Socially inclusive Lighting Design: exploring a method to enhance freedom of movement for marginalised groups.

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Abstract. Based on literature and field research, women and marginalised groups often experience unwanted attention in the public realm worldwide. This attention often produces a gendered fear, which can result in avoidance behaviour of urban public places. Universal design has been implemented to ensure everyone can access urban areas, but this access is still restricted for many vulnerable groups. This investigation aims to find relevant lighting design principles for making public urban spaces more inclusive for all marginalised groups. A literature review, case studies of three urban places, focus group interviews, and an experiment with torches in the field were the chosen methods to gain knowledge. The findings suggest that the participants experience fear in public places when they feel exposed as someone who can become a potential target. This results in a need to see their surroundings and have an awareness of the presence of others. In addition, the experiment showed how they wanted to use warm lighting and beautify the place by enhancing details. The conclusion suggests six different lighting design methods to create inclusive public areas, such as beautifying details and legibility with vertically lit surfaces. These six principles could make urban public places more socially inclusive for marginalised groups, women, and other vulnerable groups. The results should be compared and confirmed by using control groups with other non-marginalised groups.

Keywords: socially inclusive lighting design, marginalised groups, mobility

1. Introduction

The United Nations has recognised unequal access to urban public places as a global problem. Their Sustainable Development Goal 11 has been made to: "*make cities inclusive, safe, resilient, and sustainable" [1].* Equal rights to the cities have further been included in one of their targets, 11.7. By 2030, the UN aims to: *"provide universal access to safe, inclusive, accessible, green and public places, particularly for women and children, older persons and persons with disability" [2].* Also, UN Women are concerned with safe mobility and inclusion in the public realm [3].

One possible solution to make cities safer is implementing gender mainstreaming in planning [4]. The city of Vienna is an example of how they included these issues in the planning and created a city for everybody, paying special attention to the needs of women and vulnerable groups. [5].

Groups that break the norm of the majority in our society, generally defined as marginalised groups, typically suffer from unwanted attention, sexual harassment, and misrepresentation in the public realm. Women and minorities, such as racialised, older, and people with disabilities, also commonly defined as vulnerable groups, often share the experience of exclusion from urban public places. This exclusion often leads to a heightened fear of crime, and consequently, their freedom of movement and mobility in the public realm is restricted [6], [10]. This is defined as gendered fear and is a complex phenomenon discussed within the field of human geography since the 1980s; however, without conclusion [11], [12]. A study of young girls in Melbourne in 2022 shows that *"vulnerability in public space after dark are consequences of gender inequality and perpetuate the social exclusion of women*"[10, p. 86]. Their

findings show that lighting has the potential to be an element that can have a substantial spatial and social impact. These findings complement previous studies [13]–[15], where gendered fear has been studied as a factor compared to spatial design when creating safer urban places. Our literature review suggests that only a few articles have studied how lighting design can make urban public places more inclusive for marginalised groups.

1.1. The aim

In a master thesis, [16], a study was made to find relevant lighting design principles for making public urban spaces more inclusive for all marginalised groups. This article is based on this thesis. The aim is to investigate the research gap in how lighting design can make more socially inclusive urban places for marginalised groups. By broadening the research to include marginalised groups, more equitable and inclusive insights into how lighting design can contribute to more socially inclusive urban places for vulnerable groups can be gained. Although this article uses members of one marginalised group as a starting point, the findings could potentially be generalised t be valid for other vulnerable groups, such as racialised groups, women and children or older people. The article is based on studies in Oslo. This is in a part of the world where equality and legislation exist, and in Oslo, the public realm is considered safe. Still, as the results from the field study indicate, gaps remain to be filled.

2. Methodology

The chosen methods for this investigation consist of 1) a literature review, 2) a case study of three urban places in Oslo, and 3) a three-part field study. The first two parts create a basic understanding of how lighting design can support social interaction.

The literature review of three subjects laid the foundations for an analytical social inclusivity framework. These three subjects were inclusive urban planning, atmosphere as a phenomenon, and methods used in lighting design to achieve atmospheres. This framework was further used to analyse social inclusivity in the case studies.

In the case studies [17], several phenomenological methods are used when analysing the spatial design, the social aspects, and the lighting design at three different urban squares in Oslo. These sites were chosen because they represent diverse uses and variations in the spatial design. To analyse both spatial and social elements of the squares, both macro [18], [19] and micro levels [20] were chosen. The six lighting qualities as defined by Descotte and Ramos [21] were used to analyse the lighting and luminance maps.

