness (19%), not being at home (35%), it will be needed to enable again in the short time (21%) and others (8%), such as, mentioned above privacy, decoration and better view (see Appendix B).

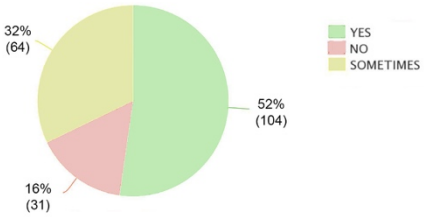


Figure 9 - Number of people who will not disable sahding when no longer needed.

Finally, every practice requires some knowledge to perform it ''correctly'', which in this case means reducing energy consumption and at the same time creating a comfortable and suitable indoor climate for each inhabitant. Based on the answers from the online survey, 65% of interviewed know that the way they use shadings influences the room temperature. However, 22% still do not think about it when they enable/disable them, and 13% do not even have this knowledge (see Appendix B).

Since the project was provided by Velux company that produce roof windows, there were several additional questions regarding this type of the windows.
In Poland, only 38 out of 236 people have roof windows, and just half of the people have some shading installed. When it comes to these windows, the main reason for solar shading is to avoid overheating. More than 60% of these group of respondents have a problem with overheating during the hot summer days when the temperatures in their rooms rise. Moreover, shadings quite often are also used for light and glare protection. The use of shading for protecting privacy or as a decoration is significantly less compared to normal windows (see Appendix B).

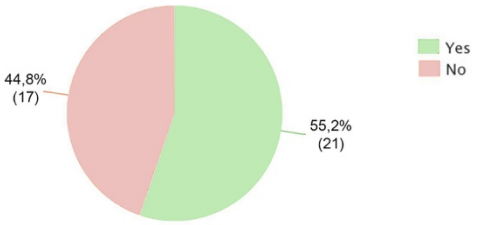


Figure 10 - Use of shading in roof windows in Poland

Regarding the lighting conditions in the room when shading is enabled on sunny days, it is rarely necessary to use additional light (less than 20% of the respondents who has roof windows).
On a cloudy day, the situation is just the opposite. According to some of the respondents (30% of the respondents who has roof windows), less electric is required than in vertical windows (see Appendix B).
However, the impact on the lighting conditions would strongly depend on the type of solar shading installed on the window.

5.1.2 Understanding the use of shading in Denmark

The questionnaire in Denmark was answered by 199 people (72% female and 28% male) from which 196 have shading and three do not.
The age range was quite similar to Poland, 75% were below 35 years old, 22% between 35-65 years old and just 3% above 65 years old (see Appendix C). The slight difference with regards to the outcome from Poland, in second age group, was probably caused by choice of the groups on Facebook where mostly I post my survey.

In Denmark again very similar results appear regarding the place of residence, 68% live in the flats, 29% in the house and 3 % in others form of housing, such as dormitories. In Denmark, most of the residential buildings are not higher than five stories, and this is reflected in the survey responses. A significantly higher number of respondents have flats on the levels lower than 3rd floor. Just 21 people out of 134 would live on the third and 4th floor and very few on the higher stories up to 9th floor (see Appendix C).

As already mentioned, shadings are additional systems that can be installed on windows. Thus, the window world orientation would significantly influence the use of them. For example, the windows located to the south would more likely need the shading for overheating protection than the ones oriented to the north.
The survey shows that in Denmark slightly more windows are located in the South (37%) or the East (30%) than the West (25%) or the North (22%) (see Appendix C).
Regarding the types of the shadings that people use in Denmark, three types occur

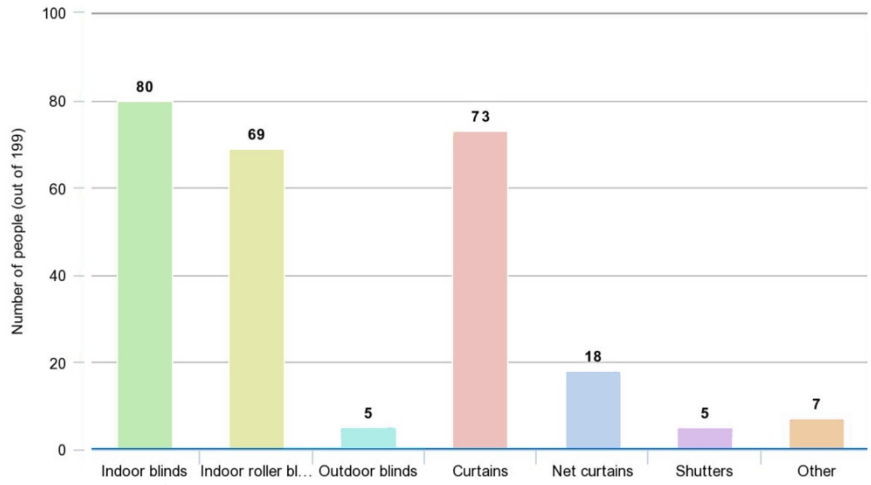


Figure 11 - Types of shading in Danish homes.

almost equally: indoor blinds (40%), curtains (37%) and roller blinds (35%). Other

kinds of shadings such as net curtain appear only to be found in 9% of the respondents'' houses. The outdoor blinds, shutters and others are not very common, and they appear only in few houses (2,5%) (see Appendix C).

People who live in Denmark have shadings mainly in bedrooms (79%) or living rooms (65%). Then, 32% have them in the kitchen and 24% in a dining room. In the other location such as home office, bathroom, shadings occur quite rarely (less than 10%)(Appendix, XX). As well as in Poland, the number of shading can be lower since home office they do not always exist in every house or the bathroom does not always have windows.
Moreover, few of the respondents (5%) answered that they have them in another type of rooms, for example, a studio apartment (see Appendix C).

Furthermore, the use of shading is motivated by different reasons. The most common one is privacy (83%), followed by light protection (55%) and glare (41%). Significantly fewer people than in Poland use shadings to protect their rooms from overheating (24%) and for decoration (18%). Sound minimization appears not to be a major consideration. It was chosen by just 6 out of 199 people (see Appendix C).

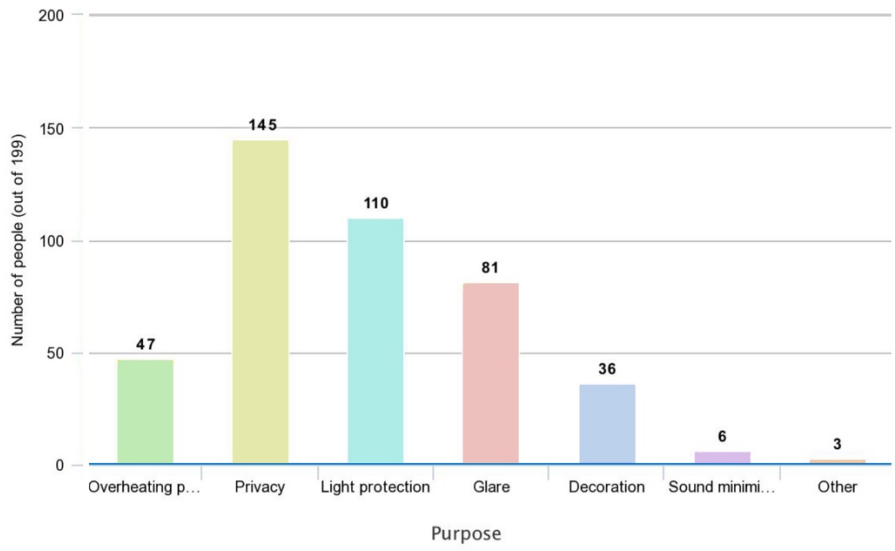


Figure 12 - Reason of using the shading in Danish homes

Even though the shading usually can be used for various purposes at the same time, there are some situations where it can negatively affect energy consumption. For example, if people have dark curtains and they use it to protect their privacy during the day, it might be necessary to use electric light instead of daylight.

According to the survey, on sunny days, most people (61%) will not have a problem with the light condition while using the solar shading for the other reason. However, on cloudy days, it would be the opposite, and roughly half (51%) will have to use electric light. In both weather conditions days, around 13% said that the use of additional light would depend on how much the solar shading is covering the window (see Appendix C).
Also, some of interviewed also said that they never used solar shading the day hours.

The energy consumption would not only depend on the weather but also the seasonal changes that affect the daylight hours. Usually during the winter days up in the mornings is still dark so the electric light would be needed, even though, shading would be disabled.

The same as in Poland, the practice of using shadings can positively contribute to energy consumption and comfortable indoor climate if they are used 'correctly'. Nevertheless, almost 50% of respondents would not or sometimes disable their shading when is not longer needed what in some cases can have a negative influence.
The reason of that can be various, often because we are not at home (46%). Less frequently, it could also be caused by a laziness (18%), forgetfulness (22%) or the need to enable it again in short time (15%) (see Appendix C).
Moreover, there are more personal reasons that some of the respondents pointed out, one of respondent said that she is not disabling the shading when her baby is sleeping during the day. Another one mentioned that it is only enabled partly, so it does not disturb him/her (see Appendix C).

Regarding the knowledge that shading can contribute to the indoor temperature, 56% of interviewed claimed that they are aware of this. However, 28% would not think about it when they use solar shading since they probably have it for the other proposed, such as many times mentioned privacy (see Appendix C).

In Denmark, only 12 people out of 199 have roof windows, and just 8 use the shading on them. Mainly as a means is to protect from the light and glare. Even though, six people have problems with overheating during the summer, only two of them state that they use solar shading. Similar to the findings from Poland, shading is very rarely it will be used for privacy protection or a decoration (see Appendix C).

5.1.3 Differences and similarities in the use of shading in Poland and Denmark

In sum, the outcome of both surveys is very similar in many aspects. Even though there are slight differences which I will present and elaborate on below, it does not seem that culture or weather have a significant impact on peoples' shading practices in these two countries.

Concerning the type of shading that people have in both countries, indoor roller blinds and curtains are the most commonly used. The only difference is that in Poland a larger number of individuals use net curtains that usually permanently cover the window. The use of outdoor blinds is also more common in Polish houses. This is because they can provide additional isolation during the winter, that in Poland are usually colder.

In both countries, shading is most commonly used in the bedroom and living room. It was significantly higher in these rooms than in other rooms. This is presumably strongly connected to the reasons why people use shading. Again, the answers from Poland and Denmark were quite similar. Firstly, it is to protect the privacy, secondly, to protect from the light and glare. It appears that solar shading is used more like an overheating protection in Poland than in Denmark. This can be related to slightly warmer and sunnier weather in this country, especially, during the summer. Moreover, in Poland more than in Denmark, it appears that some shading serves decorative purposes as well.
Moreover, the common reason of using the shading for the privacy protection was stated by to the Bettina Hauge, in her article she wrote that people's need to protect themselves against (a sense of) being watched is why privacy becomes more important reason than overheating protection. Also, she states that "the prospect of being watched by a potentially malicious person is by far more concerning than the heat coming from an innocent sun" (Hauge,2015, p.4).

Moreover, another crucial point that she concluded during her research and that also is supported by the results of my survey is: "the sun provides people with the much-desired daylight and people may be more willing to compromise with overheating, such as accepting a higher room temperature rather than drawing curtains that take away the daylight (and view), precisely because of their pleasure in daylight" (Hauge, 2015, p.4).
However, the collected data shows that on sunny days, people in both countries rarely have a problem with the daylight while using their shading. Thus, the proper type of solar shading which allows for overheating protection but at the same time allows daylight access would be the best solution. However, on the other hand, it

might not provide enough darkness for the users who cannot sleep well with daylight.

Considering the reasons why Danish and Polish people do not disable the shading when is not longer needed, they are quite similar. Mostly, people leave the shading enable when they are absent at home. The next most common reasons are laziness and obliviousness.

Regarding the knowledge about the use of shading, it can be noticed that in both places are quite high. Even though, it seems that quite a lot of people know about benefits from using solar shading. Usually, the use of it is not connected to the indoor thermal conditions but more likely to control of light and visibility.

Also, in both countries, just a few respondents had roof windows. However, only around half of the them who have roof windows also have shading installed, despite the fact that more of them claimed that they have a problem with overheating on the hot sunny days. The ones who had shading installed, use it mainly for overheating, light and glare protection, what were quite the opposite results to the reason of using the shading on vertical windows.
Moreover, it can also be noticed that roof windows provide more influx of daylight access, even though they are sometimes might be covered with solar shadings.

5.2 Use of shading in Poland and Denmark

The use of shading can be understood in two different ways. In some cases, use can be seen as only having the shading installed on the window, for example, as decoration. While on the other hand use will be an activity in which the people enable/disable the shading for various reasons. Depending on the type of a shading, the user has to perform slightly different activities. To enable/disable the curtains it is necessary to slide them on the curtain rod (manually or with a curtain drawing mechanism).

Regarding the roller indoor/outdoor blinds, people need to use the string to pull them down or up. The Venetian blinds would work similar to roller blinds in enabling/disabling them. However, they also have a possibility of changing the angle of the blinds. Thus, to allow the light to the room there is no need to pull them up, but it is enough just to adjust the units into to the right angle.

The use of shading for decorative purposes and/or other purposes is influenced by various factors, mostly related to user individual choices and needs since the use of shading is not limited by any common rules or principles.

5.2.1 General elements in the material arrangements of using the shadings in both countries

The material arrangement of using the shading are similar in both countries. The four core elements that are always involved in this practice are the place of living, a window, a shading and a user.

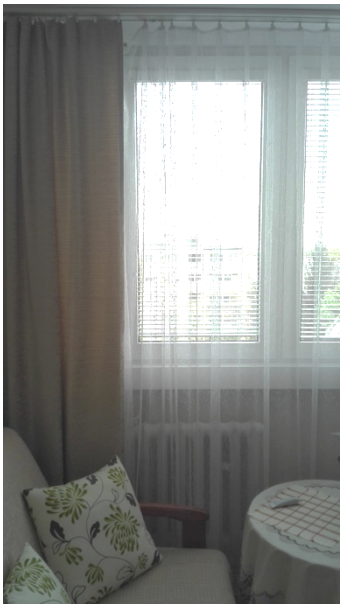


Figure 13 - Shadings in Polish home

Regarding the first one, it can be flat, house or other types of accommodation, such as a room in the dormitory. They can be located in various places with different surroundings and climates that would influence the use of shading. For example, the use of shading to protect privacy would probably be more frequent in the flat that is located in the building surrounded closely by other buildings than in the house located in the countryside with a private garden. Also, the interior of the place, its arrangement and things would play an important role in the use of shading.

Secondly, there is the window that is an inseparable part of the residential buildings, and it is a reason why the use of shading come into the practice. The use of solar shading is strongly related to qualities that windows provide to the people since the shading are installed on them. The location of the window would be significantly important regarding the reason for using the shading. For instance, it would be more common to use shading in the bedroom if it helps people to sleep better.
Moreover, as mentioned in Bettina Hauge (2013) studies, the people have a strong relation to the windows, particularly, with the daylight that they allow to access to our homes' interior and the use of solar shading allows people to control this.

Figure 14 - Shading in Danish home

The next element is a shading itself, the choice and the way of use of it will depend on each user individually. Today, on the market there is available an enormous amount of various shading devices from simple curtains to more complicated indoor/outdoor blinds which can fulfil various users' requirements and needs.
The last component is a user that involved the part of his/her parts of the body in using the shading, for example, enabling/disabling it. Moreover, the user is also responsible for competencies and meaning part of the use of shading, that would be described in the following sub-sections.

5.2.2 Use of shading in Poland

The use of shading in Poland was investigated in eight Polish homes. Seven of the participants lived in Wroclaw city, that is located in Southwest Poland and one in the village close to it. All the users filled up two times the activity maps and participated in the interviews. The short outcome of the results of both methods will be presented along analyses in the Table 1– Activity Maps, and Tables 2.1, 2.2, 2.3– Interviews.

5.2.2.1 Time and reason of using the shading

As mentioned above the use of shading is not limited by any common rules or principles. Thus various users will perform activity differently. In Poland, according to the activity maps and interviews, four types of users can be distinguished. Important is to notice that they are not identical, but they have a quite similar routine.

The first group of user would mostly disable the shading in the morning so as to allow daylight into the room and enable the shading again in the evening to protect their privacy and/or to ensure that they are not disturbed in the morning by incoming light (see Table 1).
Again from the answers as it was in the online survey, it is quite clear that privacy protection is crucial for many shadings' users. For example, on of them said: *"I have solar shading in the bedroom and living room because people are looking into my house, so I use it to protect my privacy"* (User 1).

	Activity Maps
User 1	Bedroom; Windows' orientation – East; Shading: outdoor blinds/ net curtains. March: Each day disable around 6-8 am > to get daylight in the room. Enable around 20:30 since is getting dark and to protect privacy. April: Each day disable around 4 am > I like to wake up with sun light. Enable around 21 since is getting dark and to protect privacy.
User 2	Bedroom; Windows' orientation – East; Shading: outdoor curtains/ net curtains. March: Each day disable partly between 9-11 am > to air out the room. Enable in the afternoon – sleeping baby and disable around 4-5 pm. Again enable it around 7-10 pm > to sleep better. May: Each day disable partly between 10-11 am > to air out the room. Enable in the afternoon – sleeping baby and disable around 4-5 pm (not always). Again enable it around 7-10 pm > to sleep better.
User 3	Bedroom; Windows' orientation – Northwest; Shading: indoor roller blinds March: Working day: disable at 7 am > to get daylight in the room and enable at 6 pm > protecting privacy. Free days: disable at 10-12 am > to get daylight in the room and enable at 5 pm > getting dark. May: Working day: disable at 7 am > to get daylight in the room and enable partly at 5 pm and fully at 9 pm> protecting privacy. Free days: disable at 1 pm > to get daylight in the room and enable at 9 pm> getting dark.
User 4	Living room; Windows' orientation – West; Shading: metal blinds/ net curtains March/May: Enable if is sunny afternoon around 3-4 pm until 5-7 pm > overheating protection.
User 5	Living room – North and East; Shading: indoor roller blinds March: Each day disable 7-8 am > to get daylight in the room and enable it around 6-7 pm > cosiness. One free day > enable between 10-12 am > sun is reflecting in TV. May: Each day disable 7-9 am > to get daylight in the room and enable it around 9 pm > cosiness.
User 6	Living room; Windows' orientation –South; Shading: indoor roller blinds/ net curtains March: Working day: disable at 6-7 am > to get daylight in the room and enable at 6 pm > protecting privacy. Free days: disable at 9 am > to get daylight in the room and enable at 6 pm > getting dark, privacy protection. May: Free days: disable between 8-10 am > to get daylight in the room and enable at 7- 8:30 pm> getting dark, privacy protection.

User 7	Living room; Windows' orientation –Southeast; Shading: net curtains May: sometimes user is disabling her net curtain to get better light in the room.
User 8	Bedroom; Windows' orientation – Southeast; Shading: indoor blinds March/May: sometimes user is disabling her blinds because the sun is disturbing her while sleeping longer in the morning or using computer in her bed. Not everyday.

Table 1 – the information about Activity Map from Polish participants.

The time when the shading would be enabled in the evening would depend on the time of the sunset that changes over the year and the weather conditions cloudy/sunny day.
When it is getting dark, the people usually will start to use an electric light that makes our place brighter, but it also makes our interior more visible from outside.
The change of the time according to the year time and weather conditions when solar shading is enabled is well visible on the activity maps of the User 6 (see Table 1/Appendix F). The first one was filled in during the first days of March, and the user was enabling solar shading around 6 pm o'clock stating that he needs to turn on the electric light. On the other hand, the second one, that was filled in during the first days of May, shows that solar shading was enabled at 8 pm o'clock or later during the sunny days. While on a cloudy day at 7 pm o'clock, always pointing out as the reason- demand for the additional lighting, thus privacy protection. Also, an important fact is that during the weekend/holidays, the time when shading is disabled is slightly later than the weekdays.

Additionally, in this case, the participants usually would not cover all of the windows in their homes as it will depend on the windows' orientation and what is in front of them. For example, one of the users said: "*In the kitchen, the window is in front the other building, and we do not want people to see us, also in my brother room as well we use it as a privacy protection"* (User 8).

The second group of users that I can distinguish from my research, use the solar shading for the overheating protection. Depending on the window orientation, the user would enable solar shading on the east – in the morning, on the south- around the noon time, and on the west – in the afternoon/evening.
Moreover, the participants who had problems with overheating stated that it is only during the spring/summer on a sunny day. One of them said that the sun in the winter is much lower, so she does not use blinds at all (User 4, see Table 1).
According to her (User 4) activity map (see Table 1 /Appendix F) which was done in the living room where the windows are oriented to the West, so the strong sun is in

the afternoon hours. On a sunny day, she would enable the blinds around 3-4 pm o'clock and disables again around 7 pm o'clock when the sun goes down. Even though she is using the shadings, the temperature in the room increased around 2 degrees in the afternoon hours.

The third group are the users with the small baby. The participants with a small baby (User 2) would disable party the solar shading between 9-11 am o'clock (see Table 1). They do not disable curtains straight away when they wake up since they are not in the room, so it does not disturb them. Moreover, around midday, approximately from 12 pm to 5 pm for about three hours, they would cover the window again because the baby is sleeping. This practice is not taking place every day as sometimes their son stays with his grandmother in her place.
Moreover, in the research also participated the other family with the small baby who does not enable the shading when the child is sleeping during the day. However, in their case, the windows are oriented to the north, so there is not strong light in the room see Appendix F).

The last group of the users are the ones who use the solar shading very unpredictable, without any daily pattern. For instance, one of them would enable the blinds when she wants to protect from the sunlight and glare that disturbs her during the sleep or to have a better view on her computer. This situation would not always take place every day, but very randomly as it is visible on her activity map (see Table 1/Appendix F).

Besides the described above patterns, there are some situations that users would use the shading in addition to the daily ritual.
One of the reason would be when the people use their computers or watch TV to have a better view. The of the interviewers as an answer to the question if there are any specific situation that you use solar shadings, besides daily ritual, said: "*When it is strong sun during the morning hours, and it reflects on the TV. Also when my wife is not at home, and I play on the computer*" (User 5).

Another reason which appears among the participants when they enable solar shading is while they are taking a nap during the day. However, this is not happening every day. One of the users, during the interview, said: *"Only, sometimes when my husband is taking a nap I need to put it down cause the sun shines and it disturbs him"* (User 1). Also, the other one stated similarly: *"For example, when I lay on the couch, and the sun is shining on my face I enable it"* (User 6). From these answers, it can be assumed that those users would allow solar shading during their nap time only on the sunny day (see Appendix F).

The last reason that activity on enabling and disabling solar shading is performed, besides the daily ritual, is privacy protection. Two of the users mentioned in the interviews that occasionally they would cover their window in the evening to do not allowed other people to see them. For example, one of them said: *"Sometimes I use the blinds in the kitchen while I am doing something in the evening to protect from people looking at me*" (User 5) (see Appendix F).
Moreover, in all the cases described above, the users in Poland mostly would have permanently cover windows with the net curtains as they give the feeling of nice and cosy (see Figure 15).

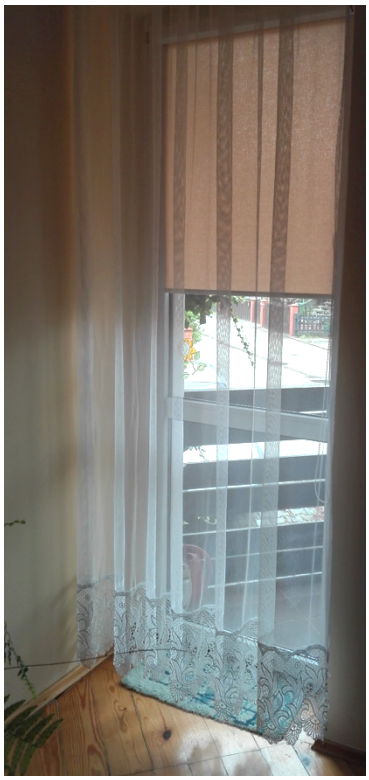


Figure 15 - Net curtain

In conclusion, even though, there are some similarities in the way how people use their shading, all of them are performed slightly different from each other. Since the use of shading depends on many unpredictable factors, such as weather or personal needs and/or requirements.

5.2.2.2 Materials involved in use of shading

The group of materials would be the same as described above in the section of the general material arrangement for Poland and Denmark. However, the use of it and its influence on the practice would have some differences, and some of them will be presented below.

As a first is a place of living and its surrounding that strongly influence their shading practices. Among the users from Poland, few of them said that they protect the privacy in some rooms because they are in front of the other apartments' blocks or they are living on the ground floor, so people passing by can easily look inside (User 1,6,8).
Moreover, the level on which the flat is situated for some users might also change the practice, as one of the interviewers said: "... *not many people can see me on the fourth floor*" (User 5), so she does not need to use the shading for the privacy protection. However, she uses it for the overheating protection because her windows are more exposed to the sun.

	Rooms where solar shading is installed and the reason	Type of the solar shading. Why?	Easy to use?
User 1	Bedroom – privacy, decoration Living room – privacy, decoration Kitchen – privacy, sun protection, decoration Bathroom – privacy Office room- sun protection	Indoor blinds- cheap Outdoor blinds- security Net curtains- decoration	Yes
User 2	Bedroom – light control (better sleep), Living room – cosiness, sun protection	Curtains, net curtains – nice and cosy	Yes
User 3	Bedrooms – privacy, sun protection Living room – privacy, sun protection, decoration Kitchen – privacy, sun protection	Curtains, indoor roller blinds, metal blinds and vertical blinds	Yes
User 4	Bedrooms – overheating protection, decoration Living room – overheating protection, decoration Kitchen- overheating protection, privacy, decoration	Metal blinds – it was most popular type when I was installing the shading Curtains and net curtains – looks nice	Yes, but difficult to clean
User 5	Bedroom – light control (better sleep) Living room – sun protection	Indoor roller blinds – there where already installed when I moved in.	Yes
User 6	Bedroom – light control (better sleep). Living room – sun protection, privacy	Roller blinds – modern and cheap when I was buying them	Yes
User 7	Bedroom/living room – light control (better sleep), overheating protection Kitchen – overheating protection	Curtains and net curtains – looks nice, cheap. Roller blinds – good protection	Yes
User 8	Bedrooms- overheating protection, privacy Living room- overheating protection, glare protection, decoration Kitchen- privacy	Roller blinds, blinds, net curtain – looks nice and are functional	Yes

Table 2.1 - the information related to use of shading in Poland that was gained from eight users through interviews.

Furthermore, depending on the reason of solar shading, many of things located in homes but not only, can become the material part of the practice. For example, if the user uses the shading to have a better view on the computer screen, then the computer becomes also the material part of the practice.

In the practice of using the shading in Poland, the windows which are the second main material would have an impact on the activity. Depending on the orientation of it, the reason and time of the usage would be different. For example, one of the participants (User 8), on one side of the flat would use the shading for the privacy protection while on the opposite for the solar heating protection (see Appendix F).
Moreover, a location of the window regarding the type of room will have an impact on the practice in Polish homes. Some of the interviewers have a solar shading in various rooms for different reasons, as stated by one of participant: *"In the bedroom, I have them because it has to be enabled when we sleep and during the day when the child is sleeping. In the dining room, I have curtains because it looks nice and cosy. Also, I use it sometimes when the sun is shining" (*User 2) (see Table 2.1/Appendix F).

Regarding the shading itself, in Poland it is very common to have more than one type of shading on the window, very often it is a combination of two or even three different. For example, one of the users has blinds, a curtain net and a curtain (User 4) (see Tbale 2.1).
Moreover, the type of solar shading would usually vary depending on the room, like User 7 who has indoor roller blinds in the kitchen while in the bedroom/living room she has a combination of curtains and net curtain. She said: "*I have indoor roller blinds in the kitchen because I do not have any other window covering and in the bedroom, I am planning to install blinds, but for now the curtains were cheaper option"* (see Appendix F).
Also, the other user stated: "*In some of the rooms, I have indoor blinds as they are cheaper. Moreover, there is no need to be outdoor blinds as the rooms are on the first floor. In the living room that is on the ground floor are outdoor blinds because of security reasons. The same are in the bedroom because there is a balcony"* (User 1) (see Appendix F).

