

PAPER • OPEN ACCESS

The Influence of Urban Lighting on the Sense of Belonging

To cite this article: Laura de Frutos *et al* 2024 *IOP Conf. Ser.: Earth Environ. Sci.* **1320** 012011

View the [article online](#) for updates and enhancements.

You may also like

- [Research on Lightweight Design of Automobile Collision Safety Structure Based on Multiple Materials](#)
Tingting Wang, Ruoyan Dong, Shan Zhang *et al.*
- [Light Pollution and Health: Case Study of the Lighting Fixtures Applied on Penang Town Hall in George Town, Penang Island](#)
Alaa Abdalla Saeid Ali, Safial Aqbar Zakaria, Lim Jit Wei *et al.*
- [Preface](#)

PRIME
PACIFIC RIM MEETING
ON ELECTROCHEMICAL
AND SOLID STATE SCIENCE

HONOLULU, HI
Oct 6–11, 2024

Abstract submission deadline:
April 12, 2024

Learn more and submit!

Joint Meeting of
The Electrochemical Society
•
The Electrochemical Society of Japan
•
Korea Electrochemical Society

The Influence of Urban Lighting on the Sense of Belonging

Laura de Frutos^{1,#}, Luca Pellizzari^{2,#} and Mette Hvass³

¹ Kardorff Ingenieure Lichtplanung GmbH. 10789 Berlin, Germany.

² Les Éclaireurs, Lighting Design Agency. 69001 Lyon, France.

³ Aalborg University Copenhagen. Department of Architecture, Design and Media Technology. 2450 Copenhagen, Denmark.

These authors contributed equally to this work and share first authorship.

Corresponding authors: laura.frutos.llorente@gmail.com; lucaPELLI97@gmail.com

Abstract. This research aims to gain a better understanding of the influence of artificial lighting on the sense of belonging in urban spaces and to investigate whether lighting is a determining factor in establishing bonds between humans and the city. An exploratory method is employed to give possible answers with the purpose of sparking a discussion in the lighting and urban design practice but without intending to be conclusive. The topic is addressed by an integration of a literature review on related concepts such as place attachment, the connections between urban lighting and atmospheres, the social dimension of urban lightscaapes and placemaking, and input from conversations with professional lighting designers. The proposed answer consists of a series of models, design principles and methods for the lighting designer. It is argued that lighting can act as a generator of atmosphere, propitiating shared experiences in the outdoors, or as an object of memory when it acquires the category of a symbol. Both qualities can contribute to building a collective identity and, consequently, a sense of belonging. The lighting design - if unique, meaningful and sustaining social interaction - and the design process employed - if participatory - have a role in strengthening ties within the community.

1. Introduction

We are social beings. We grow up, live and dwell in communities. As described by Abraham Maslow in his 1943 paper *A Theory of Human Motivation*, we human beings hunger for social relations and a place in our group, “*If both the physiological and the safety needs are fairly well gratified, then there will emerge the love and affection and belongingness needs*” [1].

Throughout history, an important part of our social interactions has taken place in the public realm: people exchanged news, made deals, arranged marriages or attended events; goods were sold, artists entertained and processions, celebrations or political acts were held. The city has been the meeting place [2]. But city life takes place at night as well. Since the appearance of electrical light, our economic and social life has become more and more nocturnal, tending to blur the limits between day and night [3]. In recent years, recognised lighting designers such as Roger Narboni have stood by a change in the profession, going from lighting urbanism to nocturnal urbanism, which considers the subjective experience of its inhabitants [4]. Moreover, the latest developments in lighting technology make it possible to create a large variety of atmospheres. Indeed, there has been a change in the



paradigm of both research and design practice in lighting, taking an interest in the human and social dimensions of urban lightscapes, but research and evidence are missing [5]. Over decades, lighting research has provided vast quantitative information about light levels and task performance, as well as visibility and perceived safety, but information about other dimensions of the perceived environments is lacking [6, 7]. As part of their work, lighting experts need an understanding of the social aspects of light and how to integrate these into their everyday practice [8]. As Casciani says: “*Because lighting is primarily intended for people, urban lighting should be focused on the human experience with a qualitative social engaging role*” [9]. Among all the possible emotions related to public life, the need to belong and connect with others is universal, can be found across all humans and has a proven impact on our mental and physical well-being [10].