10 members of one marginalised group participated in all of the three parts of the field study. These people identified themselves as members of the LGBT+ community in Oslo. They were selected to learn how marginalised groups in Oslo restrict their movement in urban public places and how lighting can influence their choice of routes. The members gave informed consent to their participation and that the anonymised data would be recorded and published.

The first part was primarily a focus group interview to discuss avoidance behaviour. For the second focus group interview, a method of visual ethnography called walking with video was chosen. This was done to enable the participants to reflect on how the lighting influenced their walks and their embodied experience in the space; this open method of handing over the camera to them was chosen so they could reflect on the felt experiences and used as a method to start a discussion with the participants [22].

The equipment used in the experiment, as the third part of the field study, was handheld torches provided by the lighting department at the University of Southeast Norway (USN) and two work lights. The equipment consisted of 10 tiny LED torches called Ledlenser P7R Core with 1500lm, 6 Ledlenser P18R Signature with 4500lm, and two work lights called Canopus 3000 RE. These two had a colour temperature range of 6500K-27000K and a dimming function. The audio from the whole experiment was recorded using a tape recorder in the author's pocket and documented by a photographer. The photographs and audio recordings from the experiment were analysed and used to develop a proposal for socially inclusive lighting design principles. The interview data were transcribed and analysed through NVivo software. After coding the material, a “Content analyses” method was chosen. This is a text-driven, problem-driven, and method-driven content analysis [23].

3. Literature review

Socially inclusive lighting design is a new direction within the lighting industry [24]. Only a little research has been done on this subject. A review of the first 50 articles through a search on Google Scholar with the search words: *"lighting + marginalised groups + urban public places"* found that only two hits were related to the subject [16]. One article, [10], mentions in their conclusion how marginalised groups should be included in future studies. The other hit was the book where this article was published [25].

Then, the search was broadened to replace "marginalised groups" with "gender": *lighting + gender + urban public lighting."*A new review of the first 50 articles showed that though some of these studies included an overview of gender in their sampling, only six had a gender perspective on perceived safety [16]. A review [26] found that five of the 1315 articles they reviewed focused on how lighting influenced women's perception of safety. The review concluded: *"…important knowledge gap is related to the insufficient representation of cultural or ethnic groups." [26, p. 28].* These reviews of articles on this issue confirm a knowledge gap in how socially inclusive lighting design can enhance freedom of movement for marginalised groups. Yang, Berry, and Kalms conclude that *"other marginalised groups should be included in future studies"* [10, p. 100]. From the research review findings, three subjects were found relevant to further investigation through a literature review: urban planning, atmosphere as a phenomenon, and lighting design.

The literature reviewed on urban planning shows the importance of considering the social aspects of spatial design. Inclusive and more participatory planning processes will help urban planning create urban spaces that are more accessible for everybody. Some ideas for gender-inclusive urban planning have evolved from Jane Jacobs [27] and her thoughts about spatial diversity. Jacobs is, however, most known for her theory of how safety can be achieved by "*eyes on the street"* and that form of social control. William Whyte made many vital observations when studying urban public life and strongly influenced placemaking [28]. His theories show how to turn a space into a place people are attracted to, while Jan Gehl was more concerned about which elements in the spatial design influenced the social life in the cities [20]. His theories have significantly impacted the methods of analysing what makes people stay in urban spaces.

The literature reviewed on the atmosphere as a phenomenon [29]–[31] shows that the atmosphere is complex and cannot create a socially inclusive place alone. Participation, such as light walks with lighting designers and architects, [32]–[35] can help make a foundation for more sociable sustainable places and to find atmospheres that could change the place.

The literature review on lighting design was divided into three subcategories that comply with methods commonly used by lighting designers: 1) reassuring atmosphere, 2) welcoming atmosphere, and 3) inclusive atmosphere [21], [36]–[38].

The findings from the literature review showed how lighting design can contribute to a change by highlighting elements like urban furniture, activities, and dark corners of an urban place. In that way, predict future use and promote diversity and inclusion. In addition, by lighting architectural features, lighting design can enhance public places' perceived safety, beauty, and image so more people are attracted to the place. This, in turn, can attract more people and ensure more eyes on the street, making the place safer and more inclusive.