Additionally, the net curtains that very often occur in Polish homes, have various forms, some of them would cover the window completely, while others only half. Some of them would be more transparent than the others.

5.2.2.3 User's competencies for the use of shadings

To perform the practice each of user needs to have skills and knowledge on how to do it.

Regarding using the shading, the first competence would be the personal ability to choose the shading that would fulfil the users' requirements and need.
For example, some of the users (User 1's wife) would sleep better when the room is completely dark. Therefore, it is important that they know which type of shading would completely block the accesses of the light to the room (see Appendix F).
Sometimes the choice might be wrong, and in the future, this can result, e.g. with uncomfortable indoor temperature as it was for the User 2 who chose her shading before moving in. During the interview, she stated: "*The true is that my current solar shadings are not very functional and we should have the blinds that would prevent the overheating and we are planning to install one soon. This flat is getting hot during the summer. However, I would still keep the net curtains as I like it a lot*" (see Appendix F).

	Overheating problems	Everyday use	Specific situations when SS is used	Disable when no longer needed
User 1	Yes in some rooms	Yes	Sometimes during the nap	Yes
User 2	Only in the summer.	Yes	Privacy, Light/ glare protection while using computer/TV	No- not using the room
User 3	Only in the summer.	Yes	Light/ glare protection while using computer/TV	No-laziness, like when is dark
User 4	Yes	No	Privacy	Yes
User 5	No	Yes	Light/ glare protection while using computer/TV	No- laziness, luck of time, not home
User 6	No	Bedroom- Yes Living room- No	Glare protection	Yes
User 7	Yes	No	Sleeping longer	Yes
User 8	Only in the summer.	Depends on the room	Light/ glare protection	Yes

Table 2.2 – the information related to use of shading in Poland that was gained from eight users through interviews.

After choosing the right shading, the user needs the knowledge and skills on how to install it on the window. Most of the indoor system are provided with the instruction that allowed the users to fix it by themselves. However, more complicated systems, such as outdoor blinds or the curtain rod would require more professional skills or the specialist to do it.

Furthermore, according to the interview, the use of shading is very easy for all the participants (see Table 2.1/Appendix F). For that reason, it will not require any special training or skills.
The knowledge of using more complicated systems, such as, indoor blinds that allow adjusting the angle of the elements can positively contribute to the better visual condition of the room. For instance, if the user knows how to set the angle of the blinds' elements properly, he/she can protect the room from the glare but at the same time have excellent lighting conditions.
The use of shading for many of the users, it is very routinized behaviour that in some of the situations. For instance, the use of shading for the night, it is strongly connected to the other practices, such as sleeping or using electric light, and it will be talked over in the discussion chapter.
Moreover, the practice of using the shadings can be carried out by people in almost all ages if they can reach the mechanism controlling them or in a case of curtains the shading itself.

Also, according to the collected data from Poland, the users' knowledge about positive contribution to the lower energy consumption by using the shadings is quite broad. However, most of the users would not consider it as the main factor while using their shading. Usually, among the interviewers, the use of them was connected to their feelings and needs that would be described in the next sub-section (see Appendix F).

Since the competences part of this practice does not have any limitations or rules that would significantly impose the way it should be performed, the knowledge and skills can be very various.

5.2.2.4 The meaning of using the shading

Very often the way that Polish people use the shading is related to the meaning of the use, thus their needs and requirements. The importance would also be strongly connected to the users' competencies that allow them to use it correctly depending on the situation.

For example, if the user has the solar shading for the overheating protection, he/she would be required to enable it on the window that is exposed to the sun, afterwards, disable it when is not longer needed.

	Indoor climate (temperature/ lighting conditions)	Well-being	Daylight	Automatic solar shading
User 1	Temperature – overheating (some rooms) Lighting conditions- sleeping	Yes – I like light in room so I prefer to have them open	If they are closed is getting very dark	Yes/No
User 2	Temperature – No use Lighting conditions- sleeping	Yes - privacy, decoration	Yes, in he bedroom is getting dark	Yes
User 3	Temperature – No use Lighting conditions- like when is dark	Yes – like darkness, privacy	Yes it makes room dark.	No- I do not need it.
User 4	Temperature – overheating Lighting conditions- no	No	No	Yes
User 5	Temperature – overheating Lighting conditions- sleeping, use of computer/TV	Yes- better sleep, cosiness	Influence but no need of electric light	Yes/No
User 6	Temperature – rarely overheating Lighting conditions- use of computer/TV	Yes- privacy	Influence but no need of electric light	No
User 7	Temperature overheating Lighting conditions- No	Yes- I do not feel good and prodactive when is too hot	Influence but no need of electric light, besides if I would like to read	Yes
User 8	Temperature overheating Lighting conditions- use of computer/TV	Yes- I do not like when is too hot	Yes – I use electric light quite often	Yes

Table 2.3 – the information related to use of shading in Poland that was gained from eight users through interviews.

There are several reasons on why Polish people will have and use the shading. Even for some of them, the fact of having shadings would be obvious (User 3).

According to the interviewers from Poland, mainly it would be to create better sleeping conditions and/or protect privacy. As stated by one of the participants: *"I have shading in the bedroom to sleep better and in the living room to protect privacy so when I turn on the light or TV, people will not be able to see me from outside and what is happening inside."* (User 6) (see Table 2.1/Appendix F).

Another reason that has importance to people, it is to prevent uncomfortable temperatures in a side of the room by using the solar shading. One of the users said: *"On the hot days, solar shading helps me to prevent the overheating in the rooms. In the winter I do not close it (…)"* (User 1).
On the other hand, two of the users noticed that solar heating is beneficial during the winter time and it is better to keep the shading disable. The interviewer said: *"In the winter the solar heating is good, so we do not have to use more energy from the gas to warm up space.* (User 1's husband) (see Appendix F).

Furthermore, the use of shading helps the users to control lighting conditions in the room. Sometimes, it will be to protect from the glare while sleeping, watching TV or using a computer. However, other time it will be just to feel better, as one user stated: *"I like when is dark"* (User 3) (see Appendix F).

Additionally, the solar shading, especially, for the women, are the significant elements of the room décor. It gives to rooms the feeling of a nice and cosy environment (see Appendix F).

Moreover, there are several reasons on why people would not disable their shading when is not longer needed (see Table 2.2). For instance, one of them said: "… *Very often when I use solar shading during the day to do not have the sun in my face, I have to put electric lights on and sometimes my mother gets angry that the sun is not so strong anymore and it does not shine on my face, so the additional light is not necessary as it is still enough light outside.*" (User 8) (see Appendix F).
On the other hand, the other user mentioned that when he and his wife leave the house, and it is still dark, they do not disable their blinds.
Both of the situations above, can unnecessary increase the energy consumption. In the first one, because of the user laziness while using electric light when the daylight is still sufficient. Moreover, in the second one that more likely would take place during the winter months when the sun rises late. On the sunny days, this would have an adverse impact on the power use for the space heating if the users would not come home for the whole day. It is very beneficial to use the solar heating during the winter to minimise the use of an additional heating to warm the space.

Today, there is a tendency to make automatic systems to less involved the users. By optimising the performance of selected devices, the designers aim to make the users' lives easier. In some cases, these systems can also contribute to lower energy consumption if designed with a focus on sustainability. In regards with the interviewers, in Poland people seem to be interested in having an automatic solar shading (see Table 2.3) which would enable/disable according to the outdoor/indoor temperature, to prevent the overheating in the room.
Notwithstanding, some of the participants would have additional uncertainty or requirements. For example, one of the users said, *"I would like to have atomised solar shading, but probably I would be afraid that it will get broken or it will not cover the window when it is necessary"* (User 4). Her doubts can be related to the age that is 75 years old, so she does not have the custom to use automatic systems or even electronic devices in general (see Appendix F).
On the other hand, another one stated that he would have it only if there is also a possibility to control the solar shading in other situations manually and to make own configurations.

The amount of personal needs and requirements among the users of shading can be quite significant and difficult to predict.

5.2.3 Use of shading in Denmark

The use of shading in Denmark was investigated in six Danish homes. All of them were located in Copenhagen city and its suburbs. Each of the participants filled up two times the activity maps and participated in the interviews. The short outcome of the results of both methods will be presented along analyses in the Table 3– Activity Maps, and Tables 4.1, 4.2, 4.3– Interviews.

5.2.3.1 Time and reason of using the shading

In Denmark, the use of solar shading as well would depend on similar factors as in Poland, and four general patterns can be distinguished, almost the same as Polish one.
However, interviews show that the use of it seems to be way even more related to individual needs than the weather conditions, such as, solar heating protection, what was for almost all Polish participants an issue during the summer.

The first group of users that also was the most common one among the interviewers in Poland would disable shading in the morning and enable it in the evening. In Denmark, this situation would mostly take place in the bedrooms. Some of the users stated that they do not like to be disturbed with sunlight in the morning and this become an issue, especially, during the summer since the sun rises even at 4 am (User E) (see Appendix G).
According to the activity maps older users would have a more constant ritual when they disable/enable the shading, even during the weekend days when they do not have to go to work. Usually, they will disable them around 7-9 am in the morning and enable in the evening when they go to sleep (see Table 3).

	Activity Maps
User A	Kids' Bedroom; Windows' orientation – Northwest; Shading: Ikea blackouts (white) March: Each day disable only 1 or 2 out of 3 around 7-8 am > to get daylight in the room. Enable around 6-7 pm since kids are going to sleep (not always as they are sometimes at grandmother's place). April: Each day disable all around 7-9 am > to get daylight in the room. Enable around 7 pm since kids are going to sleep.
User B	Livingroom; Windows' orientation – North and South; Shading: curtains March: Each day disable around 7-8 am > to get daylight in the room. Enable in the evening around 9 pm > cosiness. May: Each day disable around 7-8 am > to get daylight in the room. Enable in the evening around 10pm > cosiness.
User C	Dorm room; Windows' orientation – North; Shading: metal blinds March: Working day: disable around 9 am > to get daylight in the room and see outside. Enable variously> to avoid the daylight in the morning, to have privacy. Free days: disable at 10-12 am > to get daylight in the room and and see outside. Enable variously> to avoid the daylight in the morning, to have privacy. May: Working day: disable around 8-9 am > to get daylight in the room and see outside. Enable variously after 10 pm> to avoid the daylight in the morning, to have privacy.
User D	Living room/Bedroom;; Shading: curtains down/up May -LR: Enable if is sunny day and working on the computer or watching TV. Mostly open. May -B: Working day: disable at 7 am > to get daylight in the room and see outside. Enable around 10 pm> to avoid the daylight in the morning. Free days: disable at 9 am > to get daylight in the room and and see outside. Enable

	variously 6-12 pm> to avoid the daylight in the morning, to have privacy.
User E	Living room; Windows' orientation – South; Shading: modern curtains March/May: Enable/Disable variously all the days. No routine.
User F	Bedroom; Windows' orientation –Northwest; Shading: pull down curtain March: Working/free day: disable at 7-8 am > to get daylight in the room. Enable half around 7 pm > sun protection. Enable fully around 10 pm > privacy protection. May: Working/free day: disable at 7-8 am > to get daylight in the room. Enable half around 6-7 pm > sun protection (only sunny afternoons). Enable fully around 10 pm > privacy protection.

Table 3 – the information about Activity Map from Danish participants.

The second type of the users that can be defined in Denmark would be very similar to the previous one. However, it only refers to the room where the children sleep. The time when the user enables the shading would not depend on the time when it is getting dark, but the time when the kids go to sleep (User A). The User A's Activity Map was filled up in her kids' room, where she needs to enable solar shading around 7-8 pm to put the kids to sleep. She said: *"… I think without the solar shading; it would be challenging to put kids to sleep when the room is still very bright."* (User A) (see Appendix G).

Moreover, she puts one of her children to sleep also during the afternoon for about 2 hours, so if it happens at her home, she will use the shading to make the room darker. Nevertheless, it is not daily routine as her kids are often in the other place.

Figure 16 - Outside view on User E windows.

The third group of users would use the solar shading to protect from overheating. In Denmark, only two of the participant said that they would use the shading for that reason. For one of them, it would only take place during the summer in the living room since the windows are oriented to the south. While, the second user, said: "*In the summer I have a bit problem with overheating in the living room and also in July in my room which is on the other side because the sun heats a lot in the morning even through the curtains. They do not*

stop the solar heating or light that well." (User E) (see Appendix G). In this case, the problem with uncomfortable indoor temperatures can be connected to quite big windows, some of them also oriented to the south (see Figure 16).

The last group of user would enable/disable the solar shading variously during the day. The reason for this would mainly be to protect from the glare or the daylight to have a better view on their computer/TV screen or to sleep longer in the morning.
For example, one of the users would have enabled curtains most of the time, firstly, because he lives on the ground floor so to protect his privacy. Secondly, he has huge windows that, even though they are covered, the room is bright enough to do core activities, but also it provides him better conditions to use his computer. Thus, according to his Activity Map, he disables curtains only when he wants to air out home and get additional light what in total would be around 2-6 hours between 9 am to 5 pm (see Table 3/Appendix G).

On the other hand, another user usually enables the shading for the light protection during the night/morning (User C). However, since she has not stable schedule (not working), the time when she enables/disables the shading is very various, in the morning it can be even five hours' difference between two different days. Her Activity Map was filled up very diversely in each of the days so she cannot be considered as a first group user, even though, she enables shading for the same reason(see Table 3/Appendix G).

Moreover, the same as in Poland, each of the users also would sometimes use the shading besides the daily ritual. For example, on of the user would disable his solar shading in the living room only during the sunny day to get a better view on the laptop or TV (user D). However, it has to be noted that this would not be an issue on every sunny day (see Appendix G).
Another situation beyond the ritual behaviour would be the naps during the day. However, according to the some of the participants, they would take them only on the weekend days or holidays.
One more exception was described by one of the interviewers who said: "*Maybe sometimes I would use my blinds if I do something that I do not want the neighbour to see me. I have to close them since the other buildings are very close. For example, the other day I was changing clothes, and it was a sunny day so people were outside on their balconies in front of my window so they could see me better."* (User C) (see Appendix G).

5.2.3.2 Materials involved in use of shading

The materials involved in the practice of using the shading in Denmark would also be the same as in the section of a general material arrangement for Poland and Denmark. However, there are slight differences in comparison to Poland on how the Danes used them and how their influence the practice.

Also in Denmark, the first material part of the practice would be a place of living. Here, some of the participants live in the apartment building in the city centre while the others live in blocks of flats or housing in the city suburbs. Even though in the city building are usually located close to each other the users rarely would need to use shading to protect their privacy. The exception would be the User E who lives on the ground floor and has unusually big windows facing to the sidewalk (see Figure 16).
The other users might use it occasionally, like User C who use it sometimes when people are sitting on the balcony in the building in front of her window. In this case surrounding of the place of living would only change the practice in some specific situations, not every day.

	Rooms where solar shading is installed and the reason	Type of the solar shading. Why?	Easy to use?
User A	Bedroom – light control (better sleep) Living room – not used	Blackout roller blinds – make room very dark.	Yes/No depends on the model
User B	Bedroom – light control (better sleep), privacy Living room – privacy, cosiness	Curtains - old fashioned, easy to make.	Yes
User C	Bedroom/living room – light control, sometimes privacy	Metal day/night indoor blinds – were installed before user move in.	Yes
User D	Bedroom – light control (better sleep) Living room – glare/light control	Open up/down white curtains – do not take much of the space and they are functional	Yes
User E	Bedroom – light control (better sleep), privacy, overheating Living room – light control, privacy, overheating	Sliding modern curtains – looks nice and easy to install	Yes

User F	Bedroom – light control (better sleep), privacy Living room – overheating, glare protection	Roller blinds – make room very dark (bedroom) Semi transparent blinds – allow the access of the light even used during the day (living room)	Yes

Table 4.1 – the information related to use of shading in Denmark that was gained from six users through interviews.

In material part that is a place of living also the things that are located inside of the user homes might become the equipment of the practice. For instance, when the Danes use shading to protect from the light while they sleep, the bed would become the material part of the practice.

Secondly, the material part would be a window that is an inseparable component of the residential buildings. According to the interviewers from Denmark, the size of windows and their location will definitively change the practice.
The User E who has big windows on the ground floor needed to protect his privacy most of the time by using shadings.
Moreover, the users with windows located to the south mainly would use the solar shading to protect from the solar heating and/or glare (see Table 4.1). Others stated that if they have problems with uncomfortable temperature in the room would rather open the window than use the shading. This might be a good solution if the temperature outside is not higher than a comfortable internal one.

Regarding the shading type that occurs in Danish homes, people mostly have only one type of shading installed on the window. Usually, in the bedroom is the one which will block as much as possible the access of the daylight while in the living room the one which would only protect from the glare but at the same time allow the influx of daylight to the room. Also, there are cases that they are the same in all home, like in homes of the User D or E (see Table 4.1).

5.2.3.3 User's competences for use of shadings

In Denmark, the competences part of the practice would be the same as in Poland. The knowledge to choose the right shading might contribute positively to our well-being. For example, in Denmark, one user who had no possibility of choosing the shading by herself, said: *"The metal blinds were already installed in the room, but it is not good for me because it is not making the room dark enough during the night. I have a problem with sleeping well if the room is not dark completely. Those are not*

covering window enough from any daylight or even lamps outside." (User C) (see Appendix G).

Moreover, for some of the users' choice of the shading has also different reason, like mentioned by one of the user: *"(…) I think it has something with generation. I guess we are too old fashioned and also because my wife was sewing curtains by herself and that is traditional way. We did not find a need for change it."* (User B) (see Appendix G).

Sometimes the choice can be related to the future need of installing it. As mentioned in Poland part of knowledge and skill that this practice requires is the ability to fix the shading on the window. Among the interviewers, one participant mentioned that he chose this particular curtains because they seem easier to install (User E).

Regarding the use of the shading, all of the users stated that is very easy. Besides one of them who said: *"Yes, the one which you can scroll with the string that we have in my bedroom. However, in my kid's room, we have a new version, that does not have a string, and I have to climb on the sill to pull it down. I could have put the string to make it easier since they roll up by themselves but I did not."* (User A) (see Appendix G).

	Overheating problems	Everyday use	Specific situations when SS is used	Disable when no longer needed
User A	No	Yes	Child sleeping	Yes
User B	No	Yes	Non	Yes
User C	No	Yes	Privacy (changing clothes)	Yes
User D	No	Bedroom- Yes Living room- No	**Light**/ glare protection while using computer/TV	Yes, I like to see the life outside
User E	Only in the summer.	Yes	Light/ glare protection while using computer/TV	Yes, but I think I need it most of the time
User F	Only in the summer.	Bedroom- Yes Living room- No	Weekends naps	Yes

Table 4.2 – the information related to use of shading in Denmark that was gained from six users through interviews.

Moreover, the knowledge that user have about shading use can be very various and depend on the user needs and requirements can help to create better indoor climate. It also can contribute to lower energy consumption, for example, by using the solar shading instead of the cooling devices to protect from overheating.

One of the users stated that during the summer he has uncomfortable indoor temperatures, even though Denmark is a country where the outdoor temperature rarely rises above comfortable indoor temperature. The reason of this is big windows in his newly built apartment (see Table 4.2).
Today, to provide better indoor lighting conditions, people design and build buildings with more glazing what contributes to faster heating of the rooms.

However, the same user also pointed out that: "*… a few months ago when it was still very cold outside the sun was heating our interior very well.*" (User E). In this case, the bigger glazing surface would have a positive influence.
Thus, the newly built housing with extensive glazing can have a highly beneficial impact on the energy consumption, especially in countries like Denmark, firstly, because it would give a considerable amount of the desired daylight in our rooms, what can reduce the use of electric light. Secondly, it can reduce the energy consumption for the heating during the sunny cold days which are significantly more widespread than the hot weather.

5.2.3.4 The meaning of using the shading

The last component of the practice- meaning, describes the users' idea of what the activity is good for. For all the interviewers from Denmark, use of shading aims to help to create better sleeping condition what means as less as possible access to the daylight.
Secondly, Danes use the solar shading to protect their privacy. However, they do it predominantly in the bedrooms. As User B, who lives on the ground floor said: "*No, people do not look inside unless they want to knock on the window to say something. Also, it is seen impolite do it"* (see Appendix G).

As a third reason, just a few of them would use the solar shading to protect from overheating.
Moreover, in some cases, to fulfil their needs or requirements, the users would not disable the shading when is not longer needed. Nevertheless, in Denmark, all of the participants stated that they always do it. For instance, User D pointed out: "…*For example, when I watch a movie I would open it right after it finished. I do not like to be in close space I like to see life outside."* (see Appendix G).

Furthermore, according to the interviews and activity maps, for Danes, the daylight influx is crucial. The use of solar shading helps them to control it if needed. Mostly the type of solar shading that users use during the day would allow enough access to the light. Thus, according to the interviews, Danes rarely would use an electric light while using the shading for some other reason, such as privacy, when it is still possible to use daylight. The exception is User B who, even though, is not using his curtains would quite often use additional light during the day. The reason of it is an insufficient number of windows and need of good light at his age (see Table 4.3).

	Indoor climate (temperature/ lighting conditions)	Well-being	Daylight	Automatic solar shading
User A	Temperature – No use Lighting conditions- sleeping	Yes - help to put kids to sleep , better sleep	Influence but no need of electric light	Yes, easier life
User B	Temperature – No use Lighting conditions- sleeping	Yes - better sleep, cosiness	SS is not used during the day, however electric light is used for other reason	No, no need
User C	Temperature – No use Lighting conditions- sleeping	Yes – better sleep, privacy	Influence but no need of electric light	Yes, but if it will make the room darker than current
User D	Temperature – No use Lighting conditions- sleeping, use of computer/TV	Yes – better sleep, cosiness	Influence but no need of electric light	Maybe in my future house
User E	Temperature – overheating Lighting conditions- sleeping, use of computer/TV	Yes- better sleep, privacy	Influence but no need of electric light	Yes, easier life
User F	Temperature overheating Lighting conditions- sleeping, glare	Yes- better sleep	Influence but no need of electric light	Maybe

Table 4.3 – the information related to use of shading in Denmark that was gained from six users through interviews.

In regards to user desire of having an automated solar shadings' system, the responses were mixed (see Table 4.3). For younger participants, they think it would be a great solution. According to the young respondent who said: *"That would be*

awesome. I would not have to think of it. Also, I will not have to climb on the sill to enable it in kids' room." (User A) Also, another user strongly agreed with the idea of an automated system: *"Yes, because it would save me few additional movements and new generations are used to the things that do things for us."* (User E). There are, however, elderly users who said: "*No, we do not feel a need for it*." (User B) (see Appendix G).

Even though some of the users would be interested in having an automatic solar shading, it would be necessary to keep in mind the users' priorities, such as light protection when they sleep, privacy and many others that usually depends on individual needs, and would be always prioritized higher by the user than the lower energy consumption.

5.2.4 Conclusion of shading use in Poland and Denmark

In both countries, the use of shading is quite similar and mainly depends on the personal needs and requirements that are usually related to the other practices such as sleeping or watching TV. Also, it is quite often connected to user's lifestyle. For example, users who have stable jobs usually have more routinized everyday lives, i.e. where they do things at specific times. Moreover, it appears that people rarely consider the effect that shading may have on energy consumption, even though they say, they know that the use of shading can contribute to energy savings.

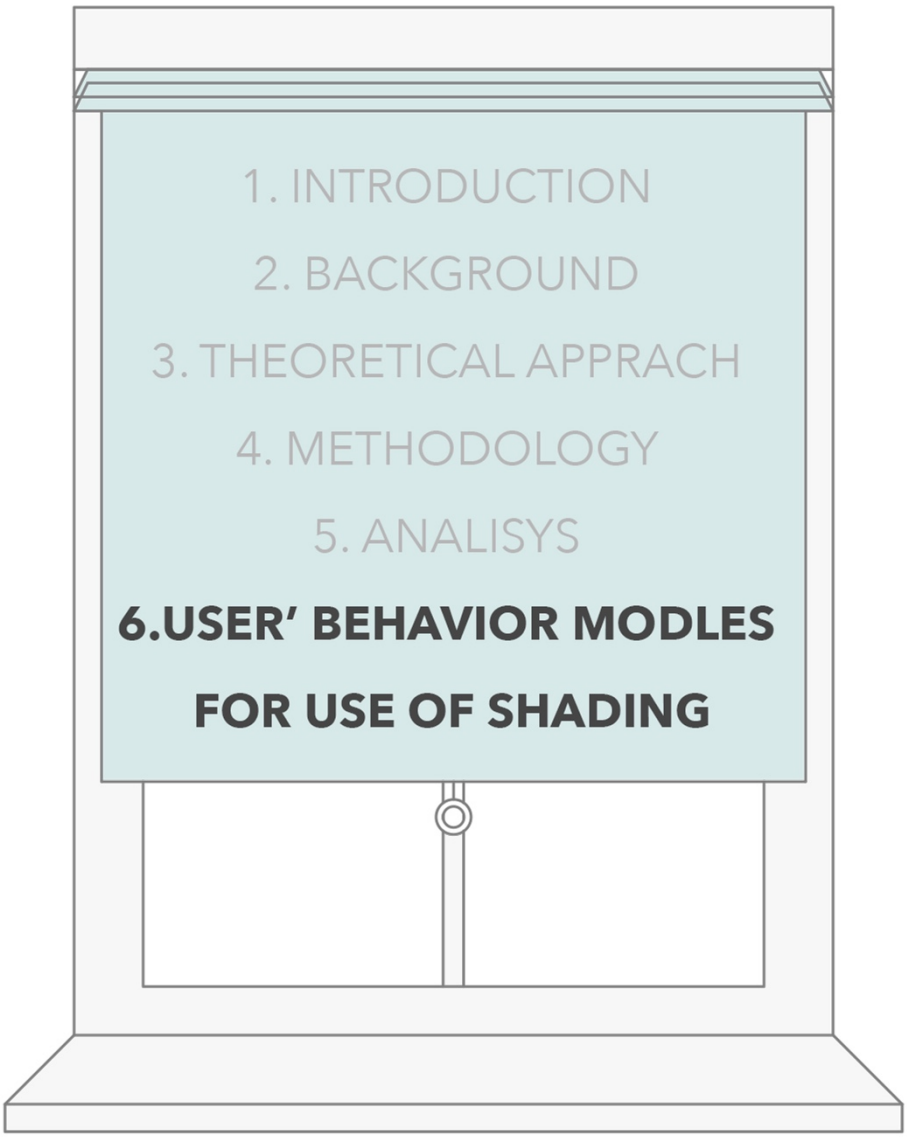
The time and reason of using the shading are very similar, and some common types of practices can be distinguished.
However, slightly more people in Poland would use the solar shading for overheating protection. This is presumably due to Polish weather conditions, i.e. a larger number of the days with outdoor temperatures rising above comfortable indoor ones.
Moreover, in Poland, the material part of the practice would slightly vary from the Danish one. The most visible difference is regarding the type of shadings. In Poland, it is very common that users have a combination of several kinds in the same window, e.g. curtain and net curtain. While in Denmark it would be only one type.
Also, if the shading is not in use, the windows in Danish homes are usually without any other covering while in Poland, they usually will be cover permanently with a net curtain.

Furthermore, there are no significant differences in the competencies part among the respondents in the two countries. Users from both countries stated that the use of shading is very easy and it does not require any special skills or training.