1.1. Objective of the paper

The purpose of this research is to gain a better understanding of the role of artificial lighting concerning the sense of belonging in urban spaces. Can artificial lighting improve mental well-being and avoid alienation by establishing an emotional bond between citizens and urban space? How can we create more inviting neighbourhoods that support social interactions and collective identity? What kind of atmospheres do citizens interpret as belongingness? How can the qualities of “feeling at home” be transferred to the public realm?

The content of this paper is based on the master’s thesis “The Influence of Urban Lighting on the Sense of Belonging” realised by the same authors Laura de Frutos and Luca Pellizzari during the year 2022 at Aalborg University. No previous studies or literature that directly links a sense of belonging (henceforth referred to as SOB) and urban lighting have been found. Thus, the main effort of this study will consist of finding the steps to connect the theories about SOB, use of public space, and outdoor lighting, as well as providing some conclusions and models that facilitate its implementation during the design practice. This study aims to open a discussion and give possible answers and solutions but does not intend to be conclusive.

2. Method

The research topic, i.e. the influence of urban lighting on SOB, lacks a clear definition and precise boundaries as no previous related data could be found. Therefore, in order to navigate, investigate and structure it, an exploratory method is employed, aimed at presenting new findings and reflections that can serve as a foundation upon which further research and investigation are drawn [11]. Exploratory research is meant to connect the information coming from different sources of knowledge, so as to get to an understanding of the topic, its nature and its underlying dynamics. It allows a thorough analysis of the problem and it explains how its variables interact with each other [12], namely identifying the steps that connect the theoretical knowledge about SOB, public space and outdoor lighting.

For that purpose, awareness of SOB is achieved thanks to the integration of a literature review and individual conversations with experts in the field. In practice, peer-reviewed research papers and books have been searched in the months from February 2022 to May 2022 in the following online databases: Google Scholar, EBSCOhost and Aalborg University Library. The starting point of the literature research consisted of defining SOB, from which it was then possible to individuate and define related concepts such as place attachment and collective identity. The research perspective was continuously widened by investigating new concepts and keywords that appeared along the way, with a major focus on topics such as urban atmospheres, the human and social dimensions of lighting, placemaking, and community engagement. All the information gathered was critically examined and organised, and further developed with the data collected through conversations with four professional lighting designers: Leni Schwendinger, Luciana Martinez, Lisbeth Skindbjerg Kristensen, and Anna Lykke Thorup (permission for publication was obtained from all interlocutors). They were chosen because they all have experience working with urban lighting but with different backgrounds and approaches. The intended purpose of the conversations was to collect knowledge on how emotional

and social approaches can be applied during the design process, as well as reflect on their understanding of urban belongingness and personal experiences and methods when working together with citizens. Topics such as social interaction, collective identity, atmospheres or memories were intentionally addressed as well.

The inputs acquired from the literature review and conversations were synthesised into a theoretical framework. This framework presents a series of models, design principles and methods for the lighting designer, using real projects as examples for a better understanding.

3. Literature review

A literature review summarising existing knowledge on belongingness as a subjective emotion within an urban context and its links with place attachment and social dynamics, as well as the role of atmospheres and outdoor lighting, is hereafter expounded. Comments from the conversations with the aforementioned lighting designers are also included.

3.1. Sense of belonging

Sense of belonging, or belongingness, is “*the human emotional need to be an accepted member of a group to maintain close and safe ties that generate a sense of security, care and affection.*” [13]. It is a subjective feeling, based on an individual’s perception of their connection to a chosen group (family, friends, school or work environments, communities, cultural groups, etc.) or physical place. It produces the feeling that “*one is an integral part of their surrounding systems*” [10]. Furthermore, this SOB is dependent on opportunities for interaction with others [10].

“*Belonging and love needs*” are in the middle of Maslow’s hierarchy of needs. They cannot be satisfied until physiological and safety needs are met, but they precede esteem and self-actualization [1]. The need to belong is universal and can be found across all humans and cultures, although with cultural and individual differences in intensity, as well as how they satisfy and express this need [14]. Even if it is agreed that almost all people seek to satisfy the human need for belonging, there is no full agreement about how belonging should be measured and what people can do to satisfy it [1]. The benefits of connecting deeply with other human beings and secure places, as well as feeling that one is part of cultural identity, are multiple. These positive effects include more positive social relationships, academic achievement, occupational success, and better physical and mental health. On the other hand, alienation can lead to mental and physical problems, such as an increased risk for mental illness, antisocial behaviour, lowered immune functioning, physical illness, and early mortality [1].