4. Phenomenological observations as case studies

To make a supportive lighting design, the lighting designer needs to gain a complete understanding of how people would like to use the place to be able to support their social interaction. Observations of three urban public places in Oslo were conducted to gain insights into how to analyse the spatial, social, and potential atmospheres together and to learn how lighting design could help social interaction in urban public places.

The places were chosen because they represented three different uses by the public and had different spatial designs. When using the analytical framework developed through the literature review, Tøyen Torg was the most successful in the social inclusion [16].

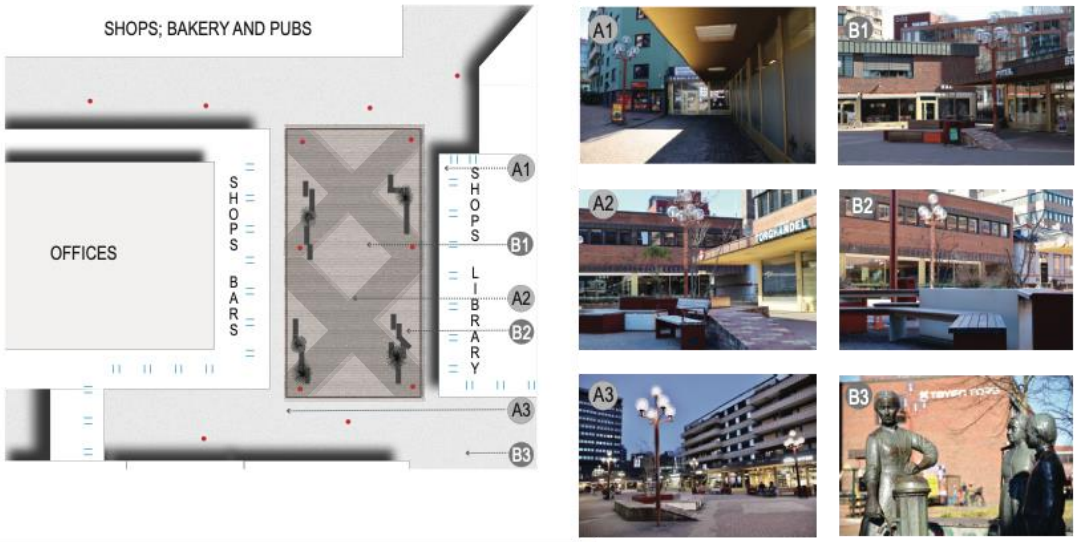


Figure 1: Tøyen torg is located at Tøyen in Oslo and is frequently used by residents and visitors from other parts of Oslo. Zenisk (lighting design firm in Oslo) made the lighting design, a re-design based on the original fixtures. The globes have been made translucent and fitted with gold reflectors. (see A2, A3 and B2)

The phenomenological observations concluded that a welcoming nocturnal atmosphere is present after dark with the pole lighting and the colours in the materials.

Despite these limitations to the spatial layout and the lack of social activities in the evenings, the warm qualities in the square's lighting are very suitable for the square. It provides a warm and welcoming atmosphere and supports social interaction after dark. The square went through a renewal process in 2014, where the residents were invited to participatory workshops. Their point of view was used to create the square as it is today, which might be the key to the success of Tøyen Torg. If urban public places become more accessible and inclusive for marginalised and vulnerable groups, everyone would feel included.

The findings from the case studies show that lighting has a vital role in facilitating this inclusion. This is further used when analysing the findings from the field study.

5. The field study.

To broaden the research within the lighting field to include marginalised groups, members from the LGBT+ community in Oslo were chosen to participate in the field study.

This community consists of people of all different social identities, ages, abilities, backgrounds, and ethnicities. However, they have one thing in common: they often experience unwanted attention, abuse, and personal attacks simply because their presence in public spaces can be provocative for some as they break the norm [39]. Due to homophobia and transphobia, their presence might be perceived as threatening or provoking [40], and being a minority can lead to a double fear [41]. This fear is often based on personal experiences and cannot be solved with lighting design. However, these are the factors which make the participants of the field study a marginalised group and very applicable to participate in the research for this article.

The field study used focus groups of members identifying with the LGBT+ community. The study consisted of three parts. 1) one interview session, 2) one session using a visual ethnographic method, walking with video and 3) one experiment in the field. The following section will present the two first focus group sessions. Then, the experiment will be presented, and the findings from all three parts of the field study will be analysed.