Concerning meaning part attributed to the practice, in both countries, the use of solar shading would contribute to the better sleeping conditions. Also, it would provide better circumstances while using computer or TV.
Regarding privacy protection, solar shading would have greater importance for Polish people than Danish, what can also be a reason of permanently used net curtains.
Additionally, in Poland, people bring more attention to the solar shading as a decoration part of the room.
Also, more frequently Polish people would not disable the shading when is not longer needed what sometimes negatively contribute to energy consumption.

In both courtiers, the desire of having automated solar shading system was various. Some of them would not feel a need of it, while the others would appreciate it but only if there is a possibility of adjustment to their needs and requirements.

Summarising, the way that people use the shading is very personalised since this practice is not limited by any common rules or principles. Thus, it is beyond the bounds of possibility to distinguish one common model of the shading usage.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The Velux company is seeking to improve their simulation tools by implementing an adequate user behaviour models of the use of shading to their programs. According to my research, four different users can be distinguished. However, it has to be pointed out that these models would never reflect the user behaviour 100%. Also, users can perform more than one model at the same time. For example, a person can always enable/disable shading for the night and also use it sometimes for overheating protection.
Moreover, the choice of model will be strongly related to Windows' orientation and the surrounding.

The first model, it would be a user who enables the shading in the evening, mostly after the sunrise and disables in the morning when he/she wakes up. The time of enabling is also related to the fact that he/she would be using electric light which makes the room more visible from outside, thus covering the window would protect his/her privacy. Moreover, enabling shading for the night aims to improve the sleeping conditions. Users stated that they sleep better if they are not disturbed by any influx of the light, especially in the early morning during the summer months.
Primarily, this model would be represented by people who have stable job and work every day at the same time. Also, it would reflect the elderly users' behaviour who's lives are quite often ritualised.
Additionally, the time of disabling in the morning would be slightly different at the weekend time.

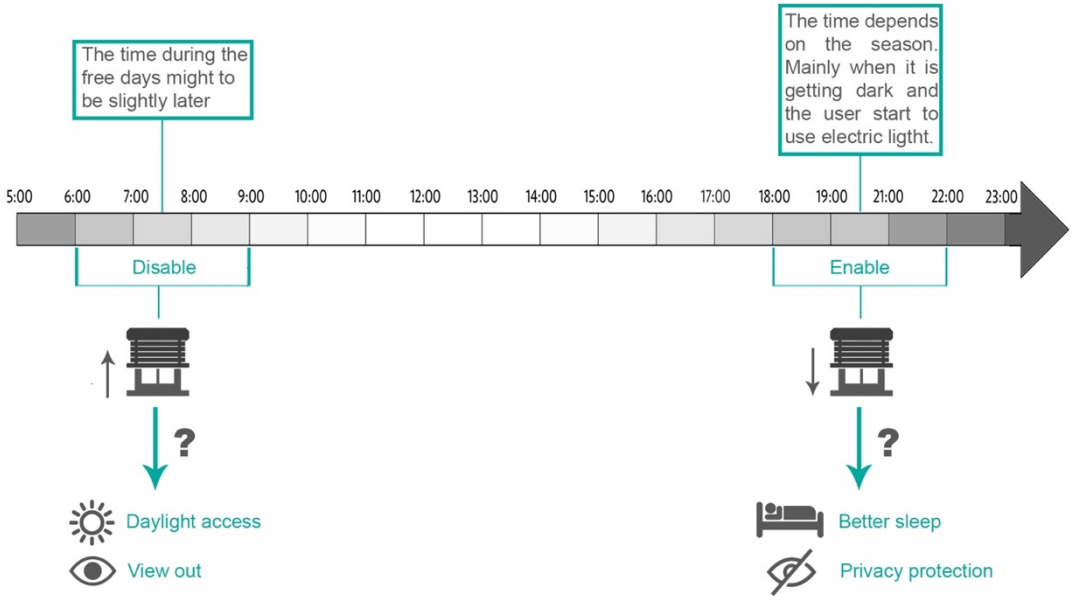

Figure 17 – The first users' behaviour model for the use of shading

The second model is quite similar to the first one. However, the user would additionally enable the shading for 2-3 hours between 12-17 o'clock. This model would more likely reflect the user who has a small baby that still sleeps during the day. Nevertheless, in many of the cases, this would not take place in the users' house, every day. As my research shows, the kids quite often are staying in someone else place during the day time.

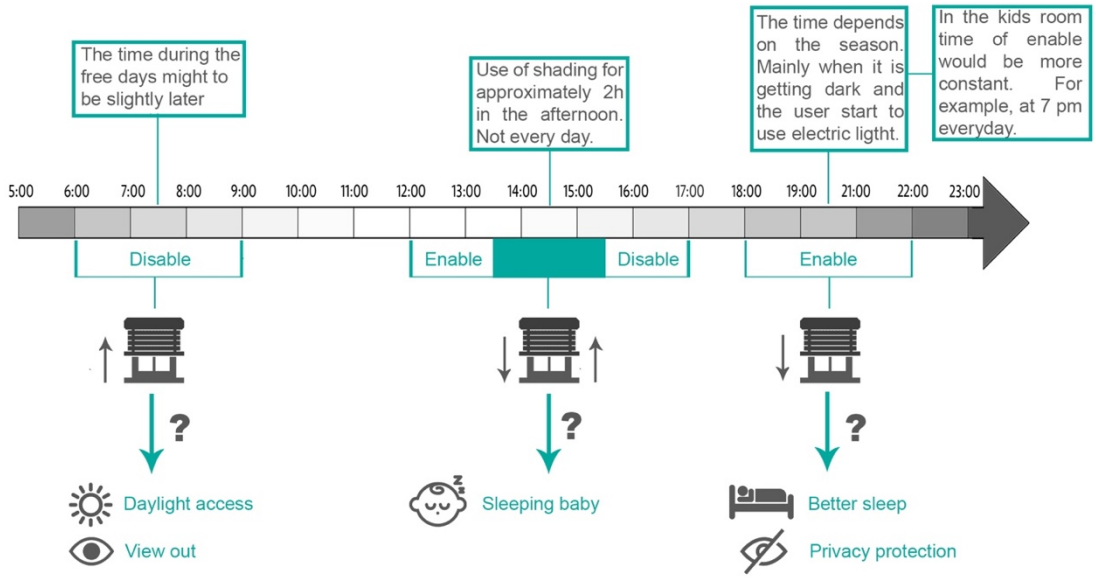

Figure 18 - The second users' behaviour model for the use of shading

The third model will represent the user who enables the shading to protect from the solar heating. The user only will cover the window during the summer months on a sunny day. Depending on the window orientation, users will enable the solar shading at different hours. In the morning, it will take place on the windows oriented to the East, at noon to the South and in the afternoon to the West. Here, the important fact would be that this will not take place if the user is not at home.

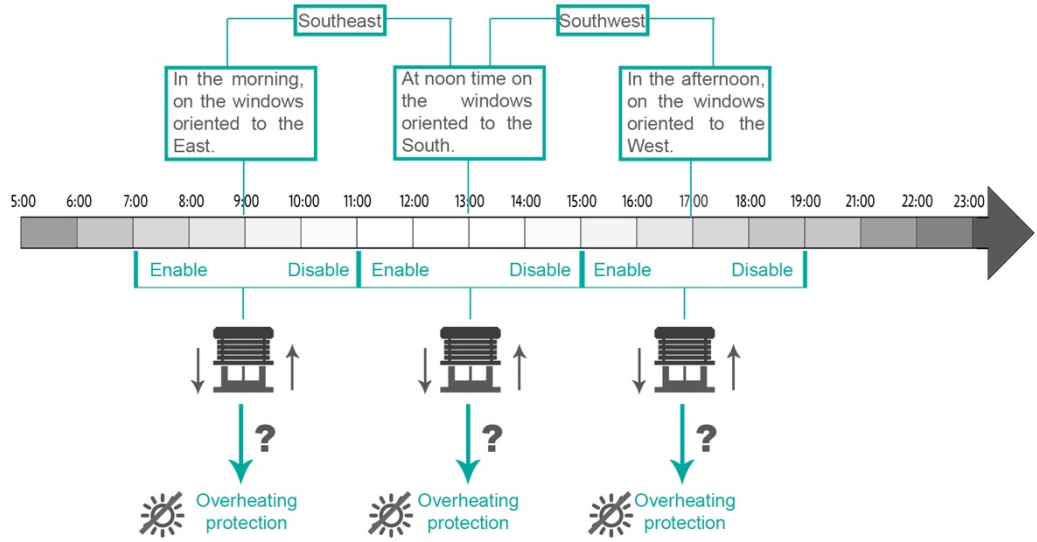

Figure 19 - The third users' behaviour model for the use of shading

The fourth and last model does not represent any particular user. It will describe the person who enables/disables shading variously. Some of the users would do it every day while others only a few times per week. One of the reason can be the same as in the first model, however, in this case, she/he will use the shading every day at the different time since he/she wakes up and go to sleep at various hours. The other person could be the one who uses shading just when she/he is disturbed by light or glare while using a computer / TV.

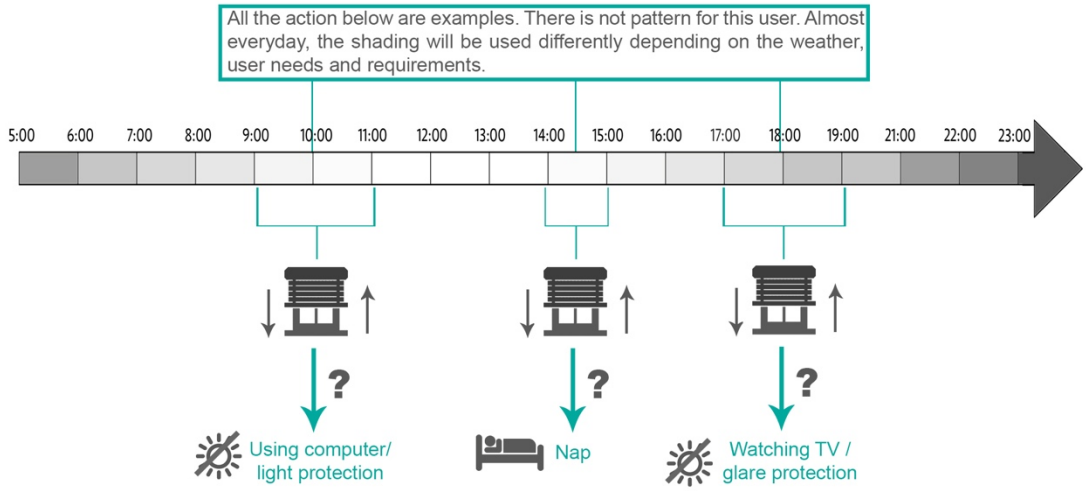

Figure 20 - The fourth users' behaviour model for the use of shading

The reason for using shading quite regularly, however, at different times can be very various, and it will depend on the individual user.
Moreover, all of this models can be interrupted by some specific situations that are not the part of the daily ritual. It is also difficult to predict how often they will take place.

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7. DISSCUSION

In this chapter, I will start from reflation upon implementation of users' behaviour models, described in the chapter above, into the simulation programs. Afterwards, I will present other possibilities of improving the energy performance of the building. In the next sub-section, I will explain the differences between Poland and Denmark. Then I will discuss the relation of use of shading practice with other practices. At the last point, I will reflect upon my approach, emphasising on methodology choice.

7.1 Difficulties of implementation the users' behaviour models into simulation programs

Implementation of users' behaviour models of the use of shading into the simulations' programs would be very challenging since there are no same users.
Even though several common models (see Chapter 6) can be distinguished, the engineers who are doing the simulations of the buildings, need to acknowledge which one would mostly represent the future inhabitants.
Moreover, the presented models are very unstable. There is no confirmation that user would always repeat activity in the same way. Especially because the condition under which people use solar shading is changing with their age, the lifestyle, the surrounding of the place they live and with whom they live. For example, the life of the young people is more dynamic and would have a repetitive ritual less frequently, while older people are usually already used to some habits. Also, it is important to acknowledge that various inhabitants of home can use shading differently.

Without the future knowledge about the inhabitants of the place and their general life, habits, needs and requirements, implemented models might still provide incorrect results of the buildings' simulation. The practice of using the shading is very personalised, and it would never reflect the models for 100%. Therefore, other solutions should also be considered to improve the energy performance of the buildings.

7.2 Other solutions to improve the energy performance of the building

Since one of the future Velux's project is to apply Active Homes concept into existing buildings, the simulation would be conducted while already knowing the occupants of the place. It would be beneficial to precisely investigate the current inhabitants' habits related to the creation of the indoor climate.
Knowing and understanding the users' needs and requirements before implementing new design solutions could solve many miss understandings between designers and the users.

Moreover, it will help to implement a correct users' behaviour model into the building simulation so a satisfactory outcome of building energy performance can be provided.
This approach also can be applied in the newly build buildings. However, installing additional systems later can increase construction costs.

Moreover, knowing the users' life habits and interaction with space also might to be very challenging. So as mentioned above, it can change over time.

Another solution that could improve the building energy performance will be to educate and raise awareness in the people about how to use various systems to decrease power consumption. According to Palm (2010), the values and knowledge of individuals are significant aspects of the development of an efficient and ecologically sustainable energy system. To create the sustainable society, people need to understand their responsibilities (Palm, 2010, p. 2).
One of the approaches could be to provide to the future inhabitants – a Home's User Guide (HUG) which could present general tips on how to achieve better indoor climate by using provided systems and how it will contribute to lower energy consumption.
Such a solution was described in the article by Baborska-Narożny, Stevenson, & Grudzińska, (2017), where researchers were investigating the overheating issue in retrofitted flats in the UK. The studies aimed to understand the kinds of practices, learning and interventions adopted by the occupants of individual homes to try to reduce overheating. The research was conducted in 18 flats for over the year.
According to the article, the users usually had the problem with uncomfortable indoor temperatures due to several facts. Firstly, because environmental control systems are not used by inhabitants as intended in optimised design models, and this has to lead to significant performance failures (Baborska-Narożny, Stevenson, & Grudzińska, 2017, p.41). Secondly, because of the poor levels of inhabitant understanding of the means to prevent overheating in their dwellings (Baborska-Narożny, Stevenson, & Grudzińska, 2017, p.57). For example, one of the participants in the research was using portable AC temporarily during the hot period of summer months. The problem with overheating was caused by lack of any solar shading in the living room and turned off the mechanical extract ventilation (MEV) system to 'save electricity'. They did not realise that using AC consume much more energy than MEV (Baborska-Narożny, Stevenson, & Grudzińska, 2017, p.47).

My research has shown that people have knowledge related to power consumption. However, they do not relate the use of shading to it. Thus, making people more aware of the importance of using systems, such as shading or MEV can contribute to positive changes in practices.

Educating the people can be achieved by providing the guide that seems to be an excellent solution, and it could presumably solve the problem of "incorrectly" used buildings. Moreover, it will increase users' knowledge about creating a comfortable indoor climate with less energy consumption. Nevertheless, several issues might also occur and some of them were mentioned in the article.
Firstly, designers who provide the homes' guide can not be 100% sure that the user would fully adapt to the guidelines. For instance, the guide advised leaving the windows constantly open to provide 100 mm air gap during the hot spells. However, the inhabitants from ground-floor only keep it open while being at home due to security reasons. Even though, the property managing company sent notices to each of household reminding them that they would be liable for any damage resulting from leaving an unattended window open (Baborska-Narożny, Stevenson, & Grudzińska, 2017, p.47). It can be noticed that not everyone would follow such an instruction or/and inhabitants maybe would not even read it when it was provided.
The second problem occurred when the households of the flat were renting the place to other people, and they did not present the guidelines to the new occupants. Thus, they did not know about existing solutions and how to use them what results with uncomfortable indoor climate.

The conducted studies have shown that involving users into it have shown the inhabitants became more aware and involved in the problem. Also, they gain some new knowledge, and they started to share their experience between themselves.

In the beginning, many of the householders found the HUG useless (Baborska-Narożny, Stevenson, & Grudzińska, 2017). However, this had changed when the researcher involved the user into their studies. During the investigation time, the inhabitants became more aware and engaged in the problem. Moreover, some of them find beneficial to share their new 'advices and insights' overheating-related on the closed Facebook group with others householders. This shared information could be collected and used to improve the HUG (Baborska-Narożny, Stevenson, & Grudzińska, 2017).

From the article of Baborska-Narożny, Stevenson, & Grudzińska (2017) and my research can be noticed that it is hard to impose rules that will aim to improve the energy performance of the building without making people more aware and educated about an issue. Mainly because the users prioritise their comfort and well-being over the reduction of power consumption that is something invisible to them.

7.3 The difference between the Poland and Denmark

According to my studies, the difference between countries is slight. Therefore, the Velux company does not need to have the different users' behaviour models for each country.

Both, in Poland and Denmark, the reason of using the shading is almost the same, and it is strongly related to user's needs and requirements, and quite often shading is a part of the other practices. Also, the shading choice and use were guided by lighting preferences rather than thermal conditions.
However, it has to be kept in mind that use of shading related to the weather conditions between those countries is small since the climate differences are little. Thus, the company has to be aware that the practice might be quite different if the studies would be carried out, for example, in Denmark and Spain.

The cultural difference between Poland and Denmark can be slightly visible regarding material part of the practice. In Poland, it is very common to have various shadings on one window and a net curtain that permanently cover them. However, if this has a significant impact, especially, on the energy consumption, needs to be further investigated.

7.4 The relation with other practices

The research has shown that the practice of using the shading is strongly influenced by our routinized daily habits and it depends on our life's style. Also, it is more connected to the lighting preferences than thermal conditions. This outcome can be related to the fact that some of the participants lived in the older buildings that less frequently have overheating issue because of more thick walls and smaller glazing surfaces.

According to Hand, Shove & Southerton (2005) to analysis on how and why the practice is changing, it is important to look at the arrangement and the relation between the various elements involved rather than one or the other part of the picture. Moreover, it is important to keep in mind that not all practices are equally visible and easy to understand (Baborska-Narożny, Stevenson, & Grudzińska, 2017, p.56). Moreover, they are also not always equally important for every person at the same level. The practice of using the shading has different meanings to various people what was visible in the research.

In my project, it has been challenging to establish boundaries of this practice since it has many factors influencing. Even tough, it can be seen as a separate practice, mostly the activity of enabling/ disabling shading or just having it as a part of decoration would be significantly related to other practices.
For example, if the shading is used for lighting protection while sleeping the use of it would be related to sleeping practice. On the other hand, if the net curtain is only installed as decoration, this would be linked to the practice of decorating the home. The relation between practices might be more or less strong, and this would depend on the individual user.

To get a complete overview of the practice of using shading the investigation about the other practices in each of the country would be essential. Especially, the ones that are often occurred among the participants, such as, the practice of sleeping, using computer/TV and protecting the privacy.

7.5 Reflection upon my approach and further studies

In this project, I have been investigating the user behaviour's models for the use of the shadings. The chosen theoretical framework – Practice Theory, previously was very often used in the project and studies that are, in essence, designed to explain patterns of individual or group behaviour similar to my research (Shove & Walker, 2014). For example, the practice theory has been applied in the project by Line Valdorff Madsen (2017) in which she was investigating everyday practices concerning the comfort and what does it means for residential energy consumption, especially for heating. Another similar example was described in article "Residential heat comfort practices: understanding users" by Kirsten Gram-Hanssen (2010). She wrote that practice theory is a socio-technical approach that helps to understand how routinized everyday activities are socially structured and it will be a proper approach, for instance, for the study of heating practices. Thus, applying this theory to my research was a suitable choice.

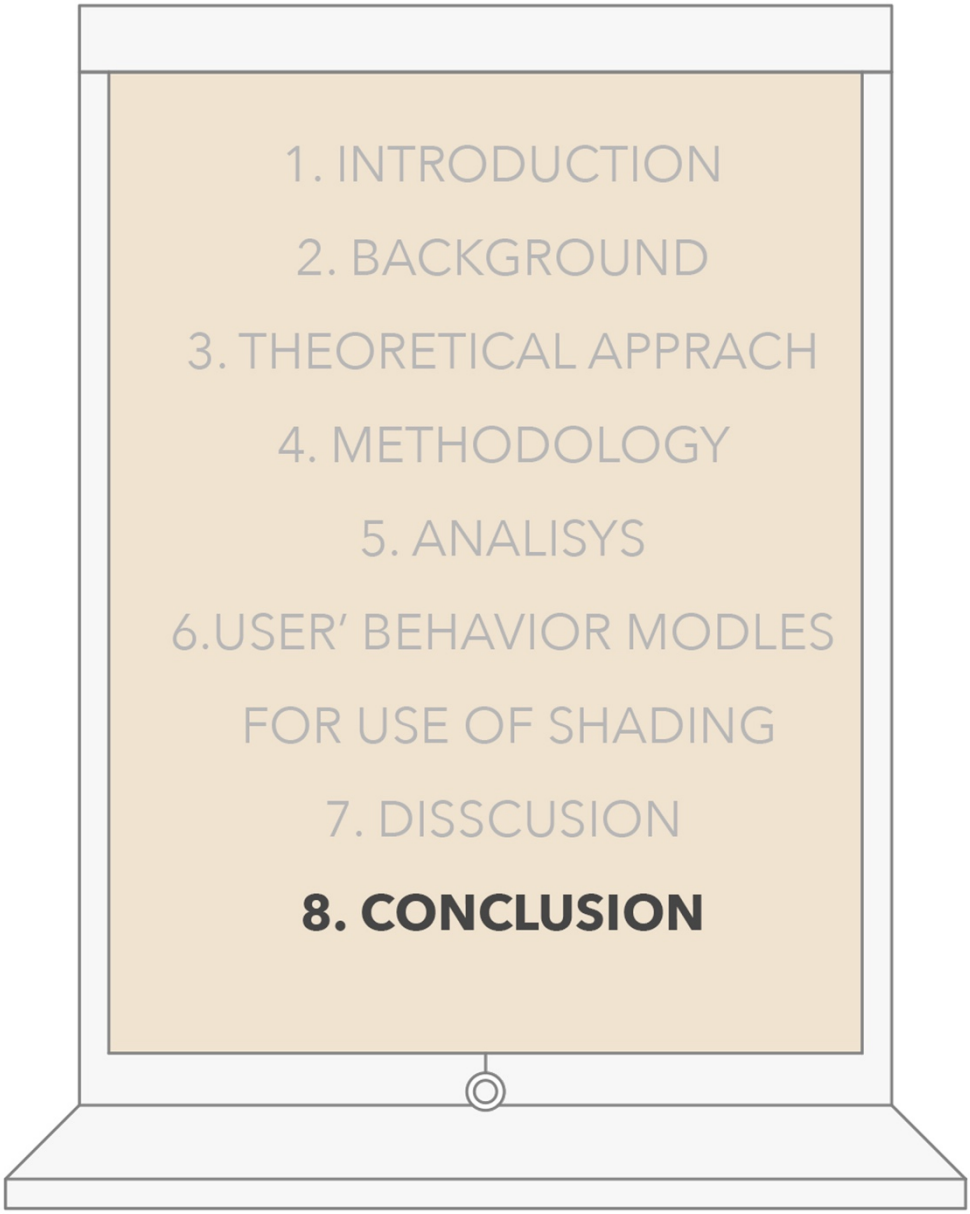
Regarding the method that I used to collect the data for the analysis, some of the changes could provide more precise results.
Firstly, it would be more beneficial if I would have possibilities to conduct the observations by myself. During the research turned out that the participants did not pay much attention to use of shading and many forget to fill up the Activity Map when asked the first time. Also, it was visible during the interviews when they had difficulties to remember, for example, specific situations that they use the shading besides everyday ritual. Thus, I cannot assume that provided information on the timelines or interviews were 100% compatible with the respondents' actual

activities. However, in this type of research that is related to home practices, personal observations are not possible since I could not move in with each of the users.

Secondly, since in the interviews, I have noticed that is difficult for the participant to remember how they used the shading, for example, in the summer which is a quite significant period.
Therefore, in the future investigation, it would be advantageous to conduct one of the interviews right after the summer months and the other after a winter period to obtain the extremes concerning outdoor temperature and lighting conditions.
Moreover, many shortcomings occurred due to limited time for the master thesis. To collect more precise information, the research should be conducted for a longer period, especially, including the summer months mentioned above when the use of shading can be more expensive than during the winter time. Moreover, it can positively contribute to the indoor climate conditions. The longer research time would have allowed me to collect more data from users and it would enable participants to easily relate to different weather seasons that usually are very important regarding the shading usage.

In regards to the choice of the participants, the variety was a good option, and it shows different situations on how the shading is used. However, none of the users was strongly interested in the topic as they see it a slightly as something unimportant and they were participating voluntary, so I could not require much dedication from them.
The future studies besides the longer period, they should include a larger number of the users, particularly, because my research had shown that the use is related more to the user's needs and requirements than to the weather conditions.

Additionally, the future studies could include the workshop on which the user would have a possibility to co-design the shading that would provide necessary features. Velux company in projects aims to improve the residential buildings' energy performance while at the same time providing healthier and more comfortable lives for the occupants. Thus, it is important to remember that user should be the main focus of their approach. For instance, it was crucial for many users to have a shading that would make the room completely dark and this means that it would be challenging to use the same one for the solar heating protection without strong influence on the lighting conditions in the room. By using the co-design approach that aims to involve as much as possible the user into the design process, the company will have a chance to develop the solutions in collaboration with the future users that would emphasise the design on their needs and requirements.


1. INTRODUCTION
2. BACKGROUND
3. THEORETICAL APPRACH
4. METHODOLOGY
5. ANALISYS
6.USER' BEHAVIOR MODLES
FOR USE OF SHADING
7. DISSCUSION
8. CONCLUSION

The rising energy consumption in the building industry caused a higher demand for energy-efficient buildings. In designing such buildings, the use of simulation's tools become very common since they allow architects to see before it is constructed, for example, energy preformation of the house.

The Velux company wants to improve their buildings' simulation tools by implementing more complex users' models that are currently mimicked in a very static way. Thus, the project aimed to investigate the common patterns of the users' behaviour concerning the use of shading to control the indoor environment regarding visual and thermal conditions. Moreover, it seeks to see if the cultural and climate differences influence the practice of using the shading.
To investigate users' patterns, in this project, I analysed several user's behaviours through the Practice Theory framework. The data was collected in Poland and Denmark by three different methods which allow me to collect general and more personal data. It has been challenging to collect precise data since I could not do personal observations and the participants were volunteers so I could not expect them to devote much time.

The analyses have shown that users do not pay much attention to the use of shading. Also, they said that it is a routinized behaviour and that they do not think of it.
The use of shading for them mainly aimed to control the lighting conditions rather than thermal one. Besides, the summer period when in few cases the solar shading is used to protect from the overheating, especially when the outdoor temperature rises above comfortable indoor ones. However, this mainly would take place in Poland since the climate is slightly warmer than in Denmark.
In both countries, the users often control the influx of the daylight because of different reasons. For instance, to have better sleeping conditions or/and to have a better view on their computer/TV screen.
Furthermore, a clear difference between countries was found regarding the type of shading that participant use. However, if this has any additional influence on the energy consumption needs to be further investigated.

As the result of the project, I distinguished four models of the users' behaviour of the use of shadings. Since the practice in Poland and Denmark has not significant differences, all the models can be applied to both countries.

Even though there are some models, the use of shading is very various that it is impossible to predict it 100%. Therefore, if the research would be conduct on the other users, the outcome might be completely different.

Also, the studies were carried out for a very short time, and it did not contain summer period that seems to be most crucial in practice of using the shading. Therefore, more precise studies should be conducted later to confirm and maybe develop more different users' behaviour models.

Moreover, the practice of using the shading is strongly connected to the other practices that influence it. For example, the use of shading practice is significantly related to the sleeping practice.

Finally, the implementation of the models into the simulation programs would be very challenging. Therefore, another solution should be taken into consideration to create more energy-efficient architecture.