Two kinds of belongingness can be distinguished: state or trait belongingness. State belongingness is related to the situation-specific SOB and it is influenced by several daily life events and stressors. Thus, the perception of one's own belonging can change over the day, as it happens with other emotions. However, trait belongingness, which is belonging as a core psychological need, is relatively stable even if the variability across time and situations depends on the subject and one’s awareness of environmental and social context [1]. Since the need for belongingness can be only satisfied by other people, this is from outside the person, there is an important dependence on the environment [15].

When talking about urban belonging, each individual can associate a variety of words with a sentiment of belongingness. The more personal experiences a group of individuals have in common, the easier it will be to find an agreement [16].

3.2. Place attachment

The development of SOB in a public space relies on the development of place attachment. If place attachment describes the direct relationship between people and space, SOB describes the relationship among people within and in relation to the space. Place attachment is “*the symbolic relationship formed by people giving culturally shared emotional and affective meanings to a particular space that provides the basis for the individual’s and group’s understanding of the environment and its relation to it*” [17]. Place attachment relies on place identity and place dependence [18].

A space becomes a place when it is assigned meaning through personal, group, or cultural processes. Place attachment, for instance, is more developed for settings that evoke personal memories [18]. An undifferentiated space becomes a place when we visit it recurrently and endow it with value [17]. According to Manzo, what can be called *experience-in-place* creates meaning [19]. In the conversation with Anna Lykke Thorup, she further developed this point in relation to lighting: light is sometimes the actual centre of the experience and it is sometimes just something that sets the mood and the scene for other experiences to happen. She mentioned New Year's Eve fireworks as a past memory around a lighting scene that is collectively experienced. In this way, there is a past memory of the lighting. On the other hand, when lighting sets the mood and atmosphere to make it possible for people to enjoy themselves and have a good time with friends and other people, you have instead a memory of those social interactions and events sustained by the lighting.

Kevin Lynch stated that the concept of place attachment comprehends three components: identity (the distinctiveness of a place, the qualities that distinguish it from any other place), structure (the mental representation, spatially outlined) and meaning (subjective feelings linked to physically separate places) [20].

Place attachment is reliant on the social and physical dimensions of the space [18]. The social dimension consists of social ties and familiarity with the other residents of the neighbourhood. Physical attachment is also predicted by the duration of residence and the plans to stay. Certain physical characteristics of the space, such as density, proximity, and the presence of amenities and other social areas, can influence these interactions. Spatial bonds become important because they reflect social bonds and the identity of the group. You are attached to the place because of its distinctiveness from other places, and because it supports the specialness of a certain group [18].

3.3. *Urban atmospheres and light*

The term "atmosphere" appeared within a meteorological context, but since the eighteenth century, the word has been also used to define a "*certain mood hanging in the air*" [21]. Atmospheres are always something spatial and emotional at the same time. To be more specific, Böhme defines the atmosphere of a city as "*the subjective experience of urban reality which is shared by its people*". An urban atmosphere is constantly produced by the locals throughout their lives but the stranger easily notices it as a characteristic of the city. Since it is continuously produced, this atmosphere can mutate over time [21]. Böhme also argues that atmospheres must be studied from the point of view of the subject, by exposing ourselves to them, but also from the side of the object, by analysing the generators and conditions. Atmospheres are characterised subjectively [21], but they can be shared because even if they do not arouse exactly the same feeling for each individual, people may share the verbal representation of the affective impact [22, 21]. To reach an agreement, previous experiences, knowledge and culture play a key role [22]. Leni Schwendinger also mentioned the interplay between culture and language when defining atmospheres.

Urban lighting (natural and artificial) has a role in generating atmospheres in the city, and it should be therefore studied both quantitatively and qualitatively, as a physical phenomenon and as the result of physical perception. Scholars agree that there is a relationship between lighting, emotions and atmospheres: lighting enables visibility but it also can influence people's mood, well-being and behaviour, impart a certain sense of place and create a certain atmosphere in the space [23, 24]. Lighting, including urban one, influences the emotions of the observer with an effect that is to a large extent subjective, with light that "*transcends the cognitive and moves into the non-representational, the realm of the affective and sensual*" [25]. The affective qualities attributed to a place can be differentiated from the emotions evoked by the lighting itself, with them being "*more related to the experience of the lighting than to the appearance of the place*" [6].