5.1. The focus groups interviews

Ten people were required to form two focus groups. This classified each group as a mini-focus group, as most focus groups typically consist of six to twelve members [23]. The participants were between 32 and 59 years of age with different gendered identities. When quoted, they will be referred to by their identity and age to preserve anonymity. The first session was an interview mainly aimed at understanding their behaviour in urban public places in Oslo. To get further insights into how lighting design could make a difference for this community, the participants were asked to make a video recording of a walk after dark. The recordings were presented, discussed, and analysed. Five participants and one moderator formed each group. The moderators were chosen beforehand. A structured guide for the discussions was prepared, consisting of eight and six questions in each session [16].

5.1.1. The set-up of the two interview sessions. The first interview session lasted for two hours. It started with a preliminary round where everyone introduced themselves, then went more in-depth about which external factors influence their everyday mobility routines and how the lighting influenced their route choice.

The second focus group session lasted for two hours and started similarly as the first session; however, with one change. After the participants had arrived, the researcher had a brief presentation of 15min with some slides that described with a few examples how much difference lighting design could make for the feeling of inclusion in urban public places. This was to create a common language and to inspire the focus group members to think of different solutions. The participants were asked to record a walk in an area they chose. Each participant presented their video, and the moderator asked predefined questions [16]. The questions were asked individually before the group could comment on how they would have wanted the lighting to be different.

5.1.2. Findings from the two focus group interview sessions. The first finding was discovering how much their identities impact their risk avoidance behaviour regardless of whether they were alone, with a partner, or with friends**.** This was the most substantial outcome and the main finding from the first interview session. The lack of social diversity causes feelings of unsafety and a wish to become less visible. Belonging to a minority often results in risk avoidance and a need to have an overview of the surroundings in the urban environment. As a lighting designer, it is hard to provide for both those needs to provide good visibility and uniformity and to give people the choice of being less illuminated and visible. *"You do not quite know what can happen when facing individuals or homogenous groups, especially in places where it's not that busy. I can think about that a bit about feeling safe" (non-binary, 42).*

The second finding was how the spatial design influenced their mobility choices. This was strongly connected to the sense of safety. One of the participants expressed this: *I didn't feel excluded, but I still did not feel comfortable because I didn't have an overview. It's a shortcut that I want to feel safe on, so that's why I go there. But it doesn't feel safe. And I go there during the day too, but it is scariest at night » (transperson, 32).* Belonging to a minority group because of gender expression, identity, skin colour, gender, or body can lead to a more vital need to control the environment and the presence of other people than the majority experiences.

A third finding is how the lack of spatial diversity causes feelings of unsafety as it influences legibility. It creates legibility by lighting the vertical surfaces, doorways, dark corners, exits, and entry points to a square. And by creating better legibility of space and providing for wayfinding, lighting design can make a more inclusive place. *"I think it's a shame that there are areas in Oslo we don't use. It restricts our freedom of movement. I also walk a long detour to avoid some places because they feel less inviting" (Man, 32).*

5.2. The experiment in the field.

The site for the experiment has suffered much crime. Therefore, a more hidden area underneath a flyover is floodlit with bright spots to ensure facial recognition on the CCTV surveillance cameras. This colour temperature might conflict with making a warm atmosphere. The participants noticed this, and one expressed it very clearly: *"The white light makes it feel creepy, and the warm light we are using feels safer and more welcoming"* (*non-binary 37).*

It is hard to change the spatial design of a place, and it is also hard to change social diversity, but enhancing the perceived safety and creating atmospheres is a point where lighting design could start to make a change. The chosen site has a bad reputation for crime and crime-related incidents and is rated as the place in Oslo most people feel unsafe. This site was also a topic in the discussions during the focus group interviews.

The experiment aimed to investigate how light could influence the participant's feeling of inclusion at the site and how they would light the areas if they could. Altogether 11 participants showed up to participate in the two-hour experiment. Nine of the participants were from the focus groups, and two additional participants were from an architectural firm. They all aged between 30 and 60 years and identified themselves within the LGBT+ community. None of the participants were lighting designers. Five tasks were given to the participants during the experiment:

1. exploring angles of lighting a person's face
2. exploring the direction and distribution of beams to enhance details and define space
3. exploring colour and indirect lighting methods
4. one group lit a passage with different angles, and the other group walked through
5. **l**ight a dark area to make it appear more welcoming.