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10. Appendix

A: Online survey questions - 86 -

B: Online survey results – Poland - 91 -

C: Online survey results – Denmark - 97 -

D: Activity Map - 103 -

E: Interview guide - 104 -

F: Participants answers from Poland - 105 -

G: Participants answers from Denmark - 127 -

A: Online survey questions

1. What is your age?
   - 35<
   - 35-65
   - 65<

2. What is your gender?
   - Female
   - Male

3. Which country do you live in?
   - Denmark
   - Poland

4. Where do you live?
   - House
   - Flat
   - Other…

5. If you live in a flat on which floor?

….

6. Mostly in which direction are facing your windows?

- South
- North
- West
- East
- Southwest
- Southeast
- Northwest
- Northeast

7. In which rooms do you have the solar shading?
- Living room
- Dinning room
- Bedroom
- Kitchen
- Bathroom
- Home office

8. What type of solar shading do you have?
- Indoor blinds
- Outdoor blinds
- Curtains
- Windows shutters
- Others….

9. Why do you use the solar shading?
- Overheating protection
- Privacy
- Light protection
- Glare
- Decoration
- Sound minimisation
- Others…

10. When your solar shading is enabled what is your lighting condition in the room between 9 to 15 o'clock in the sunny day?
- Is sufficient, I don't need to use electric light
- Is too dark, sometimes I need to use electric light
- Is completely dark, I always need to use electric light
- It depends if they are completely enable

11. When your solar shading is enabled what is your lighting condition in the room between 9 to 15 o'clock in the cloudy day?
- Is sufficient, I don't need to use electric light
- Is too dark, sometimes I need to use electric light
- Is completely dark, I always need to use electric light
- It depends if they are completely enable

12. Do you usually solar shading to control your indoor thermal conditions or indoor lighting conations?

- Mostly thermal
- Mostly lighting
- Both

13. Do you always disable the solar shading when it is no longer needed?

- Yes
- No
- Sometimes

14. If not or sometimes, what is the reason that you do not disable solar shading?

- I am too lazy
- I forget
- I am not at home so it does not bother me
- It will be necessary to enable it again in short time
- Other...

15. Did you know that the way you use your solar shadings influence the room temperature?

- Yes
- No
- Yes, but I do not think about it when I use it

16. Did you know that in the winter sunny days when your solar shading is disabled and the sun has access to the room the indoor temperature can rise for about 2-3°C?

- No
- Yes

17. Describe if you have any additional information why and how do you use solar shading?

……
……
……

Only for people who has roof windows:

1.Do you use solar shading on your roof windows?

- Yes
- No

2. Why do you use the solar shading on your roof windows?

- Overheating protection
- Privacy
- Light protection
- Glare
- Decoration
- Sound minimisation

3. Do you usually have problem with overheating in the room with roof windows?

- Yes
- Yes, but only in summer hot days
- No
- Other…

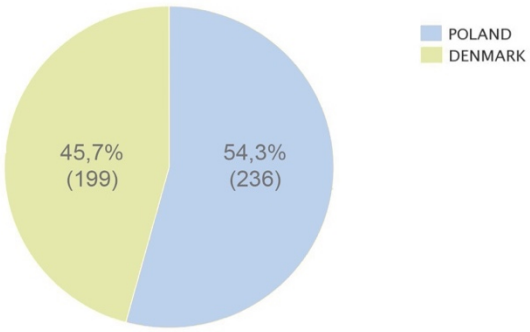
4. Do you have good lightning condition in you room when the solar shading is enable during the day between 9 to 15 o'clock in the sunny day?

- Is sufficient, I don't need to use electric light
- Is too dark, sometimes I need to use electric light
- Is completely dark, I always need to use electric light
- It depends if they are completely enable

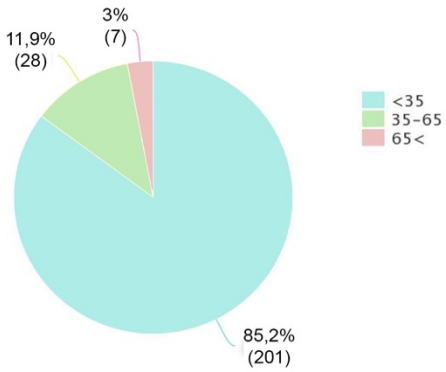
5. Do you have good lightning condition in you room when the solar shading is enable during the day between 9 to 15 o'clock in the cloudy day?

- Is sufficient, I don't need to use electric light
- Is too dark, sometimes I need to use electric light
- Is completely dark, I always need to use electric light
- It depends if they are completely enable

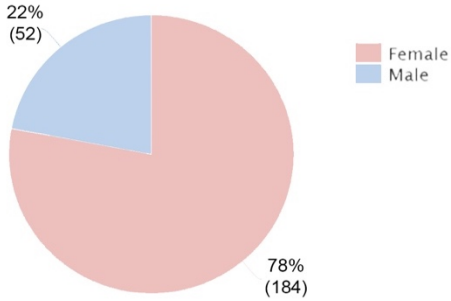
B: Online survey results – Poland



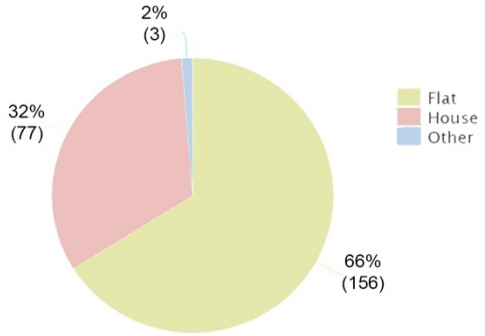
What is your age?



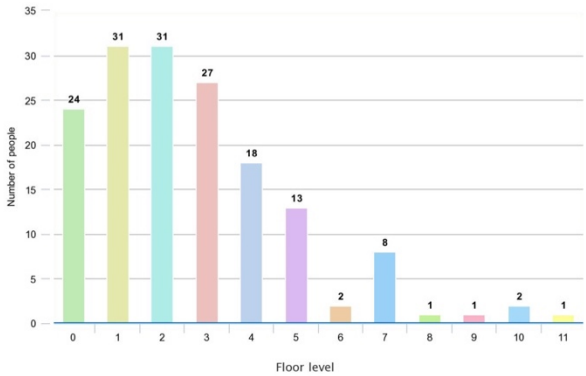
What is your gender?



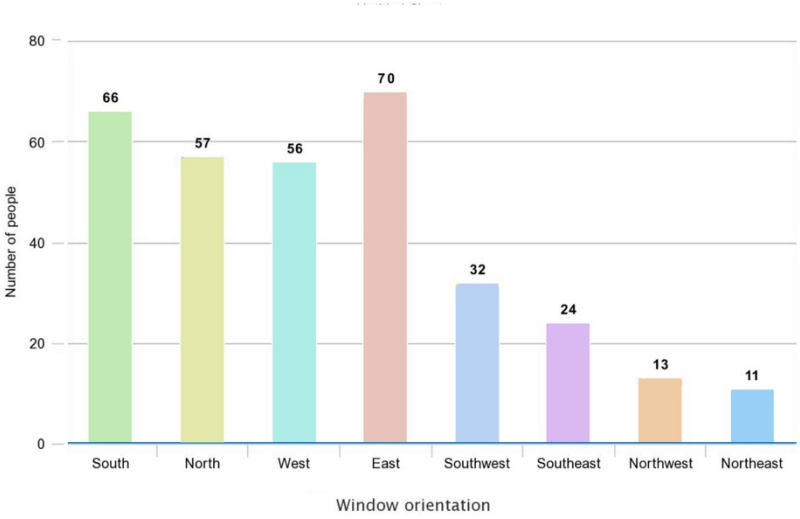
Where do you live?



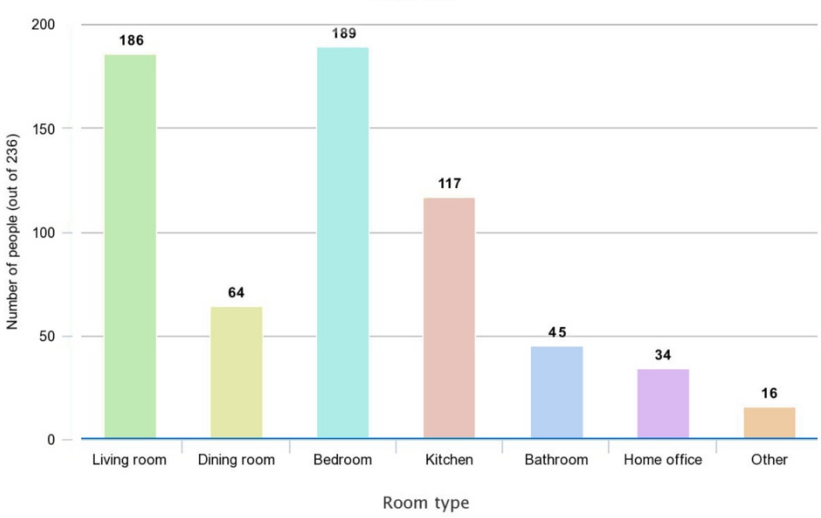
If you live in a flat on which floor?



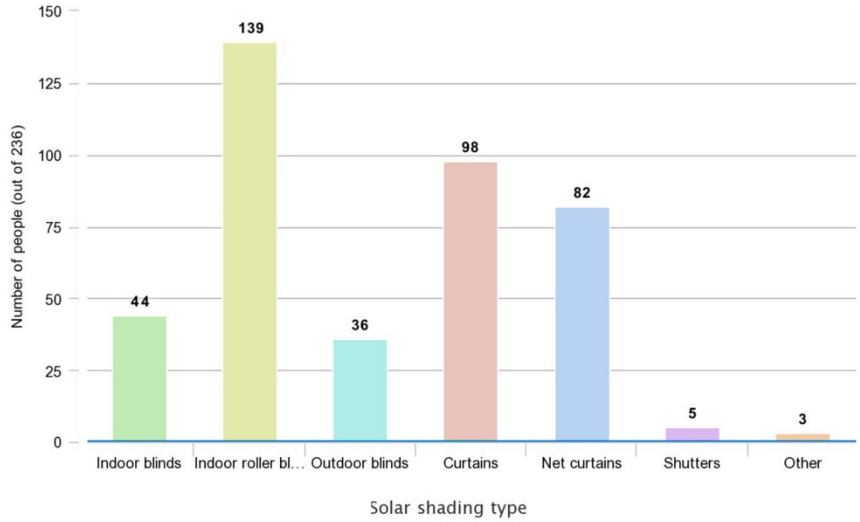
Mostly in which direction are facing your windows?



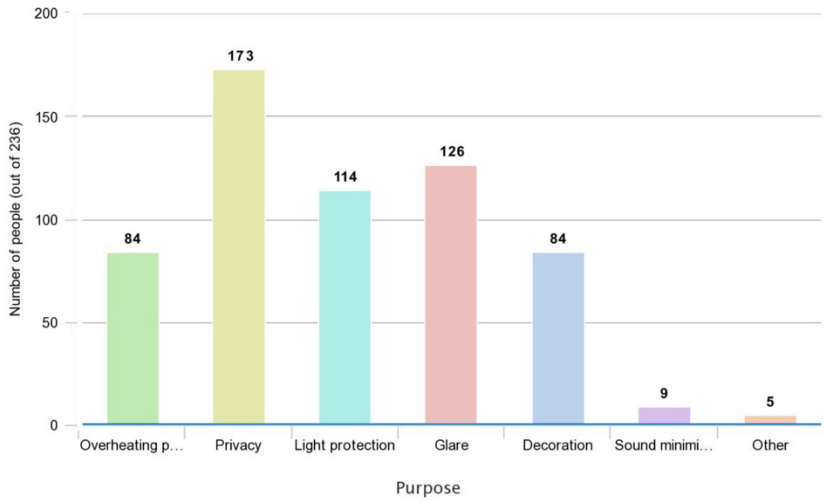
In which rooms do you have the solar shading?



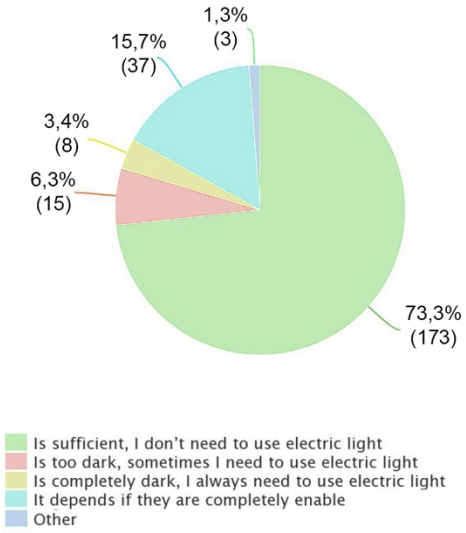
What type of solar shading do you have?



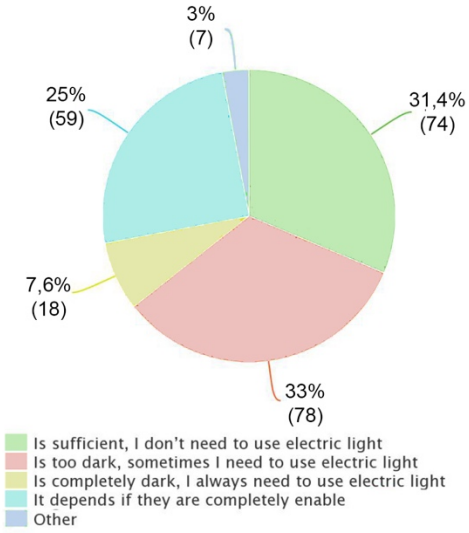
Why do you use the solar shading?



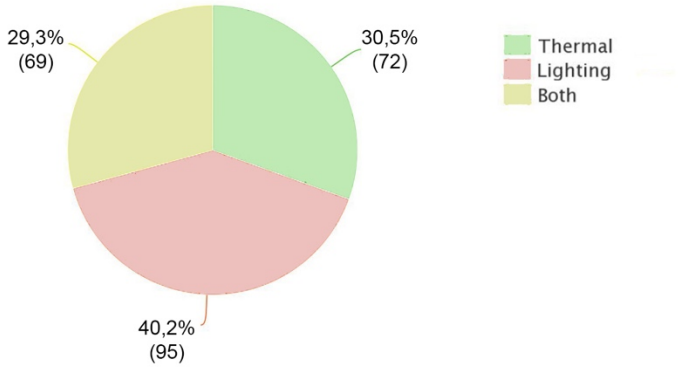
When your solar shading is enabled what is your lighting condition in the room between 9 to 15 o'clock in THE SUNNY DAY?



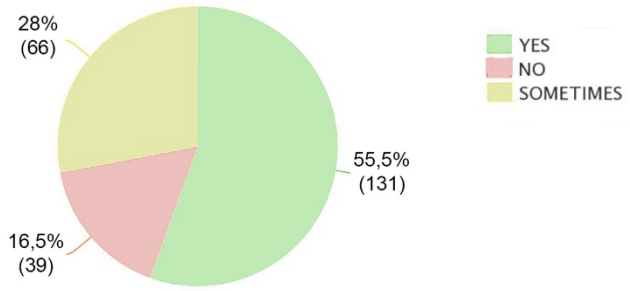
When your solar shading is enabled what is your lighting condition in the room between 9 to 15 o'clock in THE CLOUDY DAY?



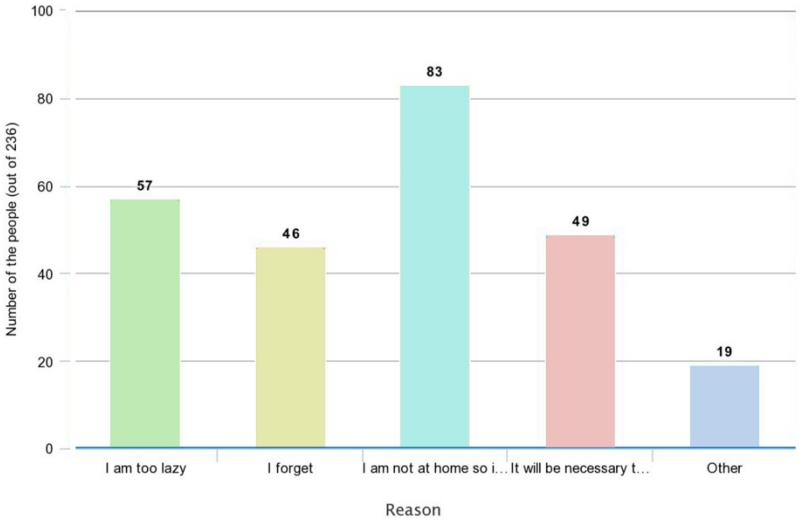
Do you usually solar shading to control your indoor thermal conditions or indoor lighting conations?



Do you always disable the solar shading when it is no longer needed?



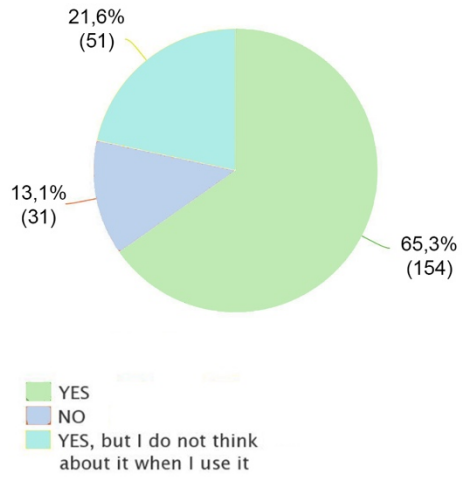
Do you always disable the solar shading when it is no longer needed?



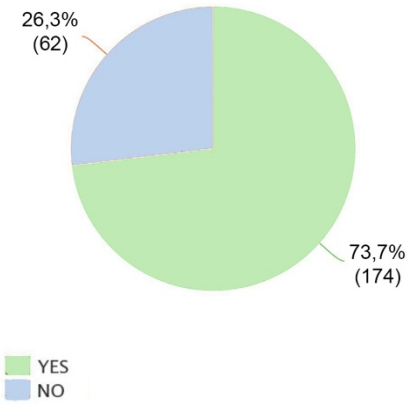
Other:

The outdoor blinds work as the additional insulation to keep warmth inside the house.
Privacy.
I like the cover window, sometimes shadings look better than what is behind the window.
I do things that I do not want people to see.
Net curtains are decoration.
I have blinds day/night so it is not necessary.

Did you know that the way you use your solar shadings influence the room temperature?



Did you know that in the winter sunny days when your solar shading is disabled and the sun has access to the room the indoor temperature can rise for about 2-3°C?

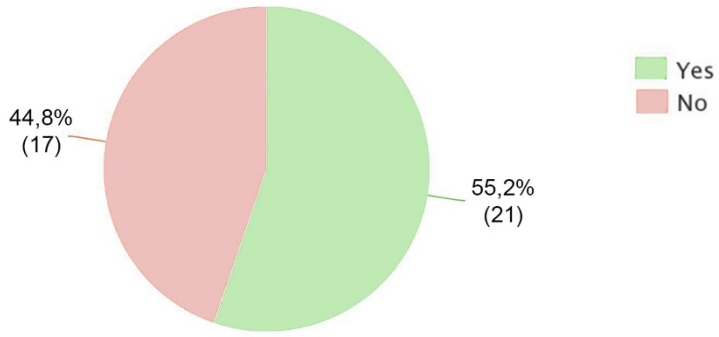


Describe if you have any additional information why and how do you use solar shading?

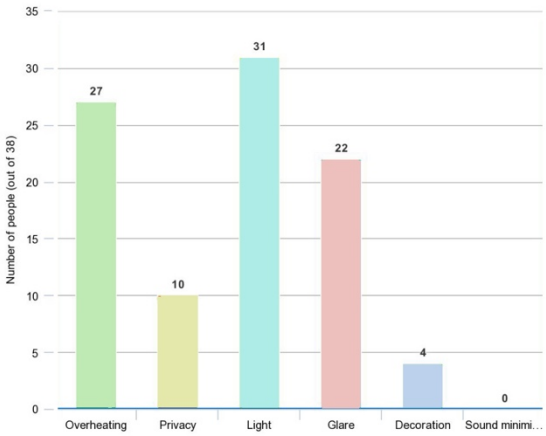
- Outdoor blinds are good as the additional thermal insulation.
- I have day/night blinds.
- Anti-burglar blinds - I use them to shade.
- I cover when the sun is shining on my window.
- Very well lighted flat is getting overheated in hot days.
- During the day I use solar shading mainly to get rid of the sun from my computer screen or TV. Sometimes when morning light is strong, I use it in bedroom, or living room. In very hot days I use it as overheating protection.
- I always use the solar shading during very hot days and I close everything.
- The sun of the spring tempts me that I cover my windows to focus on the work.

Roof window 38 out of 236 people

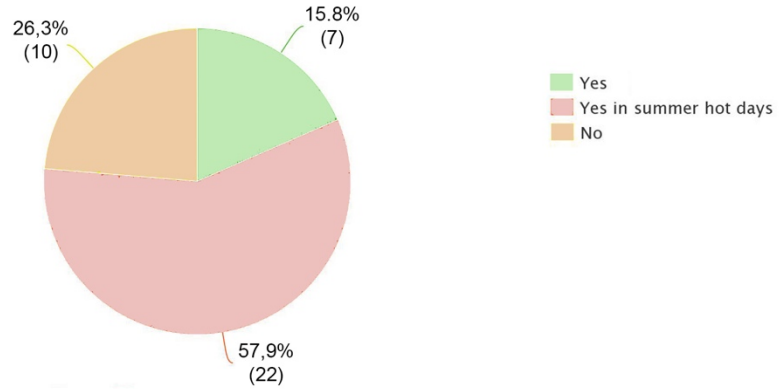
Do you use solar shading on your roof windows ?



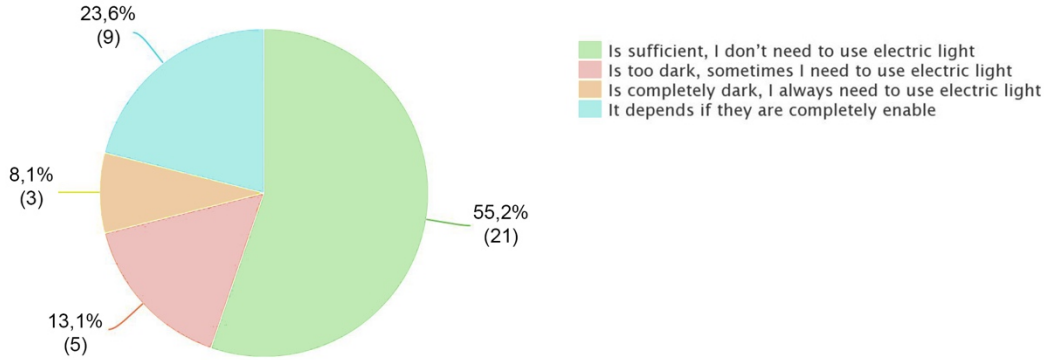
Why do you use the solar shading on your roof windows?



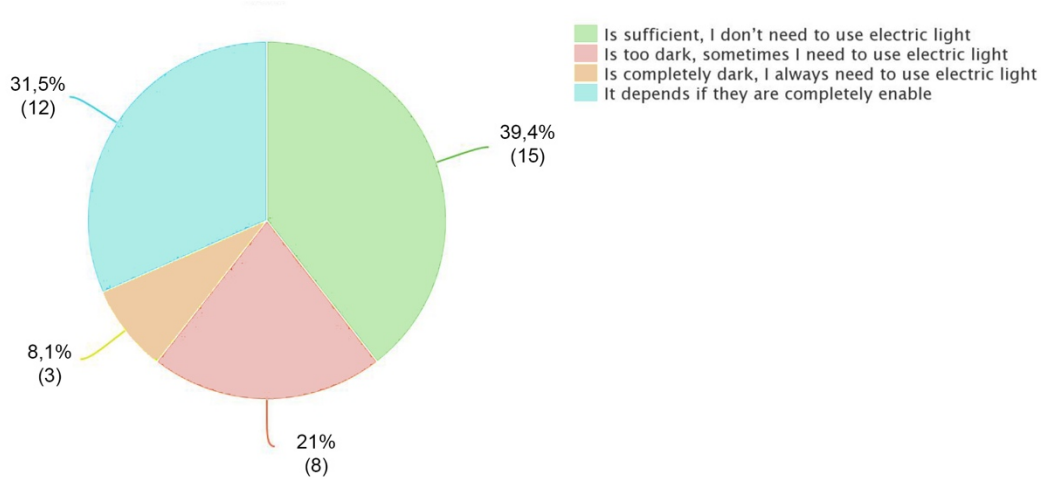
Do you usually have problem with overheating in the room with roof windows?



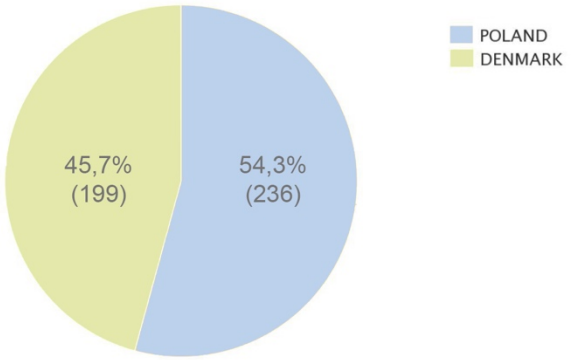
Do you have good lightning condition in you room when the solar shading is enable during the day between 9 to 15 o'clock in the sunny day?



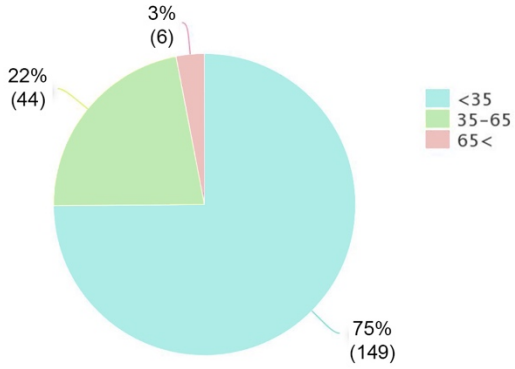
Do you have good lightning condition in you room when the solar shading is enable during the day between 9 to 15 o'clock in the cloudy day?



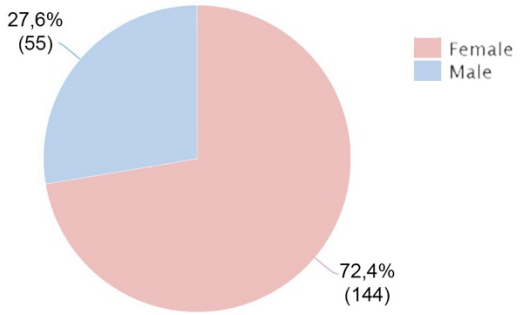
C: Online survey results – Denmark



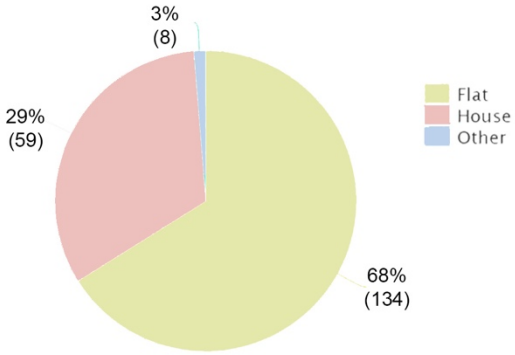
What is your age?