Facial recognition had been a recurring topic during the sessions, so the first task was to light a person's face using direct and indirect illumination. This part was primarily also a start for the participants to get familiar with the equipment. As they grew more confident handling the equipment, the participants started exploring more details. As an example, one of the participants placed one light source underneath a bench with 2700 Kelvins. This was later analysed as something they experienced as inviting when the participant's vocabularies were developed to express more precisely how the lighting influenced them.

A dark passage became a subject for testing different angles and heights with the torches. The group was divided into two subgroups, with one part of the participants getting the task to find a way to light the passage so it felt more inviting to walk there. The other group was experiencing how it was to walk in different settings (see Figure 2, image 1). This was a relevant experience for many participants, as they better understood the impact different angles and heights could have on the space and their perception of safety and inclusion.

Figure 2: Images 1 (left) and 2 (right) show the participants testing directions and illuminating vertical surfaces. Trying methods using the materials as surfaces that reflected the beam as an indirect light source was explored more in the walkway next to a hotel entrance, as displayed in image 1. Image 2 shows how vertical surfaces were being lit.

The last area that was explored was an area near a flyover next to the water. The municipality has tried many different planning ideas to make the experience safer and more welcoming but has yet to succeed. Instead, they have installed overhead lighting fixtures that floodlight the whole space. Here, the participants were asked to take control of the luminaires and use their experiences to make the place more inclusive and safer.

By this point, the participants had grown more confident with each other and using the equipment, and they used one another to discuss and change to something they felt could work better than the first

try. For example, among some things that were tried out was a warm light source lighting a wall, as displayed in Figure 2, image 2.

5.2.1 *Findings from the experiment*. The exercises from the experiment resulted in three main themes: 1) use of warm colours, 2) enhancing details, 3) exploring directions.

In the first finding, using colour, all the participants agreed upon the success of using the luminaires setting on 2700Kelvins, which produces a warm, almost amber colour. They felt the place became more inviting and inclusive by changing the colour. This colour temperature also contrasted the area's general lighting, which is very cold and white.

The second finding was how the participants used the materials and the urban furniture with the beams. The materials could be highlighted by direct illuminance or hidden by using contrast to create a brighter area next to the material. By using light and dark, light and shadow, unexpected corners and darker areas became revealed. This made the place appear more predictable, seeing what was hidden and feeling safer.

For the third finding, exploring directions, they tested how it felt to walk in different settings when the lighting came from another order than they were usually experiencing. Again, when the beams created different visible patterns on the path, it was perceived as very successful and diverse.

6. Analyses of findings from the field study

One obvious limitation of the experiment when using handheld torches is height and variation. The size of the light sources could never be very large, so all the testing was done at lower elevations. The colour temperature on the smaller torches was static, and the distribution remained the same. Only two of the luminaires could have a variable colour temperature, which contributed to a lack of variety in the attempt to create atmospheres using more variations in the colour temperature.

The outcome of the focus group interviews shows how feeling excluded and belonging to a minority result in a strong need to have an overview of the surroundings in the urban environment; by lowering the contrast ratio, balancing lux levels and providing vertical illuminance, this can be achieved. Furthermore, feeling scared, for example, due to bad experiences, leads to a change in behaviour, impacting their daily mobility and the patterns in their walkability routines. Although many participants spoke about how they did not notice the lighting unless it was very uneven, full of contrasts, causing discomfort glare by blinding directly in the eyes, or if it was absent, several factors contributed to their changed mobility routines. But also, the lighting, or the lack of illumination, could change mobility behaviour, as one of the participants said: *"Well, at night- it depends if I am walking with someone or if I'm walking alone. Because I would prefer to take the shortest route home, but if I'm walking alone, I will not go where there is less light. I will not take the shortest street. And I will not walk where I can't run" (woman 42).* The videos showed that the anxiety caused by minority stress is most predominated in the daytime or when other people can be identified. The videos' walking patterns and movements could indicate that they became more aware of their presence than the surroundings. Things change in the dark, and people are often seen as silhouettes; anyone can be a potential threat. The lighting needs to provide an overview, legibility, and wayfinding.