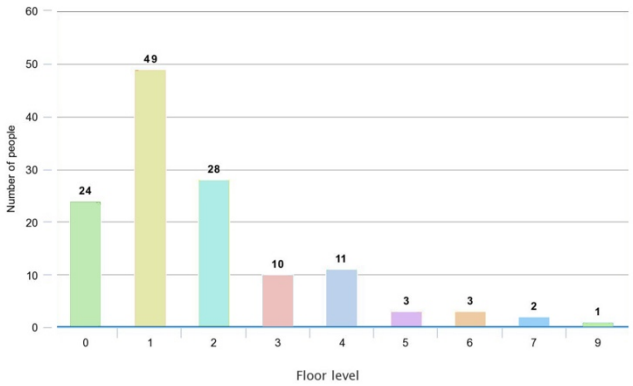
What is your gender?



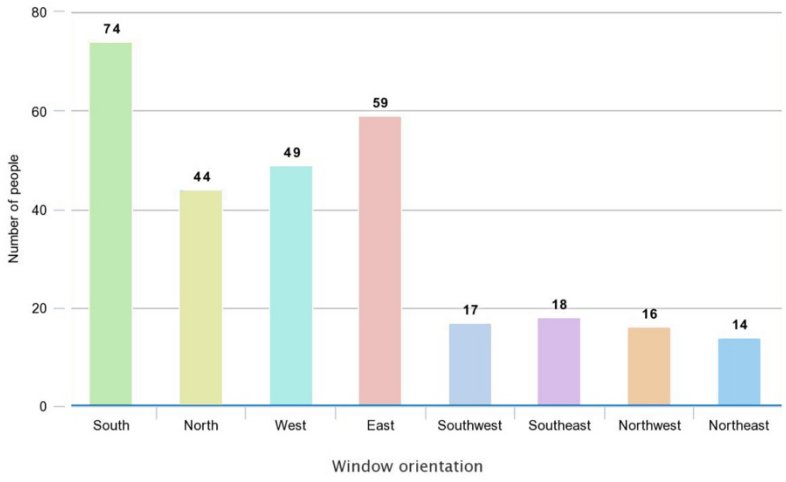
Where do you live?



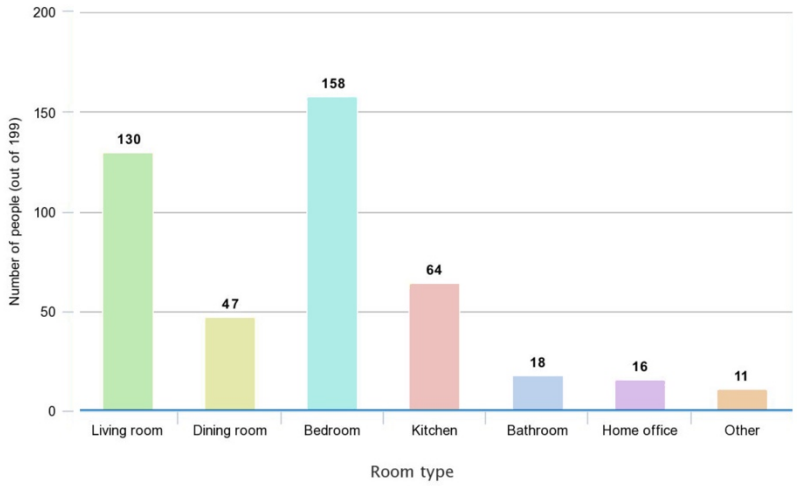
If you live in a flat on which floor?



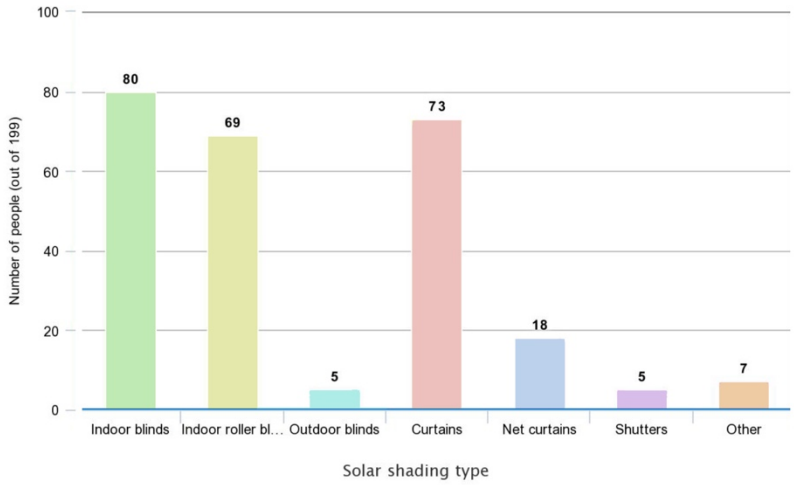
Mostly in which direction are facing your windows?



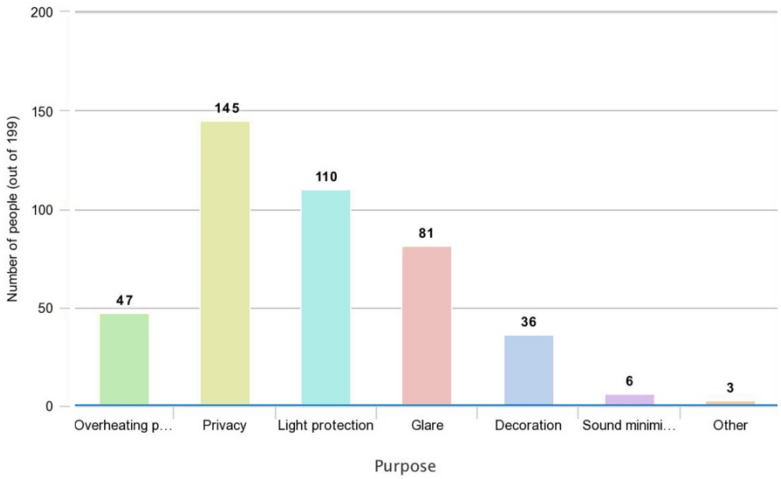
In which rooms do you have the solar shading?



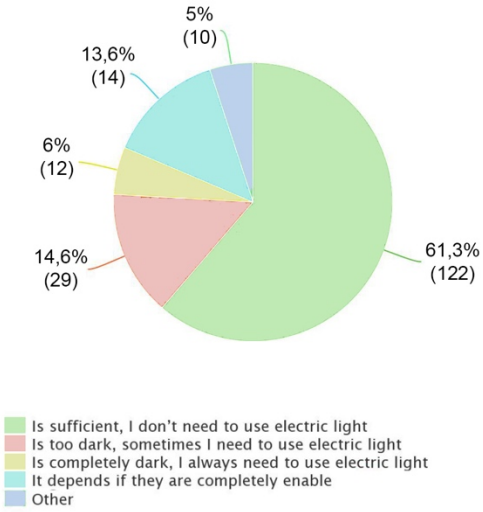
What tvpe of solar shading do you have?



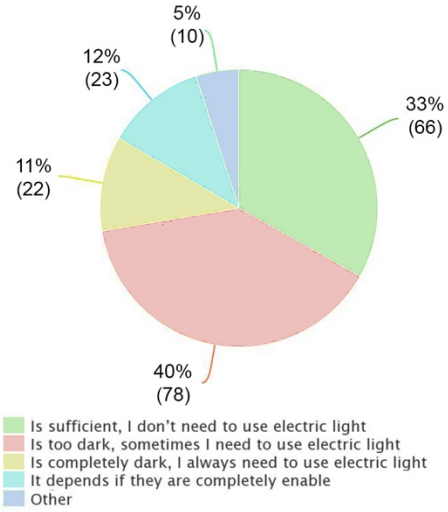
Why do you use the solar shading?



When your solar shading is enabled what is your lighting condition in the room between 9 to 15 o'clock in THE SUNNY DAY?



When your solar shading is enabled what is your lighting condition in the room between 9 to 15 o'clock in THE CLOUDY DAY?



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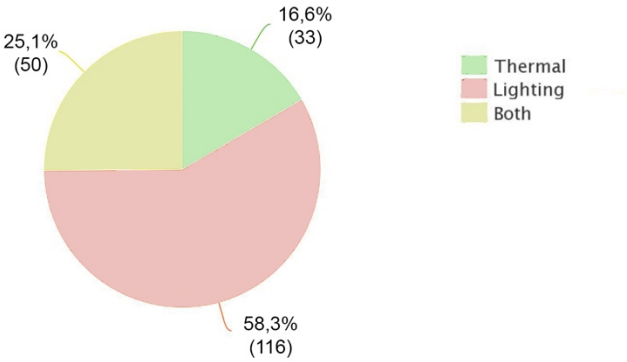
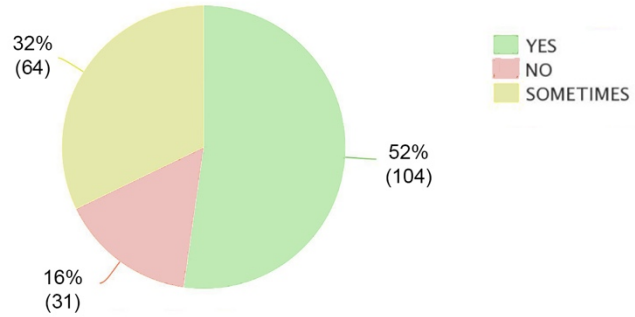


Do you always disable the solar shading when it is no longer needed?



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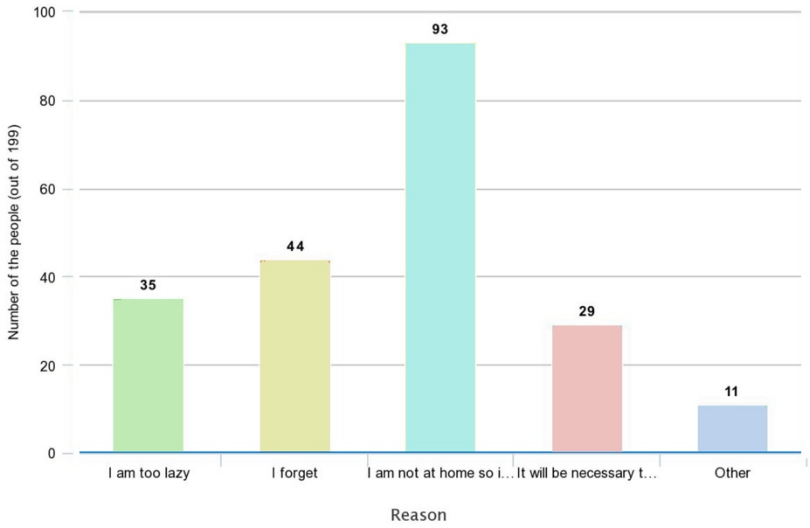
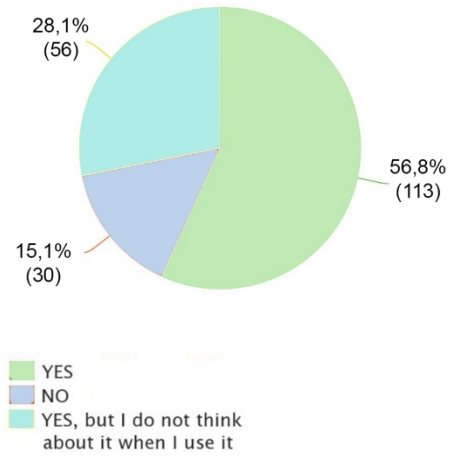


Other:
Privacy
There are just half enable so it is ok.
Child sleeping.
Night job, sleeping during the day.
I have automatic blinds with the light sensor.

Did you know that the way you use your solar shadings influence the room temperature?



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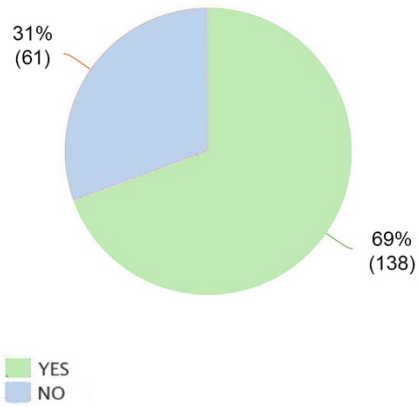
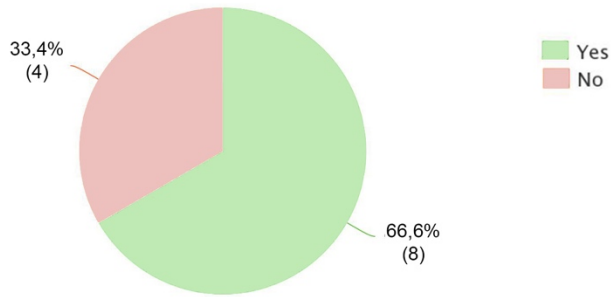


Describe if you have any additional information why and how do you use solar shading?

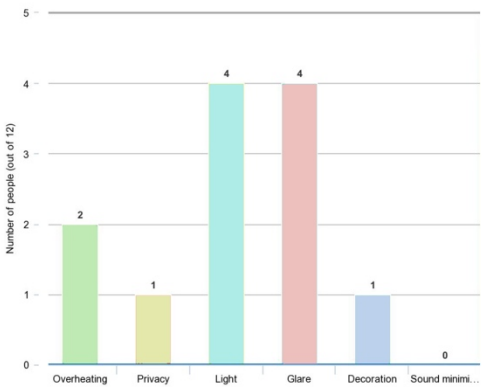
- I sleep better if the solar shading is completely enabled, but I would like it to make my room completely dark, even when it is sunny. I like to sleep when it is all dark, it is better for the eyes.
- In living room, I only have solar shading on one window, thus when I'm using it to prevent glare and too high daylight level, I still have enough daylight and don't need artificial light. If I had blinds on both windows enabled, I wouldn't have sufficient amount of daylight in the room. (just to supplement answer on questions 9 and 10)
- I use it to keep the warmth inside on cold days
- Not to be waken up by the Sun when it raises early, especially in spring and summer in Denmark
- To sleep more
- I hate bright bright bright rooms. And when it is very bright, the messy stuff in the room becomes more obvious, and sometimes it looks messy/dirty even when it isn't. Sun in your eyes sucks.
- If I keep them closed, the temperature in the room will increase since they act as thermal isolation.

Roof window 12 out of 199 people

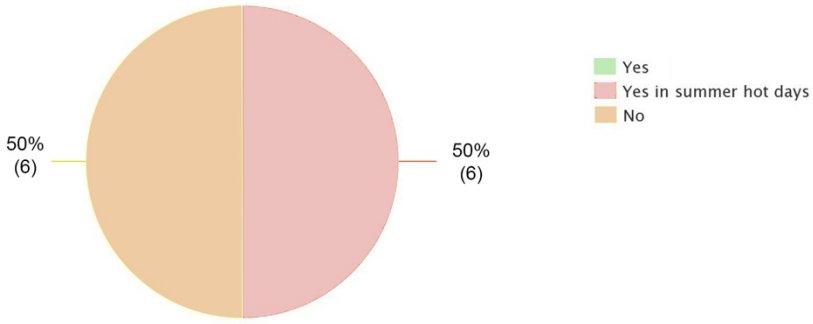
Do you use solar shading on your roof windows ?



Why do you use the solar shading on your roof windows?



Do you usually have problem with overheating in the room with roof windows?



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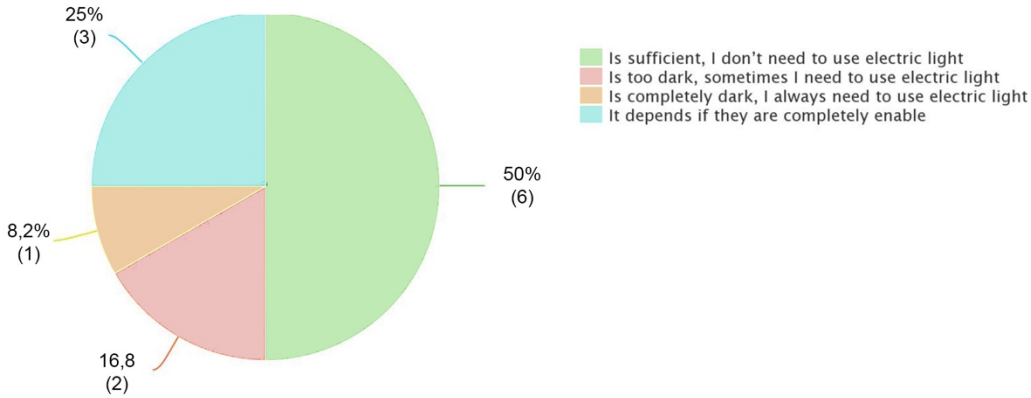
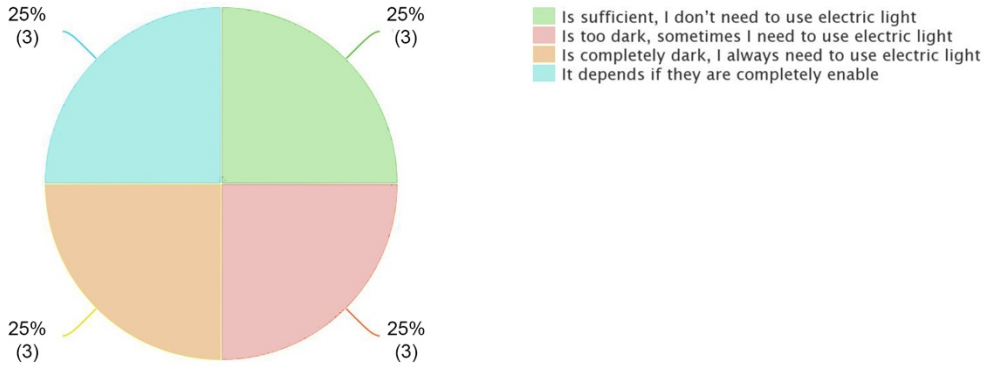
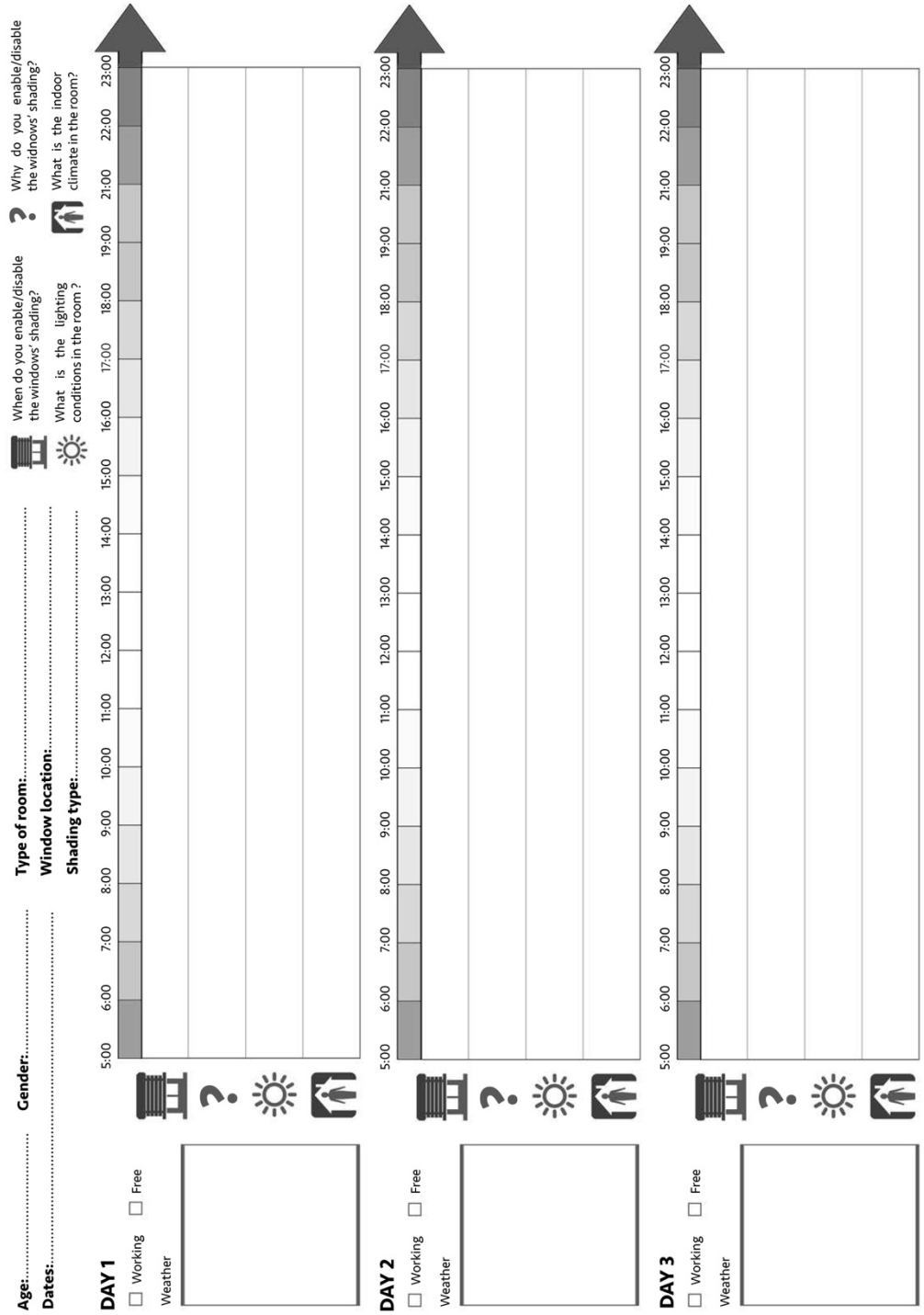


Do you have good lightning condition in you room when the solar shading is enable during the day between 9 to 15 o'clock in the cloudy day?



D: Activity Map



E: Interview guide

Presentation:

The studies aim at understanding on how users are controlling their indoor environment in terms of visual and thermal comfort, but also another factor such us privacy, habits, etc., by using the shading and what other factors are influencing the behaviour of inhabitants.

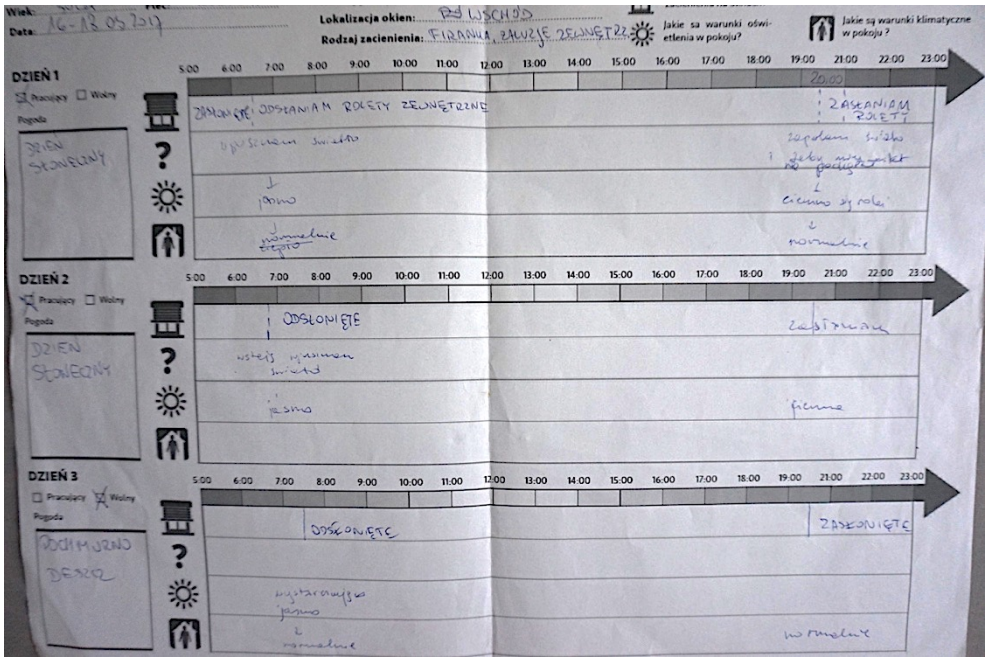
The collected data and conducted analyses will be a base to improve the simulation tools to better understand the users' behaviour in the building and prevent an incorrect design that reduces the comfort of living.

Questions:

- In which rooms do you have shadings?? And why?
- What type of shading do you have?
- Why do you have this type of shading?
- Is your solar shading easy to use?
- Do your windows are especially oriented into the sun?
- Do you use it everyday?
- Describe how you use it.
- Why do you have and use solar shading?
- Is there any specific situation that you use solar shadings, beside everyday ritual?
- Do you always disable your solar shading when is no longer needed?
- Do you know how solar shading can help you to create better indoor climate?
- Do solar shadings help you create better indoor climate in terms of temperature and lighting conditions?
- Do solar shadings help you create better indoor climate in terms of well-being?
- Do the use of solar shading influence your daylight condition during the day? how and when?
- Do you need to use electric light when your solar shading is enable during the day because of the other reason, e.g. privacy?
- Would you like to have automatic solar shadings that would close/open regarding to the room and outdoor temperature?

F: Participants answers from Poland

- **User 1**



Place of living – single family house in the village, approximately 30km form the city.
Who – Couple with two dogs, age around 50 years old, working from home.

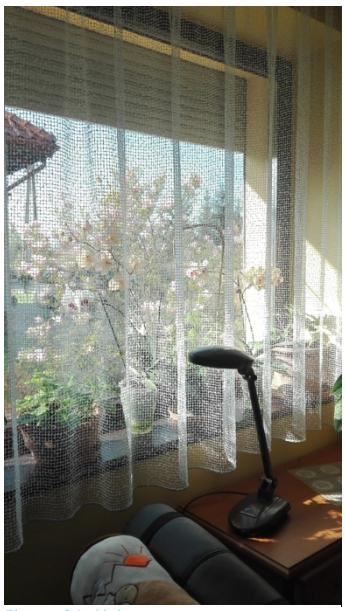
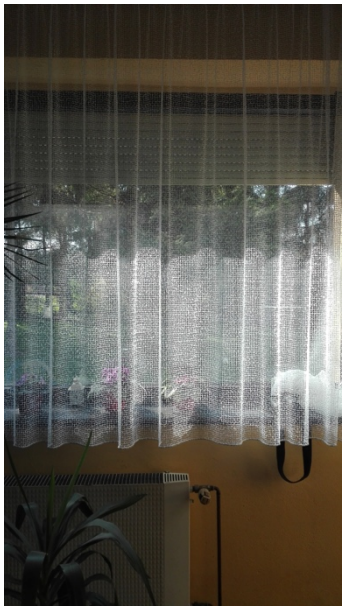


Figure 21. Living room



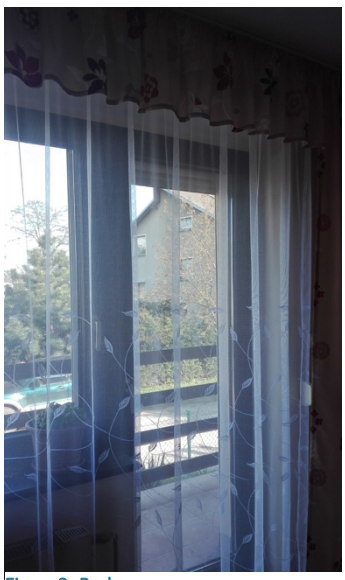


Figure2. Bedroom

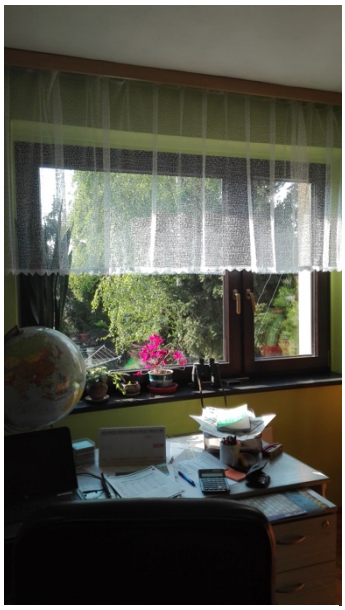


Figure 3. Office room

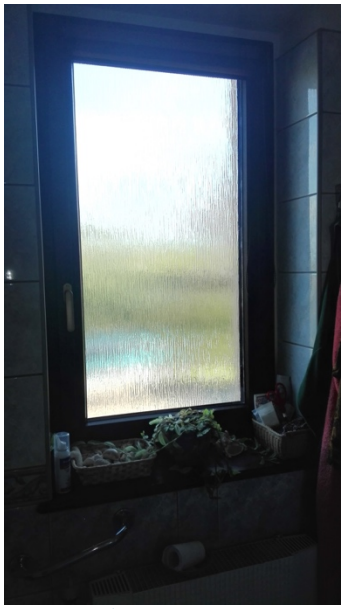


Figure 4. Bathroom

Figure 5. Kitchen

Interview with the women:

1.In which rooms do you have solar shadings?? And why?

I have outdoor blinds in the living room and in the bedroom on second floor. In the kitchen, bathroom and two other rooms I have indoor blinds.

2.Why?

It depends, in the small rooms (office) I have it because windows are oriented into west so it is impossible to be there when is sunny day as it is getting very hot. In the bedroom and living room because people are looking into my house so to protect my privacy. In the kitchen also because people looking inside and there is strong sun in the morning so I change the angle of the blinds and it reflect it to the other side.
I have also net blinds as a decoration.

3.What about the colour?

Only in the bathroom the blinds are in the same colour as the window- dark brown.

4.Why do you have this type of solar shading?

In some of the rooms I have indoor blinds since it is cheaper and there is not need to be outdoor blinds. In the living room are outdoor blinds because of security reasons. The same are in the bedroom because there is balcony.

5.Is your solar shading easy to use?

Very easy.

6.Do your windows are especially oriented into the sun?

Yes, but not all the day. In the bedroom, bathroom and kitchen in the morning as they are oriented to the east. In the office rooms into the west.

7.In which room do you have problem with overheating?
In the ones which I have windows on the west in the afternoon, and in the morning a bit in the ones that are on the east wall.

8.Is it getting so hot that you need to use the solar shading to minimising it?
Also. Especially when I have flowers on the window-sill I need to enable solar shading because the sun is too strong for the flowers.

9.Do you use it everyday?
Yes.

10.Why do you have and use solar shading?
Because it is practical.

11.Is there any specific situation that you use solar shadings, beside everyday ritual?
No. Only, sometimes when my husband is taking the nap I need to low it down cause sun shines and it disturbs him.

12.Do you always disable your solar shading when is no longer needed?
Yes. I do not like when is dark.

13.Do you know how solar shading can help you to create better indoor climate?
When I close it is dark. Also in hot days, it helps me to prevent the overheating in the rooms. In the winter I do not close it. However, I do not pay so much attention that the sun can rise temperature in the room. I only pay attention when sun is shining to much what disturbs me or it has bad influence on flowers.
***Husband**: In the winter the sun heating is good so we do not have to use more energy from the gas to warm up the space.*

14.Do solar shadings help you create better indoor climate in terms of temperature and lighting conditions?
I have never pay attention to that. I do not use solar shading to operate the temperature in the room.

15.Do solar shadings help you create better indoor climate in terms of well-being?
I like when is light in the rooms, so I prefer when they are open.

16.Do the use of solar shading influence your daylight condition during the day? how and when?
Yes, when I close its getting very dark.

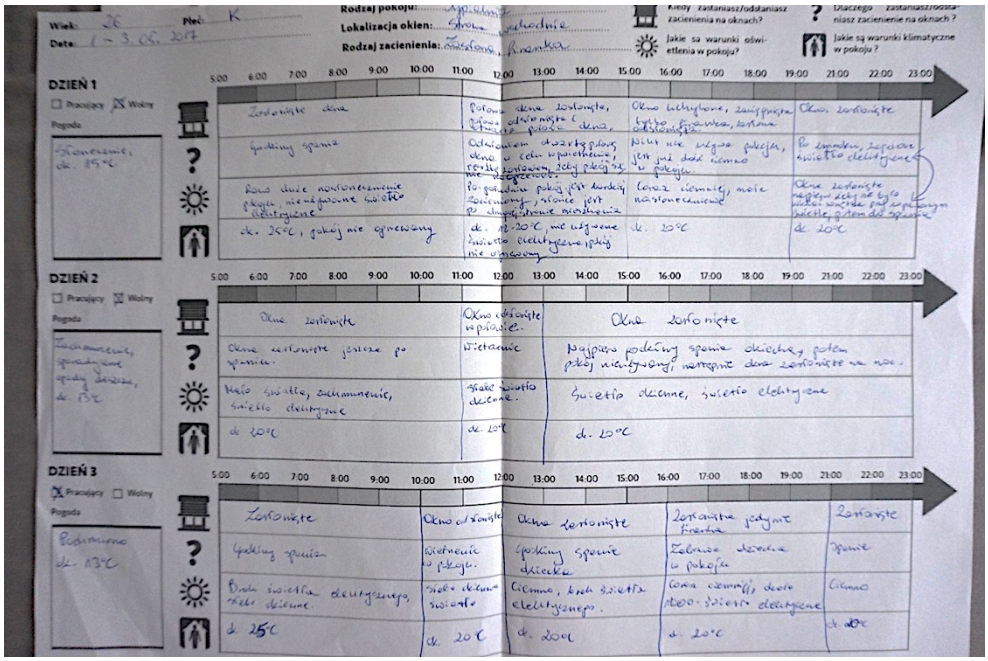
17.Do you need to use electric light when your solar shading is enable during the day because of the other reason, e.g. privacy?
Yes.

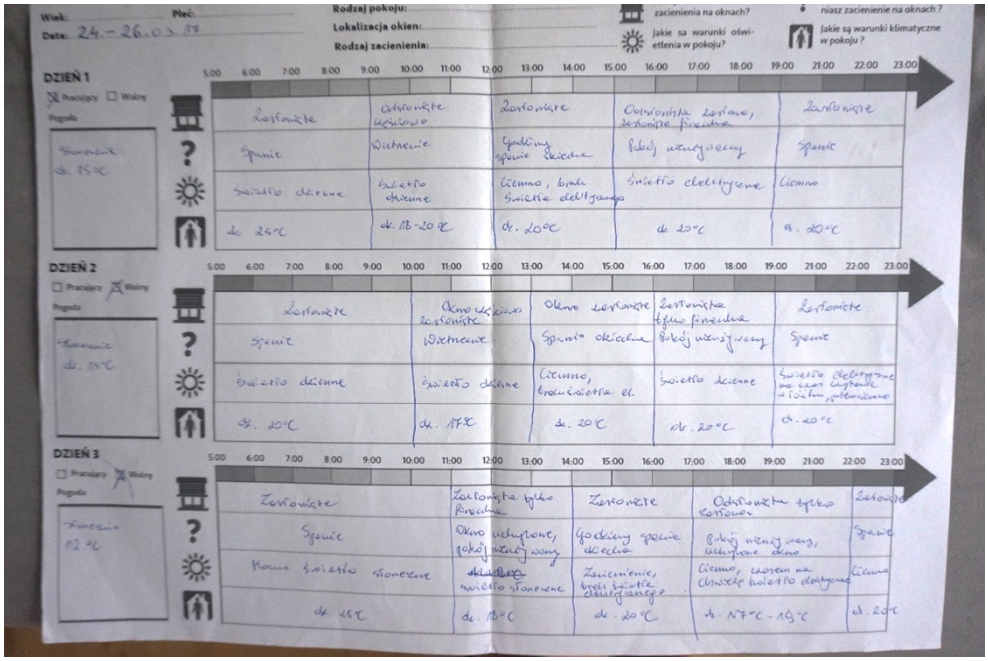
18. Would you like to have automatic solar shadings that would close/open regarding to the room and outdoor temperature?

Husband: Of course.

Wife: I do not care about temperature so much. It is always cold in my living room but regarding the lighting conations I would prefer to do it by myself. Moreover, I do not pay the bills but my husband.

- **User 2**





Place of living – small flat (1 bedroom and living room with kitchen), second floor in the suburbs in the apartments' neighbourhood.
Who – Couple with small child, age 26 years old, wife working at home, husband working outside.

Figure 1. Bedroom

Figure 22. Living room

Interview with the women:

1.In which rooms do you have solar shadings??
In all the rooms we have solar shading. In bedroom, we have curtains and net curtains. In the living room, we have just net curtain and in the dining room we have also both net curtain and curtain. In bedroom, because it has to be enable when we sleep and during the day when the child is sleeping.

2.Why?
In dining room, I have curtains because it looks nice and cosy, also I use it sometimes when sun is shining.

3.What about the colour?
The colours are like this because it fits into the decor of the room.

4.Why do you have this type of solar shading?
I think it does not look cosy and nice when there is no net curtains and curtains. (Husband: this is the most important fact.) The true is that is not very functional and we should have the blinds and we are planning to install one soon because this flat is

getting very warm to prevent it. However, I would still keep the net curtains as I like it a lot.

5.Is your solar shading easy to use?
Yes!

6.Do your windows are especially oriented into the sun?
Yes, all. In the morning the one on the east, and in the afternoon the one on the west. The west ones are more exposed since the sun is stronger and here we have more problems with overheating.

7.Do you use it everyday?
Yes. Net curtains always, only I open it when I air out home.

8.Why do not you have additional solar shading on the west window in the living room since you said that you have problem with overheating here?
I do not have curtain here cause is not comfortable to use it on the balcony window and it takes a lot of daylight. But I think, we should have blinds here because the curtains do not prevent from overheating. Moreover, we need to organised ourselves and do it.

9. What kind of blinds would you install?
The outdoor one.

10.Why this kind?
Because when is very hot and we are not at home we can completely close it so the flat is not heated. Moreover, on the balcony window the indoor blinds would be more difficult to use.

11.Is there any specific situation that you use solar shadings, beside everyday ritual?
Yes. When I am doing something that I do not people to see me, especially when the electric light is on.
Husband: *Also, when I sit in the table and play on my computer to prevent from the sun shine.*

12.Do you always disable your solar shading when is no longer needed?
No. When I wake up I do not disable curtains until I will air out the room.

13.Why?
Because I am not in this room so I do not care.

14.Do you know how solar shading can help you to create better indoor climate?
Regarding to emotional climate the shading can provide nice atmosphere. Moreover, they are part of the decoration and it is very important for me.
When is very hot it can help to prevent from overheating.

15.Do solar shadings help you create better indoor climate in terms of temperature and lighting conditions?

I have never pay attention to that. I do not use solar shading to operate the temperature in the room.

16.Do solar shadings help you create better indoor climate in terms of well-being?

Yes, to protect my privacy and the room looks more aesthetic.
Husband: To be honest I would like to not have the net curtains because we need to wash it.

17.Do the use of solar shading influence your daylight condition during the day? how and when?

Yes, when I want to have dark and it is a day. Also while I am using computer and the light is reflecting on my screen.

18.Do you think your net curtains make your rooms darker?

Yes, the one in my living room but it does not disturb me. But the other one are very light so in my opinion, it does not make room darker.

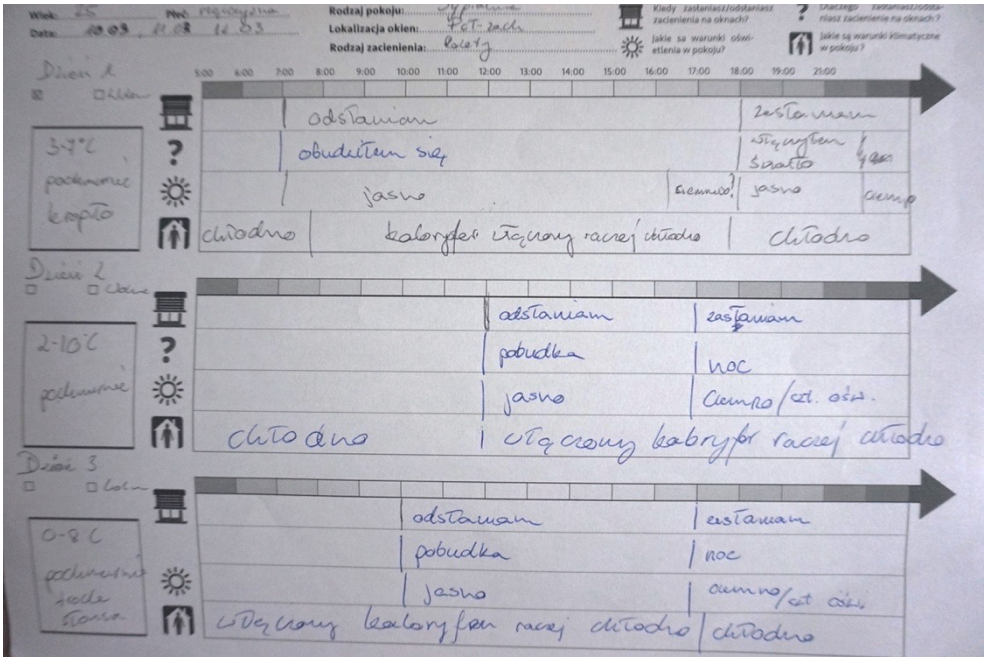
19.Do you need to use electric light when your solar shading is enable during the day because of the other reason, e.g. privacy?

No. We do not use much eclectic light during the day. Rarely I use it in the bedroom when it is a bad weather and it is too dark.

20. Would you like to have automatic solar shadings that would close/open regarding to the room and outdoor temperature?

I would like to try but the net curtains I will have always.
Husband: I want it because it is a gadget.

- **User 3**



Place of living –flat (2 bedrooms and living room with kitchen), fourth floor in the suburbs in the apartments' neighbourhood.
Who –Family of 3, parents and 26-year-old man.

Figure 1. Bedroom

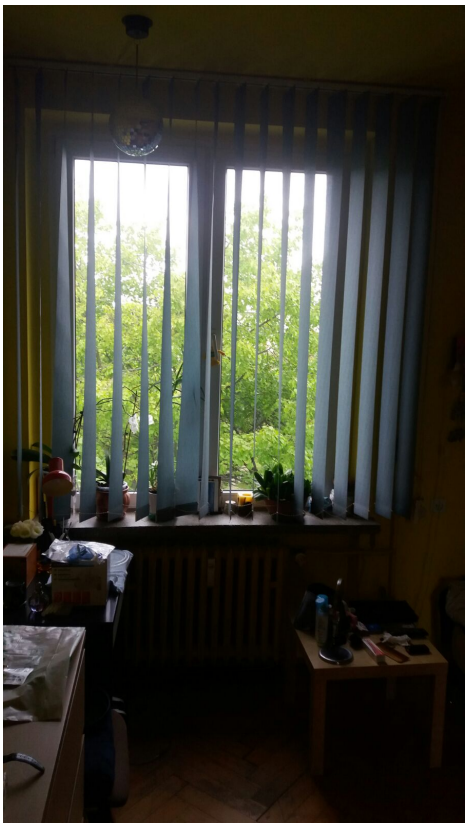


Figure 2. Bedroom

Figure 3. Kitchen

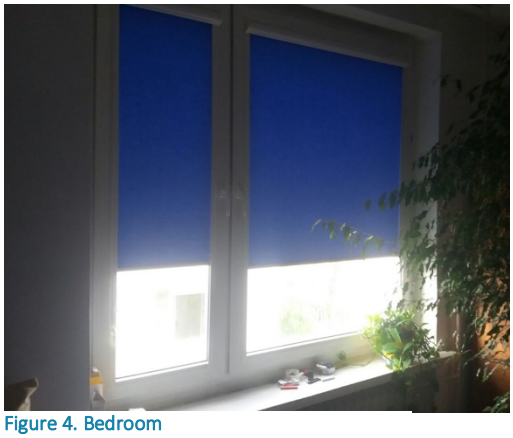


Figure 4. Bedroom

Interview with the man (26 years old):

1.In which rooms do you have solar shadings??
In all the rooms.

2.Why?
I don't know. I was thinking that every one have them and also it was my mother choice. She has it to cover a window for different reason such as privacy at night when electric light is on or during the day when sun is shining.

3.What type of solar shading do you have?
Indoor roller blinds, blinds and office vertical blinds.

4. What about the colour?
In my room are blue. The others are blue, white and yellow.

5.Why do you have this type of solar shading?
I don't know my parents chose it. I did not care what it will be.

6.Is your solar shading easy to use?
Of course, yes!

7.Do your windows are especially oriented into the sun?

In my room no, also they are mostly cover. I am not sitting in front of window. In the kitchen is a good place to take sunbath in the afternoon.

7.Do you use it everyday?

Yes, since I prefer to have cover windows. In the other rooms are used everyday too, even though we live on the 4th floor my mother used to live on the ground floor all her life so she is used to.

8.Why do you use solar shading?

To make dark or to protect from people who can see me.

9. Is there any specific situation that you use solar shadings, beside everyday ritual?

When I am leaving I do not know what is happening. Moreover, sometimes I cover window during the day when I play on the computer, I watch something or I take a nap.

10.Do you always disable your solar shading when is no longer needed? Why?

No, because I am lazy and I like when is dark.

11.Do solar shadings help you create better indoor climate in terms of temperature and lighting conditions?

It is dark and I like it.

12.Do solar shadings help you create better indoor climate in terms of well-being?

I like when is dark and when people do not see me, especially, the one from the block of flats in front who lives on 5th floor since others have no possibility.

13.Do the use of solar shading influence your daylight condition during the day? how and when?

Yes, it makes the room very dark.

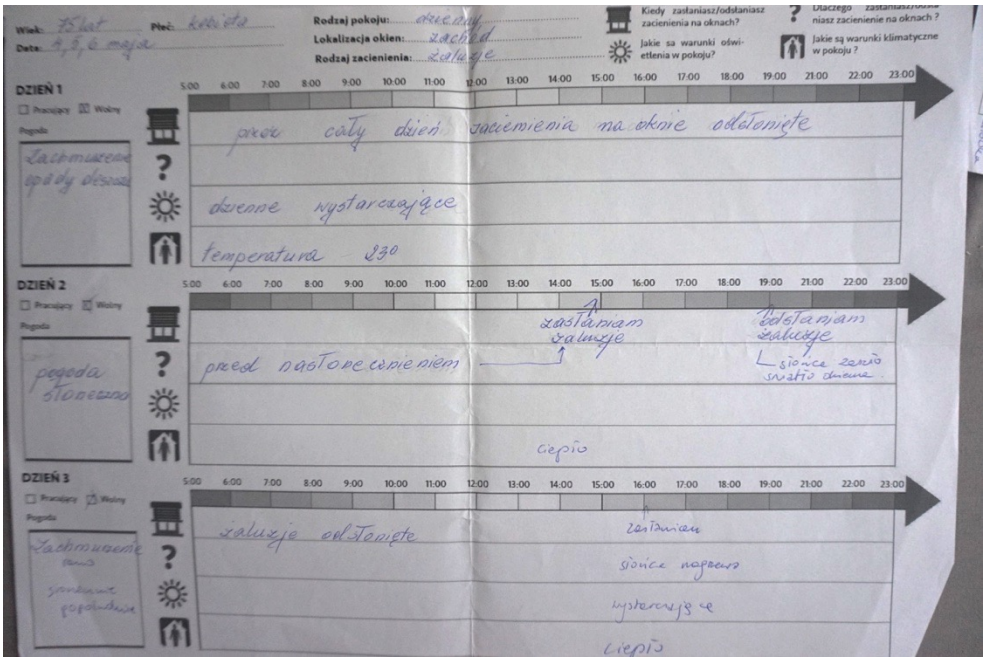
14.Do you need to use electric light when your solar shading is enable during the day because of the other reason, e.g. privacy?

Depends, if I need to read than yes.

15. Would you like to have automatic solar shadings that would close/open regarding to the room and outdoor temperature?

No, because I do not need it. Also I do not care about the energy use.

- **User 4**



Place of living – flat (3 bedrooms, living room, kitchen, toilet and bathroom), fourth floor in the apartments' neighbourhood.
Who –single lady 75 years' old

Figure 1 - Kitchen

Figure 2- Bedroom

Interview with the lady:

1.In which rooms do you have solar shadings??
In all the rooms.

2.Why?
To protect form overheating.

3.What type of solar shading do you have?
I have blinds, net curtains and curtains, but I use only blinds and net curtains are always on the window.

4.Why do you have this type of solar shading?
When I was installing them long time ago that was the only and most popular option. I have them in the living room for 17 years already.

5.Is your solar shading easy to use?
Yes, besides that I have to clean them.

6.Do your windows are especially oriented into the sun?
In the kitchen and room close by are in the morning since windows are oriented into the east. In the living room and two other bedrooms in the afternoon since they are oriented into the west.

7.Do you use it everyday?
No, only during the sunny day during the spring/summer. I do not use it during the winter days since the sun is much lower.

8. Is there any specific situation that you use solar shadings, beside sunny days?
Sometimes in the kitchen while I am doing something in the evening to protect from people looking at me.

9.Do you always disable your solar shading when is no longer needed? Why?
Mostly yes, sometimes I enable it when I left home and was sunny but I am not back before the sun is gone so it is impossible.

10.Do solar shadings help you create better indoor climate in terms of temperature and lighting conditions?
Yes, only in terms of the temperature, it protects from overheating.

11.Do solar shadings help you create better indoor climate in terms of well-being?
Not really, as not many people can see me on the fourth floor.

12.Do the use of solar shading influence your daylight condition during the day? how and when?
When I use it I still have sufficient light.

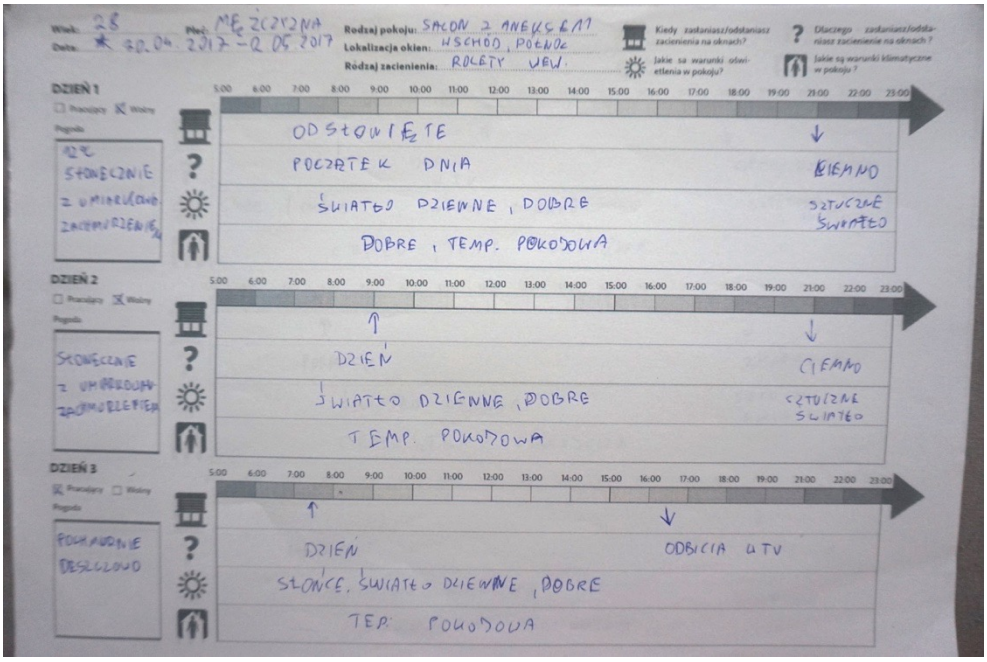
13.Do you need to use electric light when your solar shading is enable during the day because of the other reason, e.g. privacy?

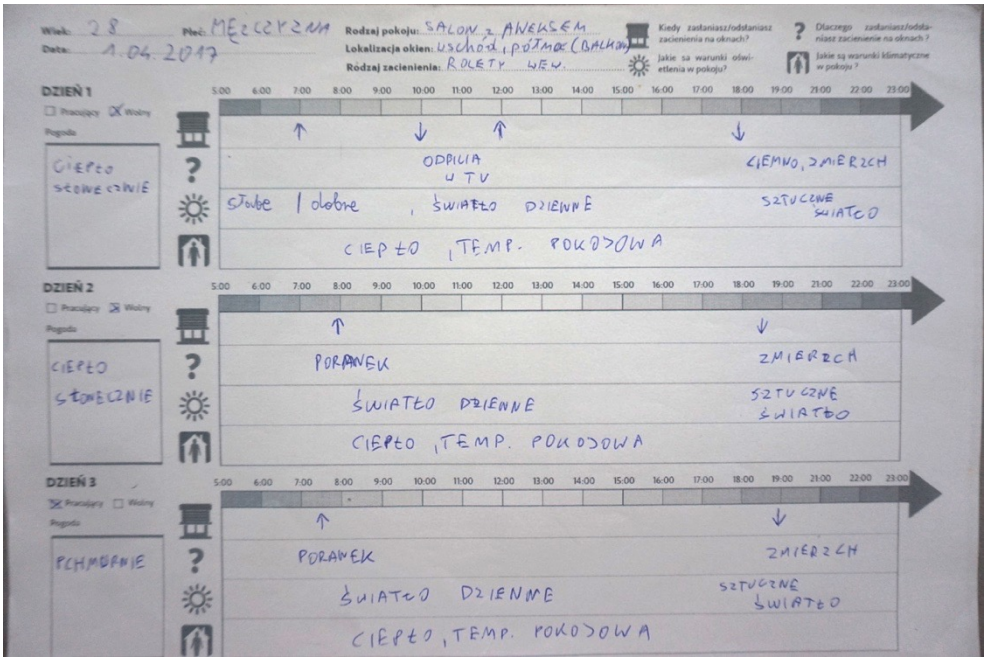
No, I do not use it even when window is cover.

14. Would you like to have automatic solar shadings that would close/open regarding to the room and outdoor temperature?

Yes, but probably I would be afraid that it will get broken or it will not cover the window when it is necessary.

- **User 5**





Place of living – small flat (1 bedroom and living room with kitchen), second floor in the apartments' neighbourhood.
Who –Family of 3, parents and 6-month old baby.

Interview with the man:

1.In which rooms do you have solar shadings??
In all the rooms.

2.Why?
When I move there it was already installed. I use it mostly to cover my windows when is getting dark, to protect form the light of the street lamps and because it is a rule.

3.Would you install them if they were not before?
Yes, but only in bedroom.

4. Do you also use it to protect your privacy?
A bit yes but it is not main reason since I do not think that they can see much.

5.What type of solar shading do you have?
Indoor roller blinds.

6. What about the colour?
They are beige, but the one in bedroom are more thick so they are not allowing the light go through almost at all.

7.Is your solar shading easy to use?
Easy, very easy.

8.Do your windows are especially oriented into the sun?
Not really, they are mostly oriented to the north and only one to the west side.

9.Do you use it everyday?
Yes.

10. Is there any specific situation that you use solar shadings, beside everyday ritual?
When it is strong sun during the morning hours and it reflects on the TV. Also when my wife is not at home and I play on the TV.

11.Do you always disable your solar shading when is no longer needed? Why?
Not always. Sometimes it is because of laziness, luck of time or we are not at home. Also we do not disable it when we leave home when was still dark, especially, in the winter time.

12.Do solar shadings help you create better indoor climate in terms of temperature and lighting conditions?