The first finding from the experiment showed that participants missed a warm atmosphere in urban public places. Using a warm colour temperature, something perceived as ugly, and repelling was changed to something more attractive. Moreover, using this warm colour to illuminate materials, walls, greenery, or darker areas, made a more welcoming atmosphere. For many of the participants, the experiment contributed to many surprises:

"It's funny; before this experiment, I always thought the solution was to add more lights. Now I realise it's not that simple. It is by lighting the surroundings that makes me see the environments better" (woman 39).

The second finding showed how lighting materials and landscape elements contributed to legibility and visual variety. By illuminating the trees and the greenery and highlighting the materials, it gave a more substantial definition of space and the vertical planes in the place. Using these techniques to beautify the space also made it feel more inclusive.

7. Discussion

How to create inclusive urban places for everyone without excluding others? In a study from Newcastle about safer city centres by Rachel Pain and Tim Townshend, four focus groups with different social identities and genders were used. The conclusion is: *"The challenge is to achieve this in an inclusive way, which does not further restrict the freedom of those already marginalised in city centre life" [42, p. 117]*. The topics for the discussion are related to freedom of movement, the lack of diversity in urban public places, and how lighting design can make a change.

The consequences of restricted freedom of movement can be greater than just a personal loss and can often result in a natural exclusion of minorities from urban public places. This was also a recurring topic in the focus group discussions as the participants spoke of how they would avoid homogenous urban public places. How gender relations are made in our everyday spatial practices and gendered power relations need to be challenged is something Yasminah Beebeejaun problematises in the article "*Gender, urban space, and the Right to everyday life*" [43]. However, Beebeejaun comes up with some simple spatial solutions, like moving a bus stop away from a pub with a homophobic reputation. Such measures can only be taken through participation, where marginalised groups are invited to participate in the spatial planning.

One of the essential findings from the focus group sessions is the consequences of the lack of spatial and social diversity in urban spaces. The literature review and case study findings implicate that the atmospheres in urban public places consist of all three elements: spatial, social, and lighting. When urban areas become homogenous because of a lack of spatial and social diversity, changing this through lighting design alone is impossible.

However, one of the main findings from the focus group interviews was that most of the focus group members agreed that they felt uncomfortable if they had to walk across very evenly brightly lit spaces with no places to be less visible. The results from the field study suggest that lighting design can do a lot to make urban atmospheres reassuring, welcoming and inclusive. This is where lighting design could start to make a change. This finding corresponds with other recent studies [10]. It contradicts most of the research on perceived safety, concluding that uniformed urban areas with white-coloured lighting appear to be the safest [44], [45]. Although non-uniformity was only one of the findings from the field study, the need for visible surroundings was also an important theme. Like the findings from other studies confirm [46]–[48], having the nearby surroundings lit enhances the perceived safety. Further, as Mette Hvass shows in her doctoral dissertation, [49], the surroundings will become more visible by lowering and balancing the general lighting levels. This method will allow 'room' for other subtle light layers to make a lighting hierarchy.

8. Conclusion

The findings from the focus groups and the experiment are divided into three parts: where the first main finding is rooted in the two focus group sessions, while the second and third finding is rooted in the experiment:

- First and foremost, the participants felt most safe when they could avoid the brightest-lit areas in order to avoid losing the ability to see their surroundings.
- Beautification was seen as making the urban place feel more welcoming.
- Legibility was created by using different techniques to illuminate vertical surfaces.

These findings were essential for creating six principles of inclusive lighting design that conclude this article. When used in a layered lighting design, these six principles can create reassuring, welcoming and inclusive atmospheres. Urban public places could become more inclusive with a lighting design based on these principles. By contributing to more freedom of movement for women, minorities and other vulnerable groups, these principles could create a foundation for making urban public places more socially inclusive for everyone.

8.1. *Principles of inclusive lighting design*

Creating legibility can enhance perceived safety by illuminating vertical surfaces. By illuminating dark areas and corners, it makes it easy to navigate around places of refuge, prospect, or escape.

Height variations can also distinguish between the public and the private and give an extended experience of space. Human-scale luminaires can create feelings of intimacy, and illuminating the greenery and highlighting points contributes to more definition of the place. It is essential to avoid glare. This technique can make materials become a light source when bouncing the luminance of the materials without discomfort glare. Glare can be blinding and contribute to unsafe environments, but with non-uniformly lit paths, people can be more or less visible when walking. By changing the perception of a place, it can make it more inclusive and welcoming. These six principles are based on the work of many other lighting designers, such as Herves Descotte [21]. However, these six principles can create more socially inclusive places when used in this way.