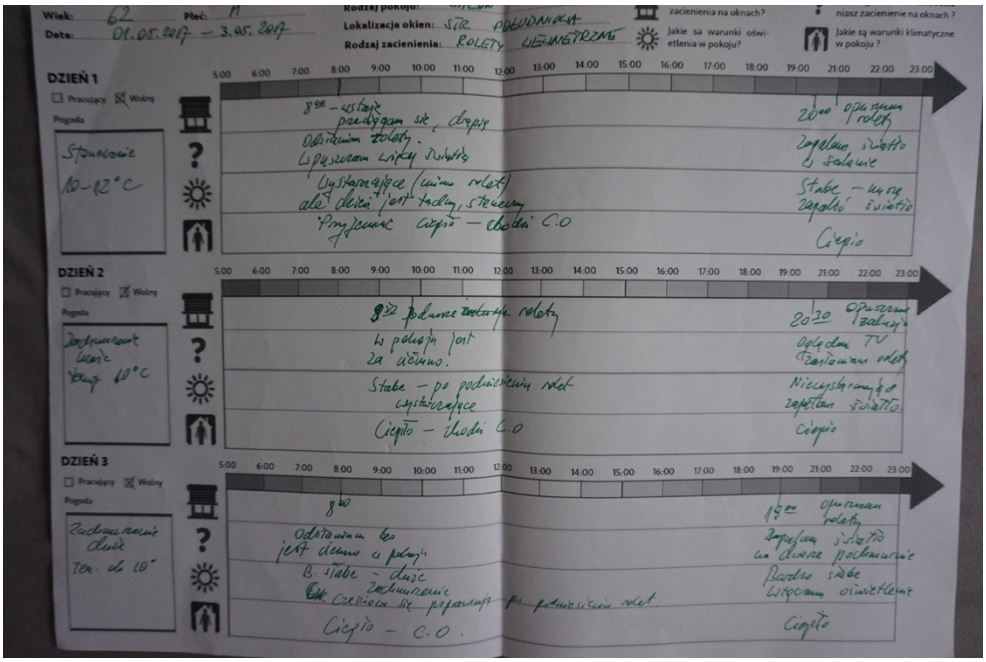
When the sun is shining on the window it can slow down the heating of the room. In terms of lighting conditions, it makes the room darker.

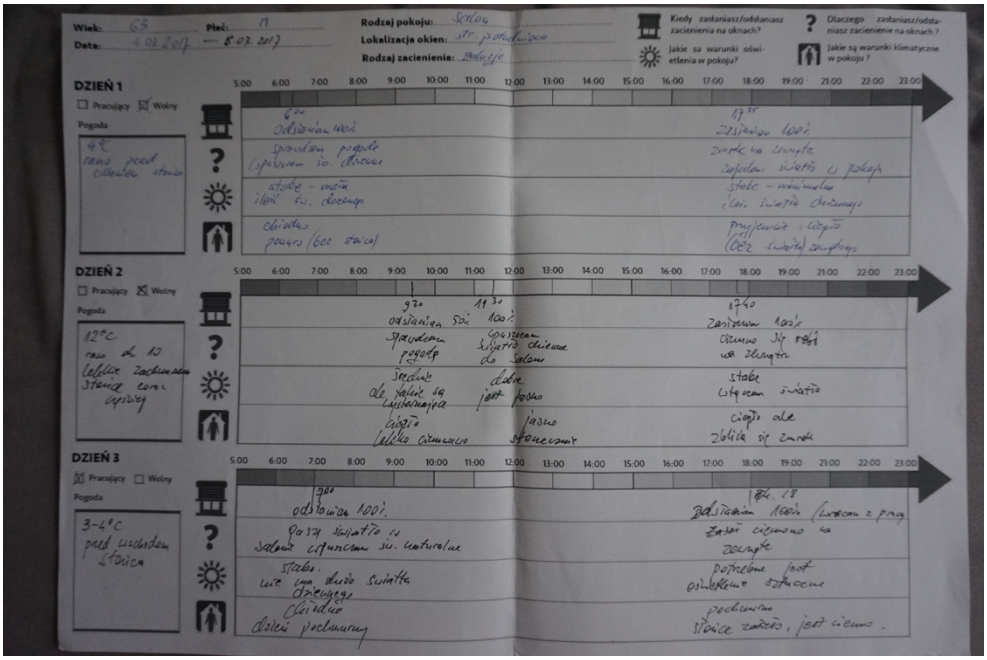
13.Do solar shadings help you create better indoor climate in terms of well-being?
It gets more cosy when is cover during the night, there is not black unknown space behind the window. Also it contributes to better sleep.

14.Do the use of solar shading influence your daylight condition during the day? how and when?
Not much. I only cover to reduce a bit the strong sun light but it does not make the room too dark so I do not have to use electric light.

15. Would you like to have automatic solar shadings that would close/open regarding to the room and outdoor temperature?
Yes, if there will be a possibility to also control it in other situations and make own configurations.
Wife: No, I think it is offhand gadget.

- **User 6**





Place of living – semi-detached house (3 bedrooms, living room, kitchen), in the suburbs in the housing' neighbourhood.
Who –Man 62 years old, working.

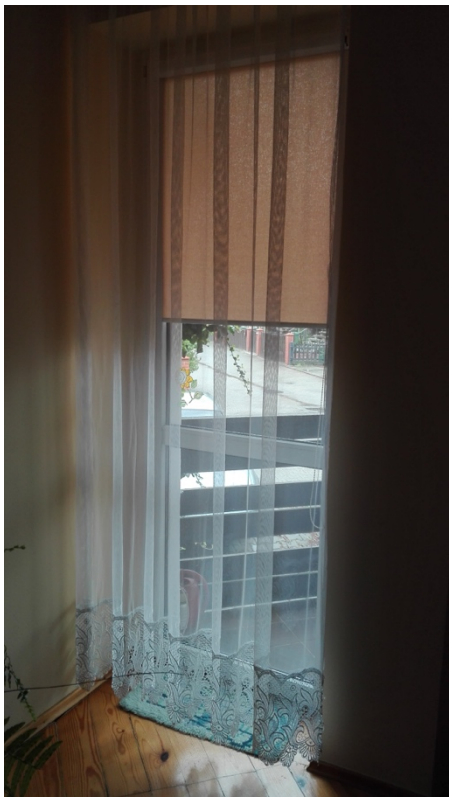


Figure 1 - living room

Interview with the man:

1.In which rooms do you have solar shadings and why?
In bedroom to sleep better and the living room when I turn on the light or TV so people cannot see me from outside and what is happening inside.

2.What type of solar shading do you have?
Indoor material roller blinds. I also have the net curtains.

3. What about the colour?
In the bedroom are blue and in the living room are yellow.

4.Why do you have this type of solar shading?
It was quite new, modern model when I was buying them and it was not so expensive.

5.Is your solar shading easy to use?
Yes!

6.Do your windows are especially oriented into the sun?
Yes, in the living room and one bedroom are on the south. But the bedroom is not used and the window of living room is under balcony.

7. Do you use on those windows the solar shadings to protect from the sun?
I do not have in the bedroom but in the living room sometimes yes since is better to watch TV, but in general not so often.

8.Do you use it everyday?
Yes, during the night I enable it and in the morning I disable everyday.

9. Is there any specific situation that you use solar shadings, beside everyday ritual?
For example, when I lay on the couch and sun is shining into my eyes I enable it.

10.Do you always disable your solar shading when is no longer needed?
Yes.

11.Do solar shadings help you create better indoor climate in terms of temperature and lighting conditions? How?
In the sunny day and I enable it the sun has less accesses to the room so the temperature is a bit lower. Also by putting it down I make a room darker.

12.Do solar shadings help you create better indoor climate in terms of well-being?
I try to use the solar shading as less as possible since I feel better when the sun has accesses to the room. In the evening I feel better and more comfortable when is enable so other people cannot see me.

13.Do the use of solar shading influence your daylight condition during the day? how and when?

Yes, but it is not so dark.

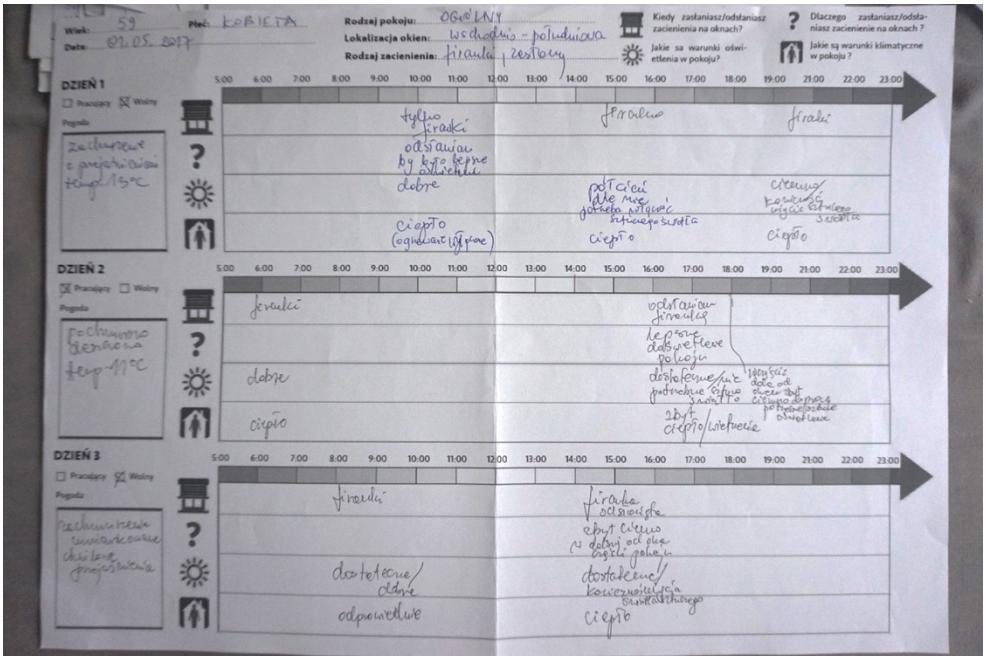
14.Do you need to use electric light when your solar shading is enable during the day because of the other reason, e.g. privacy?

No. The light is sufficient.

15. Would you like to have automatic solar shadings that would close/open regarding to the room and outdoor temperature?

No, because I prefer to do it by myself and I do not think that it will help to minimise energy consumption significantly.

- **User 7**



Place of living – small flat (bedroom, living room, kitchen and bathroom), third floor in the city in the apartments' neighbourhood.

Who – lady 58 years' old.

Interview with the lady:

1.In which rooms do you have solar shadings??
In the bedroom and kitchen. In the bedroom I have net curtains and curtains and in the kitchen I have indoor roller blinds. I used them to protect from the sun.

2.Why do you have this type of solar shading?
Indoor roller blinds in the kitchen because I do not have any other window covering and in the bedroom I am planning to install blinds but for now the curtains were cheaper option.

3.Is your solar shading easy to use?
Yes.

7.Do your windows are especially oriented into the sun?
Yes, during the noon time in the summer in both kitchen and the bedroom. In the winter time is not an issue.

7.Do you use it everyday?
No, only when the sun is strong.

9. Is there any specific situation that you use solar shadings, beside the sun?
Sometimes I enable the curtains in the evening so I can sleep better in the morning. I do not have a need of visual separation.

10. Why do not you need visual separation?
I do not have any thing in front of my windows just the empty wall and trees so no one can see me.

11. Will you cover the windows if there will be some building with windows in front or you will live on ground floor?
Yes, then I would enable it to protect my privacy.

12.Do solar shadings help you create better indoor climate in terms of temperature and lighting conditions?
During the very sunny day it will be colder in the room if the solar shading is enable. On the other hand, when are solar shading disable the room is getting warmer what is beneficial during the winter time.

14.Do solar shadings help you create better indoor climate in terms of well-being?
If it is too hot, people feels more tired and if the temperature is right, it is better for the productivity.

15.Do you sleep better if the solar shading is enable in the morning?
Yes, I sleep better because the sun is not waking me up in the morning.

16.Do the use of solar shading influence your daylight condition during the day? how and when?

Yes, it is getting darker. When I use the roller blinds in the kitchen is not too dark to do basic things, however, the lighting conditions are not enough good for reading. In the bedroom the curtains are much darker so it gets too dark to do things in comfortable way.

16.Do you need to use electric light when your solar shading is enable during the day because of the other reason, e.g. privacy?

No, I do not use much of electric light.

18. Would you like to have automatic solar shadings that would close/open regarding to the room and outdoor temperature?

Of course yes, because it is good for energy saving. It will be helpful when I am not at home and the sun is heating so the rooms are overheated when I am back and it is not so comfortable.

- **User 8**

Place of living – flat (3 rooms, kitchen and bathroom), in the city on the third floor in the apartments' neighbourhood.
Who –Family of 4 (parents and two kids)

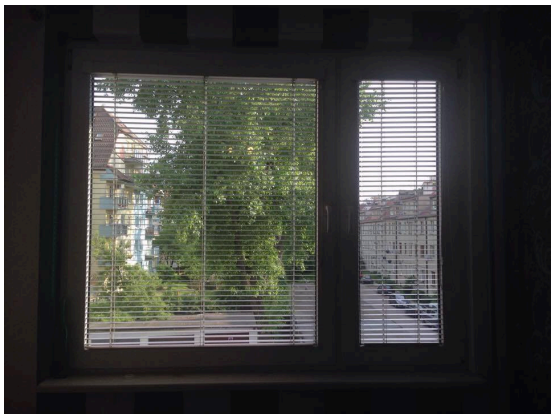


Figure 1- Bedroom

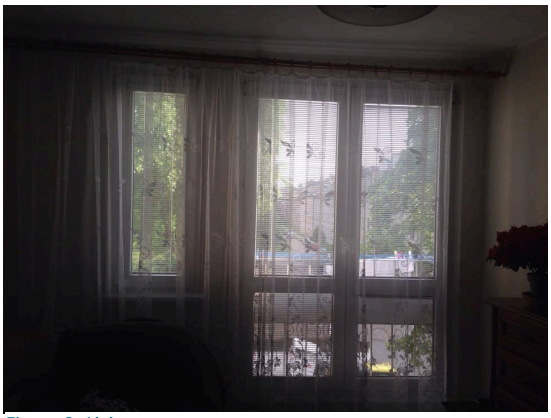


Figure 2- Living room

Figure 3- Bedroom

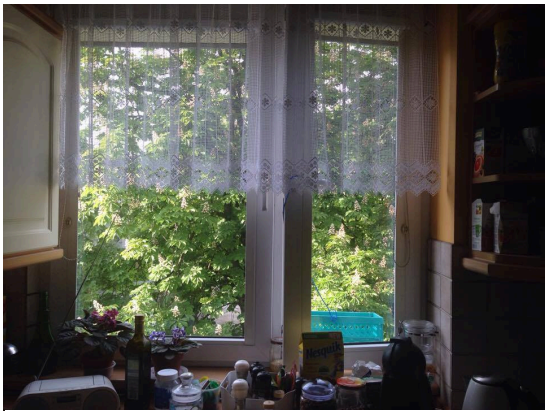


Figure 4- Kitchen

Interview with the kid (26 years old):

1.In which rooms do you have solar shadings and why?

In all the rooms. In the kitchen, we use it the mostly the window is in front the other building and we do not want people to see us. In my brother room as well we use it as a privacy protection. In my parent's room and mine which are on the same side we use it to protect from the sun heating and glare.

2.What type of solar shading do you have?

In the kitchen, we have roller blinds and small net curtain, in my brother's room are only roller blinds, in my room are only blinds and in my parents' room/leaving room are blinds and net curtains.

3. Why your parents have net curtains and why you and your brother not?

As a decoration. My brother is a boy so he does not want to have them and for me they were annoying so I took them off as well.

4.Is your solar shading easy to use?

Yes! But is not easy to clean.

5.Do your windows are especially oriented into the sun?
Yes, especially, my and my parents room

6.Do you use solar shading to protect from sun heating?
Yes, in the summer days.

7.Do you use it everyday?
Me not always, also my parents not. But we always use it in the kitchen and my brother's room.

8. Is there any specific situation that you use solar shadings, beside everyday ritual?
When I sit on my bed that is next to the window I need to use it to protect from the glare because I cannot see anything. Also when I sit on my desk to better see on my laptop. In my parents' room we use when is strong sun to better see on the TV. Moreover, when I sleep sometimes during the day.

9.Do you always disable your solar shading when is no longer needed?
Yes.

10.Do solar shadings help you create better indoor climate in terms of temperature and lighting conditions?
It can make the room darker and also it can protect from overheating.

11.Do solar shadings help you create better indoor climate in terms of well-being?
You can feel better when you protect your room from overheating.

12.Do the use of solar shading influence your daylight condition during the day? how and when?
Yes, it is quite dark. Very often I have to put electric lights on and sometimes my mother gets angry that the sun is not so strong and it does not shine in my face so the light is not necessary cause it is still enough light out side.

13.Why do not you disable than the solar shading?
I forget, but is just for the moment.

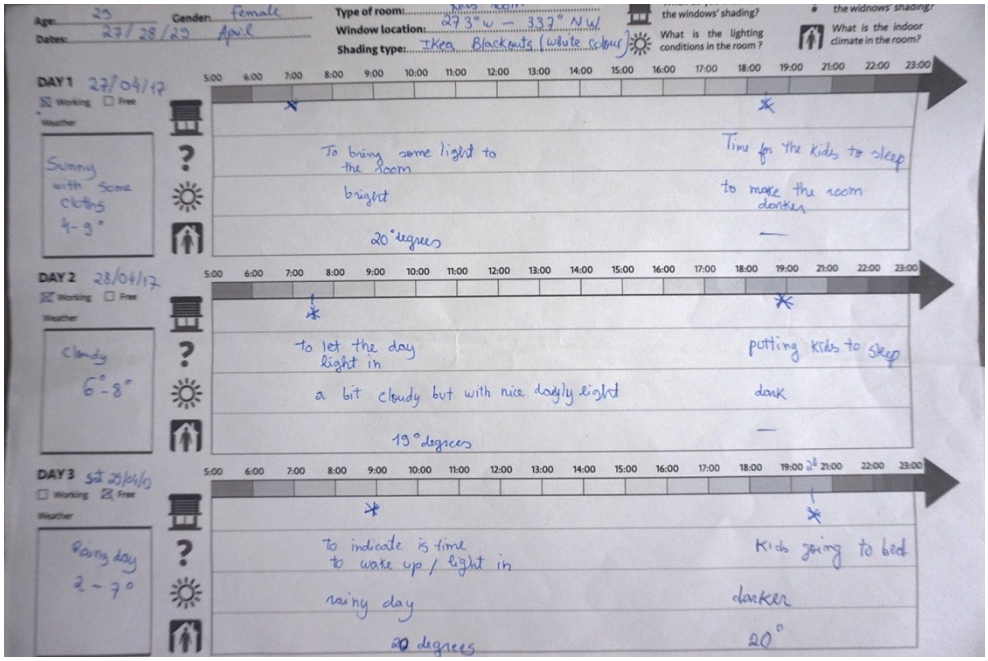
14.Do you need to use electric light when your solar shading is enable during the day because of the other reason, e.g. privacy?
Yes, quite often. But my parents not. In the kitchen I only enable when is getting dark.

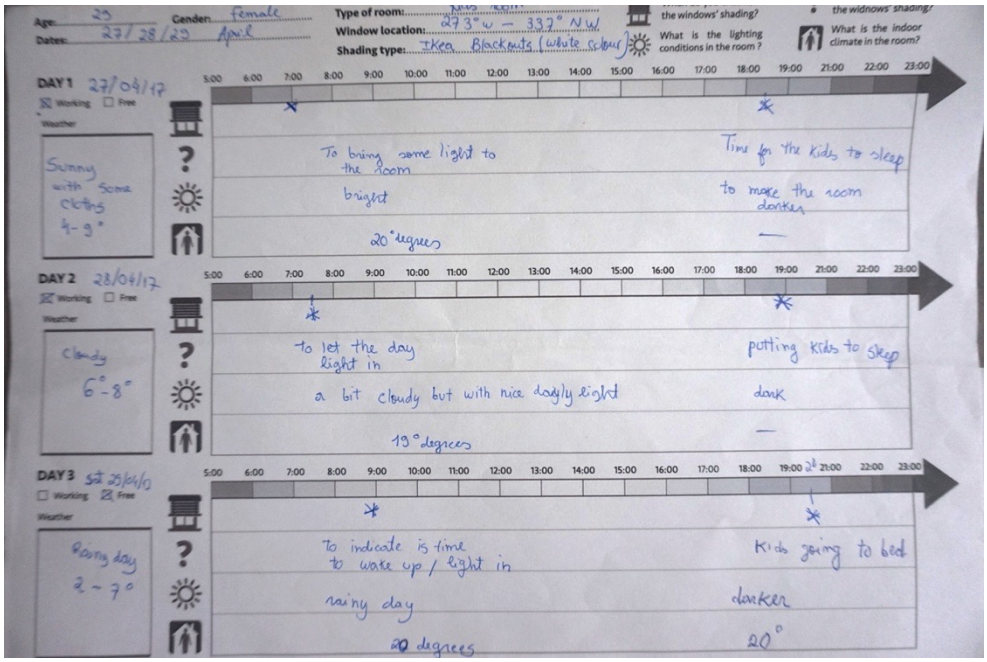
15.Would you like to have automatic solar shadings that would close/open regarding to the room and outdoor temperature?
Of course.

16. Why?
Because you do not have to think about it and remember, especially, when is hot and sunny day. I do not have to take care of the small things like this so my life is easier.

G: Participants answers from Denmark

- **User A**





Place of living – flat (2 bedrooms, kitchen and bathroom), in the city on the third floor in the apartments' neighbourhood in the city centre. Very bright apartment with a lot of windows.
Who –Family of 4 (parents and two small kids)

Interview with the women (29 years old):

1.In which rooms do you have solar shadings and why?
I have solar shadings in the bedrooms. We use them when we go to sleep to make the room darker, especially in kids' room where are three windows which make a room very bright. There is also one in the living room but we never use it. It is always disable since we like the light in the living room.

2. What type of solar shading do you have?
The blackout blinds from IKEA.

3.Why do you have this type of solar shading?
Because they make the room very dark.

4.Do your windows are especially oriented into the sun?
Yes. Especially, in the living room in the afternoon.

5.Do you use solar shading to protect from solar heating, then?
No.

6.Do you need to use additional cooling devices during the summer?
No. I just open the window if I need more air.

7.Is your solar shading easy to use?
Yes, the one which you can scroll with the string that we have in my bedroom. However, in my kids room we have a new version, that does not have it and I have to climb on the sill to put it down. I could have put string to make it easier since they roll up by themselves but I did not.

8.Do you use it everyday?
Yes, the one in the bedrooms. The kids go to sleep very early around 6-7 pm and there is still light outside so I need to put it down to make it easier for them to fall asleep.

9.Do you use it also for privacy issue?
No, I do not need it for privacy.

10. Is there any specific situation that you use solar shadings, beside everyday ritual?
One of my kids still sleeps in the afternoon so during the weekends I put down the solar shading but it is in my room. She sleeps form around 12 to 2 pm.

11.Do you always disable your solar shading when is no longer needed?
Yes, to make it light. I do not even thing of this. It is routinized.

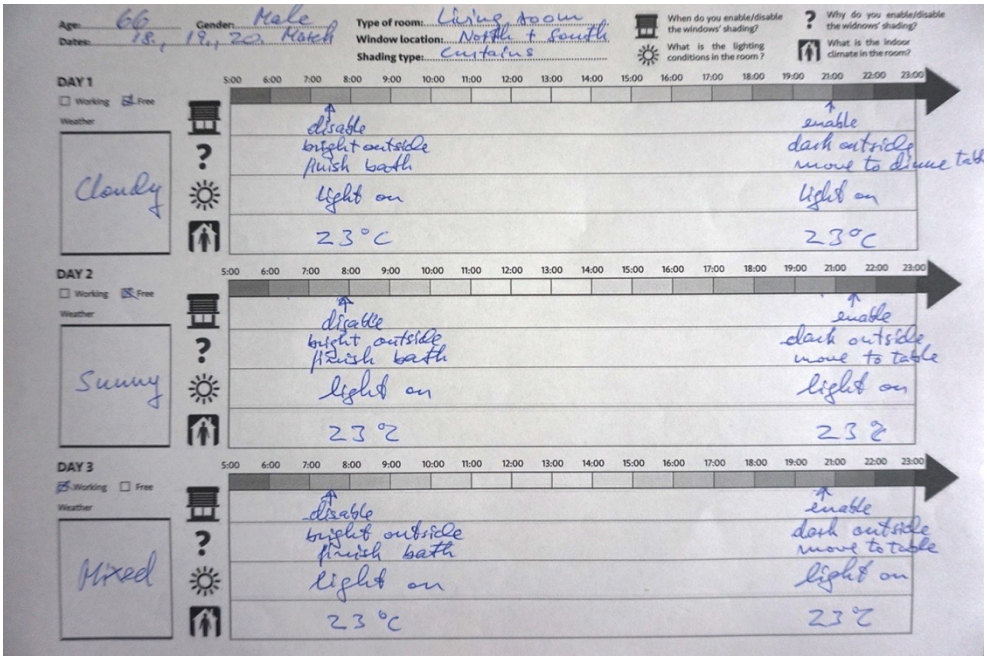
12.Do solar shadings help you create better indoor climate in terms of temperature and lighting conditions?
No, I do not.

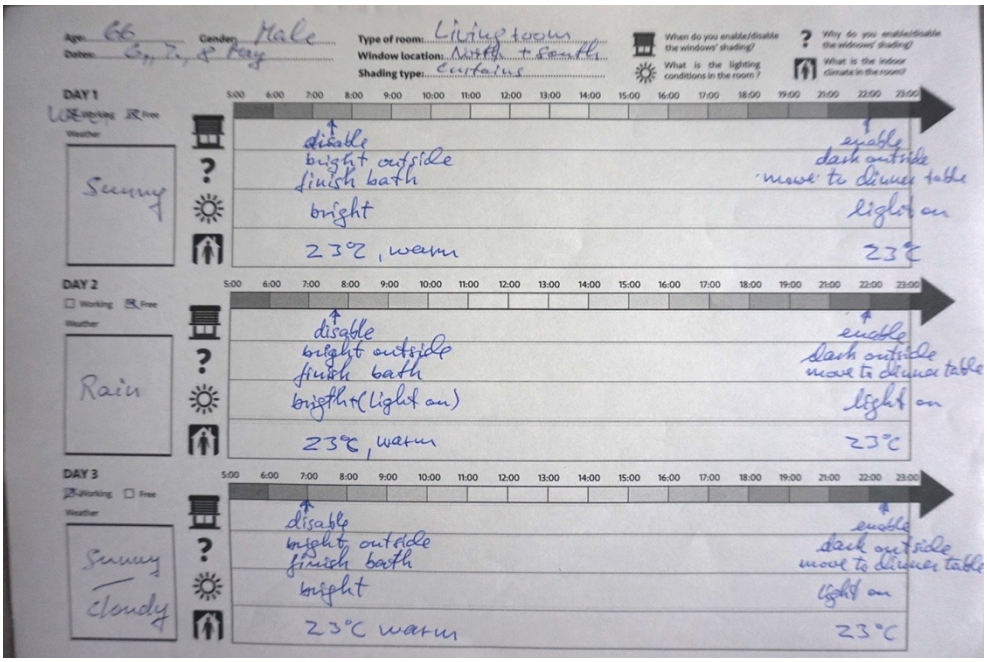
13.Do solar shadings help you create better indoor climate in terms of well-being?
Yes, I think without it, it would be challenging to put kids to sleep when the room is still very bright. It helps me to sleep better.

14.Do the use of solar shading influence your daylight condition during the day? how and when?
It makes the room darker but not that dark to turn the light on. For example, I do not need to use electric light when I put my kids to sleep. I use it only when there is no more daylight.

15.Would you like to have automatic solar shadings that would close/open regarding to the room and outdoor temperature?
That would be awesome. I would not have to think of it, also I will not have to climb on the sill to enable it in kids' room.

- **User B**





Place of living – row house (4 bedrooms, living room, kitchen and 2 bathroom), only one floor, suburbs of the city.
Who –Couple (66 years old)

Interview with the man:

1.In which rooms do you have solar shadings and why?
We have old fashioned curtains only in one par of the living room. In the living room we have a curtains only in the windows that are oriented to the public, we do not have them on the window oriented into the garden. We also we have them in the bedrooms and we cover them when we go to sleep. In the living room, when we have a coffee in the evening in our dining table and when is dark, we would typically cover the windows that are close by.