Principle 1: Legibility by illumination of vertical surfaces. Vulnerable and marginalised groups need to feel safe in urban environments, as there is an actual risk of experiencing unpleasant and unwanted attention. Illumination and contrasts between light and dark, light and shadow, can reveal unexpected areas. This made the place appear more predictable, seeing what was hidden and feeling safer.

Principle 2: The Wayfinding by luminaires on a human scale. Using light sources with a human scale in the light topography can help with wayfinding as it does not create any obstacles and provides the opportunity to see the surroundings better. The participants of the focus groups expressed a need to navigate easily in the urban environment and have an overview of the surroundings. Another element to assist wayfinding could be using different heights of the luminaries by creating focal points.

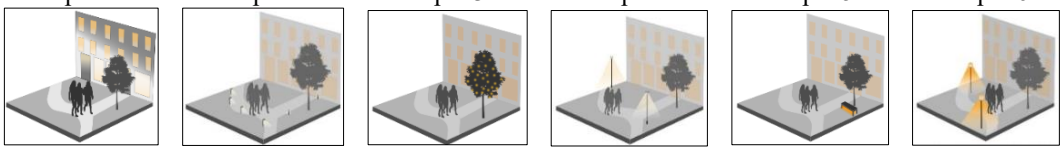
Principle 3: Beautification by highlighting materials and details. Illumination can enhance details, texture, and the colour of the different materials and the materials themselves. Enhancing details and beautifying the space creates exciting and attractive urban places. Minorities, women, and other vulnerable groups are very much aware of their surroundings and the social interaction in urban public places. Homogenous places without diversity are avoided if possible. When beautifying an urban area by highlighting the details and materials, more people can become attracted to them.

Principle 4: Inviting by indirect light sources. Indirect light sources stimulate curiosity and make urban furniture more attractive. It can also become a playful element. For many marginalised groups, the freedom of movement gets restricted due to the lack of spatial diversity and lack of activities in an urban public place. However, using indirect sources on urban furniture invites them to be used and creates a focal point on the action that can enhance social interaction.

Principle 5: Visual hierarchy by balancing contrasts. The members of the focus groups expressed a need to be able to be less visible when they felt unsure of their environments and the other people present. Lighting can define space by the placement of the luminaires, and highlighting the entrance and exits of an urban public place can also help determine the space and create an overview. Using the lighting to divide the place into functional zones of activities can also help with the feeling of privacy and intimacy.

Principle 6: Create identity by warm colour temperature. When used carefully, colours can provide visual cues and enhance a place's identity. In the context of this study, using colours can also attract other people, primarily through warm colours. In the Nordic countries, warm-coloured lighting is perceived as cosy, candlelit indoor atmospheres. This is extended when used in an urban outdoor environment. Marginalised groups can benefit from creating a visual identity that can change the perception of the urban place and make it more inclusive and welcoming. For example, a warm colour can help beautify the place and make it feel safer.

Principle 1. Principle 2. Principle 3. Principle 4. Principle 5. Principle 6.



Figures 3: Showing the principles 1-6 as visual diagrams.

9. Future works

The lighting standards restrict much of the lighting design for urban public places. Today, the standards dictate how much illumination they must provide on the horizontal plane and the uniformity rates. However, these standards need to take other factors into account. Like how much light comes from the headlights on a car or how much influence accent light can have on a square. More research is needed to determine how the uniformity rating needs to be to provide enough visibility.

The field study consisted only of 11 participants. The findings could have been different if there had been more participants. Other methods, such as lighting walks or walk-along interviews where participants took pictures, like the methods used by Mette Hvass in her doctoral dissertation. [49] , could have resulted in different outcomes. Some things might be easy to change, but it is impossible to change a place's spatial design with lighting design, nor to change social diversity.

Creating new standards and recommendations for urban lighting is essential to avoid light pollution and be aware of biodiversity. It is also necessary to be mindful of social sustainability and cater for human and social interaction. Future studies should consider the impact of balancing contrasts, warm colour temperatures and uniformity on the perceived safety in urban public places.

Other recommendations for future works are to continue to do research with including other marginalised groups. This can be done through participatory workshops and experiments. Another method could be to go on light walks with the focus groups and look at places they have marked as inclusive or unsafe to look at the differences together. Alternatively, use pictures as a visual ethnographic method instead of video recordings. Using other focus groups with control groups in the study is recommended.

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