2. Would you do it to protect your privacy?
In a way yes because in the evening when is dark people can look in but we can not look out and it is not interesting to have the black window, so it will become more cosy. If it is not black outside, we would have a view and also other would be able to see.

3.Does it ever happened that you felt that people were looking into your house?
No, people do not look inside unless they want to knock on the window to say something. Also it is seen impolite do it.

4.Why do you have this type of solar shading?
We do not have a big window so we want have as much light access as possible. Actually, we have one room with blinds where my daughter was living and I think it

was her idea to have it, I think it has something with generation. I guess we are too old fashioned and also because my wife was sewing them by herself and that is traditional way. We did not find need for change it.

5.Is it your so solar shading easy to use?
Yes, it is very easy.

6.Do your windows are especially oriented into the sun?
The windows that the sun in coming mostly in, they don't have curtains or any other protection

7.Do you use solar shading to protect from solar heating, then?
No. We open the window. My wife like to sit in the garden and feel sun. Maybe sometimes I feel I have heating problems inside but is really few times.

8.Do you use it everyday?
Yes.

9. Is there any specific situation that you use solar shadings, beside everyday ritual?
No there is not at least the couple of years back. It is really a daily routine.

10.Could you use the solar shading right away or you needed to get to used to it?
When I was a kid we had some different solar shading the roller blinds that would make the room completely dark but I do not need it any more. We have curtain just on one side so it is very easy just to pull them on the window. Its my generation style.

11.Do you always disable your solar shading when is no longer needed?
Yes.

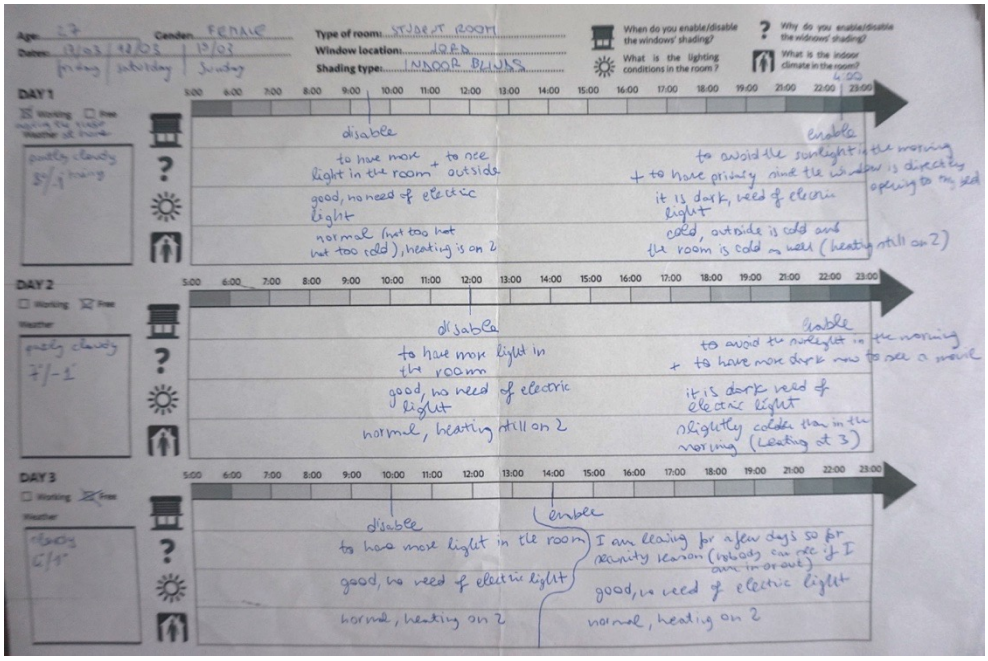
12.Do solar shadings help you create better indoor climate in terms of temperature and lighting conditions?
No, we do not use it in terms of temperature. Of course, if we pull off curtains the room become lighter.
In bedroom, we definitely use the curtains to control the influx of light.

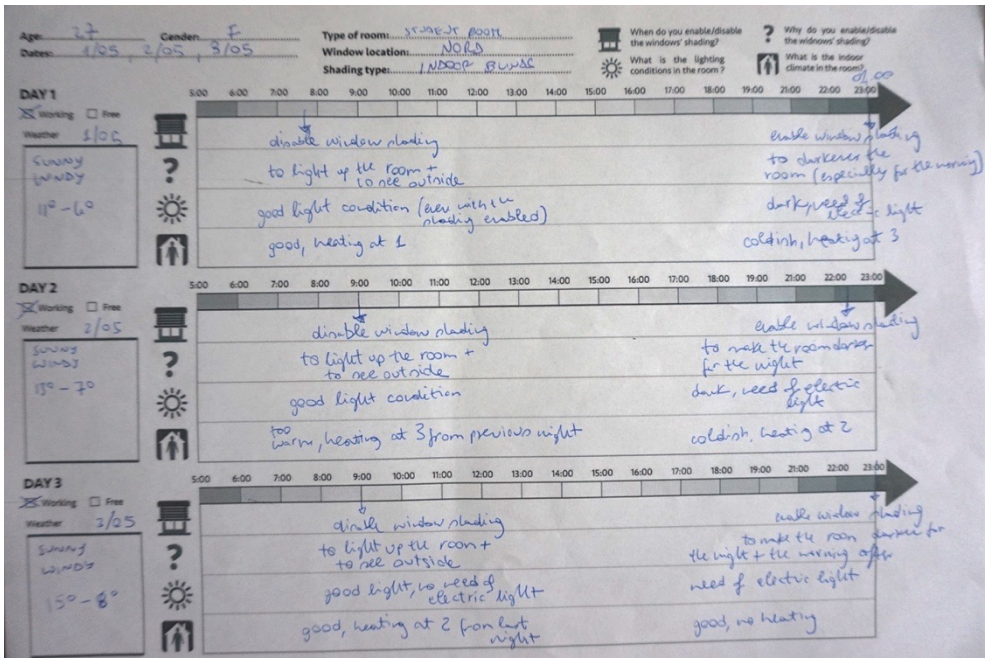
13.Do solar shadings help you create better indoor climate in terms of well-being?
Yes, the cosiness and also I sleep better, if I won't use it I will have sun on my face. I appreciate this routine so I can have better sleep.

14.Do the use of solar shading influence your daylight condition during the day? how and when?
We often use electric light, even though, our solar shading is disable, because part of our living room is very dark. I need some extra light especially at my age.

15.Would you like to have automatic solar shadings that would close/open regarding to the room and outdoor temperature?
No, we do not feel need for it

- **User C**





Place of living – room in dormitory (with kitchen annex and bathroom), on the third floor in the city centre.
Who – Woman (27 years old)

Interview with the women:

1.In which rooms do you have solar shadings and why?
I live in just one room and the solar shading is on the only window I have that is also the balcony window that I can open.

2. What type of solar shading do you have?
Metal day/night indoor blinds.

3.Why do you have this type of solar shading?
It was already there in the room but it is not good for me enough because it is not making the room dark enough during the night. I have a problem with sleeping well if is not dark. Those are not covering enough any daylight or even lamps outside.

4.Which one would you like to have?
I would like to have the one we have in Italy that are the wooden outdoor blinds that are completely covering the window.

5.Is your solar shading easy to use?
Yes, I have stripe that allows me to put it down and up, but the metal elements are very soft so some of them are twisted.

6.Do your windows are especially oriented into the sun?
No, since it is on the north side and also I have building in front that is quite close.

7.Do you use it everyday?
Yes.

8.Could you use the solar shading right away or you needed to get to used to it?
No since they are working as all the other blinds and I always have some similar before.

9.Described how you use it.

As I said I use it mostly when I sleep so as I said I always enable them in the night and disable them in the morning since during the day I want to have more light as much as possible. Maybe sometimes if I do something that I do not want neighbour to see me than I close them since they are very close.

For example, the other day I was changing clothes and it was sunny day so people were outside on their balcony in front of my window so I had to close it.

10.Do you always disable your solar shading when is no longer needed?

Yes.

11.Do solar shadings help you create better indoor climate in terms of temperature and lighting conditions?

Lighting conditions yes, in temperature not really but I think it is because in Denmark is not very hot so I cannot see it, also my window is on north side.

12.Do solar shadings help you create better indoor climate in terms of well-being?

I sleep better however I would sleep even better with other blinds. Also I feel more privacy using it, but not too much.

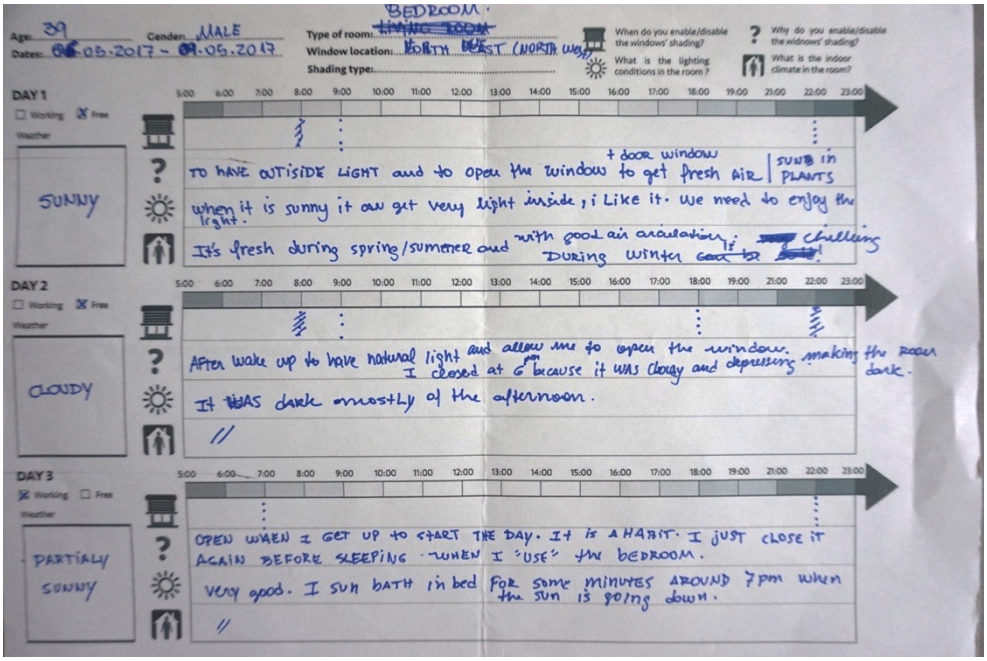
13.Do the use of solar shading influence your daylight condition during the day? how and when?

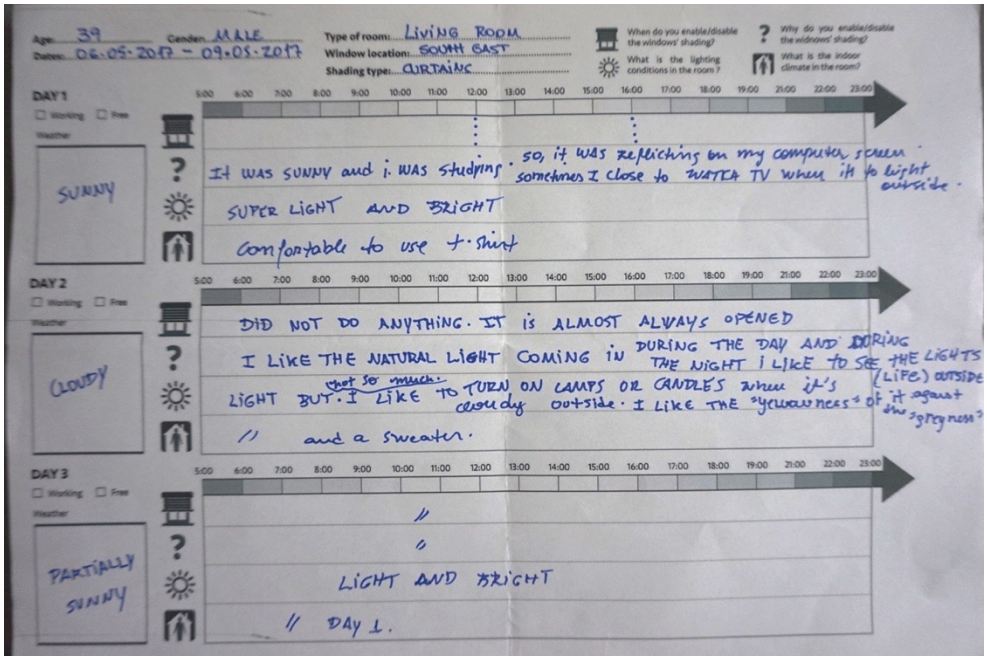
Not that much. Even though, when is cloudy day I have some light to do things.

14. Would you like to have automatic solar shadings that would close/open regarding to the room and outdoor temperature?

Yes, it could be nice if they would cover completely.

- **User D**





Place of living – flat (bedroom, living room, kitchen and bathroom), on the fifth floor in the city center
Who – Couple

Interview with the man (39 years old):

1.In which rooms do you have solar shadings and why?
I have in the bedroom and living room so I can control the light that comes into the room.

2. What type of solar shading do you have?
I have open down/up white curtains in whole flat.

3.Why do you have this type of solar shading?
It does not take space and they make a little bit light lower and also it covers so the neighbours cannot see what we are doing inside.

4.Is your solar shading easy to use?
Very easy, however, you need to know the trick to keep them in one place so they would not fall down.

5.Do your windows are especially oriented into the sun?
The windows in the living room droning the morning and the bedroom one in the afternoon.

6.Do you use solar shading to protect from the solar heating?
No, because we rarely have sun in Copenhagen so I love it.

7.Do you have a problem with overheating?
No, the living is quite cold during the winter so every time, there is a sunny day it is better.

8.Do you use it everyday?
Yes, just the bedroom ones.

9.Could you use the solar shading right away or you needed to get to used to it?
Right away.

10.Described how you use it.
I wake up and I go to the window to open it. I used the stripe to roll it down or up and I have to attached it on the wall so it won't fall down. I usually enable it before I go to sleep, unless it is very bad day outside and I want to do something in the bedroom than I close it earlier.

11. Is there any specific situation that you use solar shadings, beside everyday ritual?
Yes, when the sun is too strong outside and I need to work in the computer I would close, however, it would depend on the place I sit. Also when I want to watch something during the day I would enable solar shading as well.

12.Do you always disable your solar shading when is no longer needed?
Yes. For example, when I watch movie I would open it right after it finished. I do not like to be in close space I like to see life outside.

13.Do solar shadings help you create better indoor climate in terms of temperature and lighting conditions?
Not really, even though, when I close them in the evening during the winter days, it gets a bit warmer but it is slightly different. They are not enough protective.

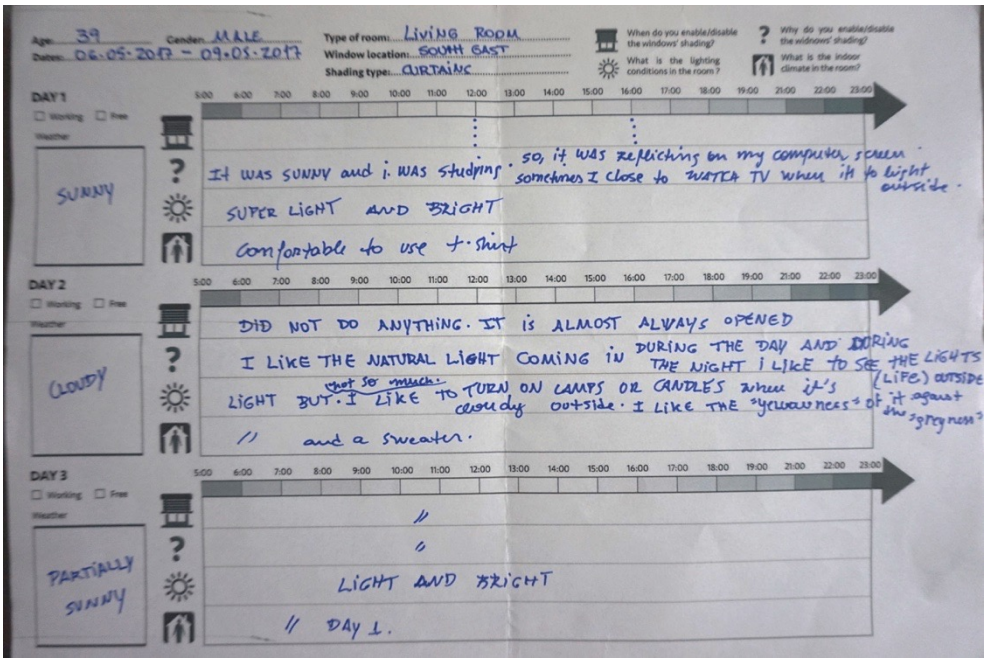
I also sleep better if they are close, but they are not protecting enough during the summer time when sun rise very early, so I am actually thinking to put additional curtain in the bedroom to make it really dark.

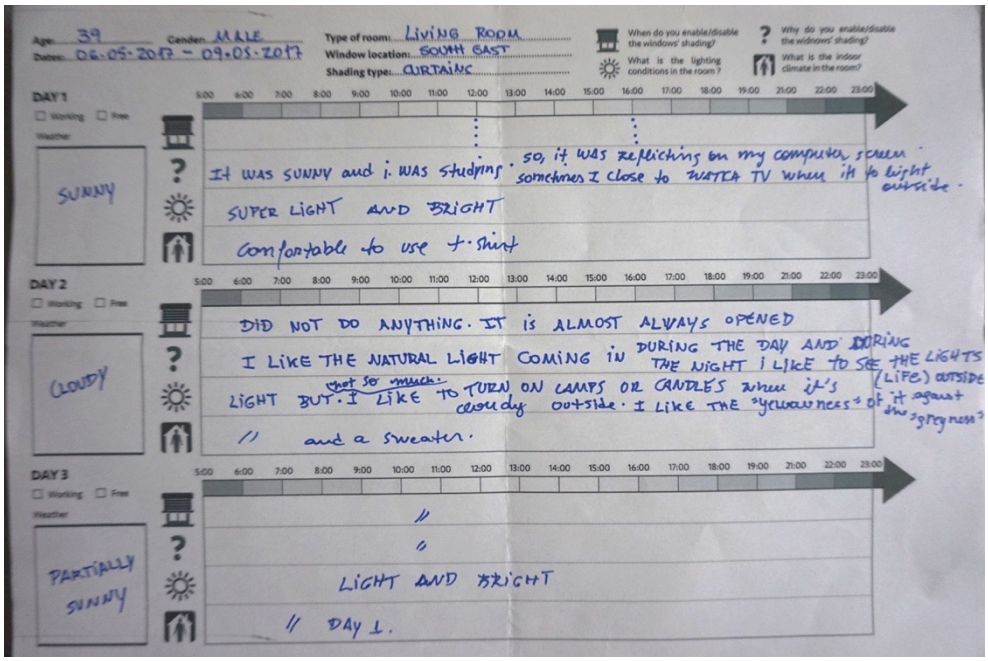
14.Do solar shadings help you create better indoor climate in terms of well-being?
No I like it open. I would like to put in the bedroom something more cosy.

15.Do the use of solar shading influence your daylight condition during the day? how and when?
Yes, but I would almost always use it if I am working or reading even if solar shading is on the cloudy day.

16. Would you like to have automatic solar shadings that would close/open regarding to the room and outdoor temperature?
If I have fancier house yes, here I do not need it.

- **User E**





Place of living – flat (3 bedrooms, living room with kitchen and bathroom), on the ground floor in apartment's area in the city center
Who – three young people

Interview with the man (27 years old):

1.In which rooms do you have solar shadings and why?
I all of them, in some of them for privacy and the other to reduce the sun light so we can use projector and watch movies.

2. What type of solar shading do you have?
Curtains but not typical one.

4.Why do you have this type of solar shading?
Because they were looking nice and they were easier to install than blinds.

3.Is your solar shading easy to use?
Yes.

11.Described how you use it.
I go to the window and slide it back and forth. They would permanently cover one side of the window.

3.Do your windows are especially oriented into the sun?
Yes, in the living room and one of the bedroom on the south. And the others are northwest so in summer we have a bit of sun in the morning.

3.Do you have a problem with overheating in the summer?
In the summer yes a bit in the living room and also in July in my room which is on the other side because the sun heats a lot in the morning even throw the curtains. They do not stop the solar heating or light that well.

7.Do you use it everyday?
Yes.

10.Could you use the solar shading right away or you needed to get to used to it?
I could use it right away, I did not to have to read instruction on how to use it.

9. Is there any specific situation that you use solar shadings, beside everyday ritual?
Yes, when we watch the movies in the living room in the afternoon.

10.How often do you watch the movies?
Almost everyday or night.

12.Do you always disable your solar shading when is no longer needed?
Yes but since we live on the ground floor and I have very big window, actually whole glass wall right next to the street so I would need shading all the time in my room to protect my privacy.

13.Do solar shadings help you create better indoor climate in terms of temperature and lighting conditions? How?

For example, few months ago when it was still very cold outside the sun was heating our interior very well.

14.Do solar shadings help you create better indoor climate in terms of well-being? How?

I feel better if I have them enable and the sun do not wake me up at 5 am.

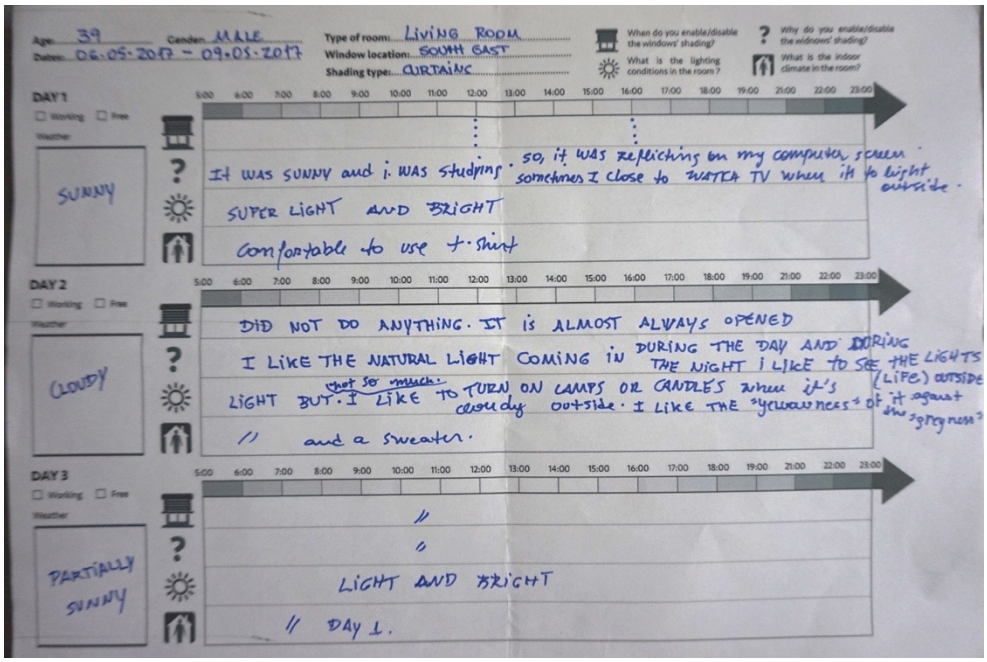
15.Do the use of solar shading influence your daylight condition during the day? how and when?

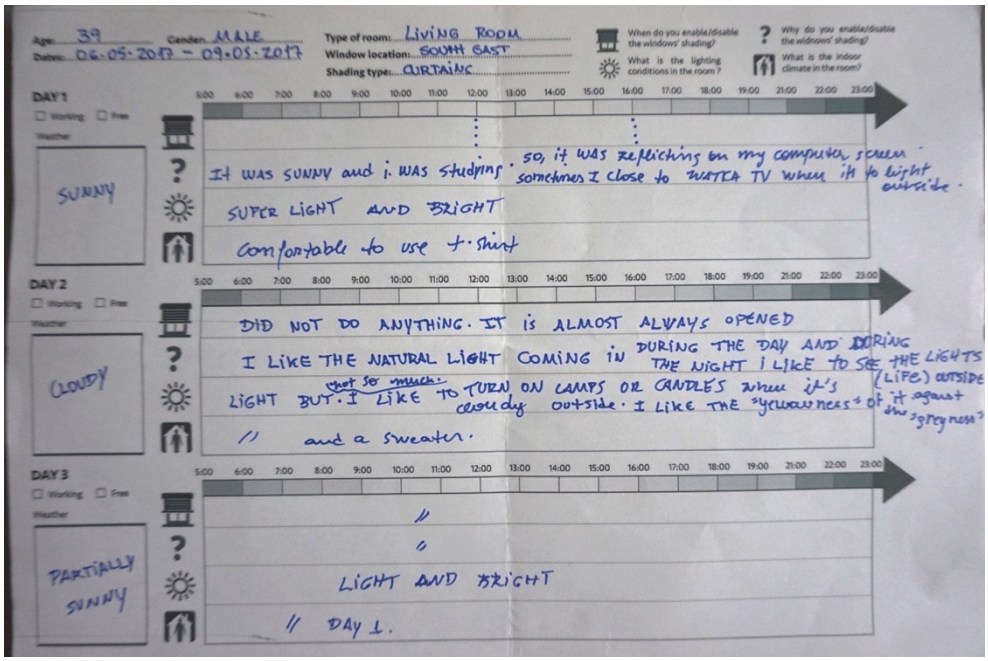
It just makes the room a little bit darker, it definitely helps enough to see better on the TV or computer screen.

18. Would you like to have automatic solar shadings that would close/open regarding to the room and outdoor temperature?

Yes, because it would save me few additional movements and new generations is used to the things that do things for us.

- **User F**





Place of living – flat (4 bedrooms, living room with kitchen and bathroom), on the first floor in apartment's area in the suburbs
Who – Couple and two kids

Interview with the man (52 years old):

1.In which rooms do you have solar shadings and why?
In three bed rooms I have roller blinds, and in the living room that is to the south we have partly transparent blinds. In the bedroom is to make it dark when we want to sleep and in the living room is to protect form the sun.

2.Why do you have this type of solar shading?
In the bedroom because it can make the room very dark. In the living room, it is fine with partly transparent do when we protect from the sun we still have some light in the room.

3.Do you use the shading to protect the privacy as well?
Not the one in the living room but in the bedrooms also for privacy.

4.Do your windows are especially oriented into the sun?
The living room is to the south but the bedrooms are west/east.

5.Do you the solar shading in the living room for overheating protection?
Yes.

6.Do you use any cooling devices in the summer?
No, only we open the window.

7.Is your solar shading easy to use?
Yes. I think so. It is manual but is ok.

8.Could you use the solar shading right away or you needed to get to used to it?
Yes.

9.Do you use it everyday?
In the bedrooms yes, in the living room only in the sunny summer days, but not during the winter.

10.Do you always disable your solar shading when is no longer needed?
Yes.

11. Is there any specific situation that you use solar shadings, beside everyday ritual?
Maybe in the weekend if we want to take a nap.

12.Do solar shadings help you create better indoor climate in terms of temperature and lighting conditions? How?
Yes, that is what we do in the living room to do not get to hot inside. Also in the winter we do not use it so the room gets warmer.

13.Do solar shadings help you create better indoor climate in terms of well-being? How?
Yes, I sleep better in the morning when it is dark in the morning.

14.Do the use of solar shading influence your daylight condition during the day? how and when?
Yes, bedroom ones a lot and living room just a bit, but it is enough to reduce the sun.

15.Would you like to have automatic solar shadings that would close/open regarding to the room and outdoor temperature?
I could consider it in the living room since we have five of them. It would be easier but maybe it is too advance, I do not know.