3.4. *The social dimension of urban lightscapes*

Daria Casciani's book *The Human and Social Dimension of Urban Lightscapes* elaborates extensively on the role of emotional and cognitive perception in the lighting and nocturnal design to achieve more accessible, sociable, hospitable and sustainable cities by defining the criteria for a good place [5]. Although not focused on the nocturnal city, Jan Gehl's vision is also especially relevant to understanding the social dynamics in urban spaces [2]. The way a space is perceived has an impact on the emotional and behavioural response, shaping the activities that take place in it. Framed in his comprehension of the city as a meeting point, Gehl distinguishes three kinds of activities: necessary, optional and social activities. While necessary activities happen under all conditions, good physical conditions are essential to facilitate optional activities. Thus, the increase in activity level causes an increase also of social activities. A successful public realm must provide opportunities for multiple degrees of social engagement: from passive (e.g. seeing or hearing others) to active (e.g. chance meetings, children playing), including planned activities (e.g. markets, demonstrations) [2].

Lighting has a role in sustaining social activities. Good lighting conditions enable correct visibility of the surroundings and faces, thus facilitating observation of ongoing events and people. On the other hand, lighting is a determinant of generating inviting and comfortable atmospheres to stand and sit, so active social activities such as events, exchanges and conversations can take place. As emerged in the conversation with Luciana Martinez, design by itself cannot force people to interact, but it can set the conditions for social interaction by helping people feel comfortable in the space. She also states that designers cannot plan spaces targeted for everyone, but it is important that diverse people are still allowed to be in the space without feeling excluded. People with different backgrounds can coexist in the place although, necessarily, with different degrees of ownership or at different day times. This is aligned with the Urban Belonging Project [16], which questions if designing for belonging does not mean making all-inclusive spaces but designing for community and variation in ownership.

3.5. *Placemaking and community engagement*

Traditionally, urban planning has been exclusively placed in the hands of experts. However, since 1960, theorists and urban designers such as Jane Jacobs, William H. Whyte and Jan Gehl, have advocated for bringing the public into the design process [26]. Currently, different organisations and city planners contribute to involving local communities through placemaking approaches. Project for Public Spaces (PPS) defines placemaking as "*the collaborative process by which we can shape our public realm in order to maximise shared value*". It strengthens "*the connection between people and the places they share [...] and facilitates creative patterns of use, paying particular attention to the physical, cultural, and social identities that define a place and support its ongoing evolution.*" [27]. The International Association for Public Participation proposed five increasing levels of community involvement based on the degree to which the participation impacts decision-making: inform, consult, involve, collaborate and empower [26].

Three of the lighting designers who took part in the individual conversations (Leni Schwendinger, Lisbeth Skindbjerg Kristensen, and Luciana Martinez) have broad experience including communities in the design process. The three of them pointed out the necessity of a deeper understanding of necessities, uses of the space, and subjective perceptions when designing for a community. From Martinez's point of view, though, the biggest impact on people developing a shared identity has to do more with the process of how the lighting design is implemented than the lighting design itself, with the community being actively involved in shaping the design of the space they live in. They have a role and they feel listened to. People remember the activities they have contributed to, such as workshops, and by working together with their neighbours they build new relationships and strengthen already existing ones.

4. Designing for Sense of Belonging: an implementation into the lighting practice

Based on the knowledge acquired through the previous literature review, a series of models are developed as an attempt to connect the previous theoretical knowledge and the lighting design practice. These models must be understood as a potential but not exclusive interpretation and, therefore, open to discussion.

4.1. Sense of belonging model

The model shown in Figure 1 allows synthesising a definition of SOB and connecting it to lighting conditions. Social interaction in a space produces shared experiences among people. The more time is spent in the space (recurring time), the more experiences are developed and so a social place attachment is built. These shared experiences are then translated into collective memories. Elements that serve as symbols with a shared meaning among the community and the groups involved, translate also into collective memories. Developed collective memories are then responsible for building a collective identity, bringing SOB to the members of the community.

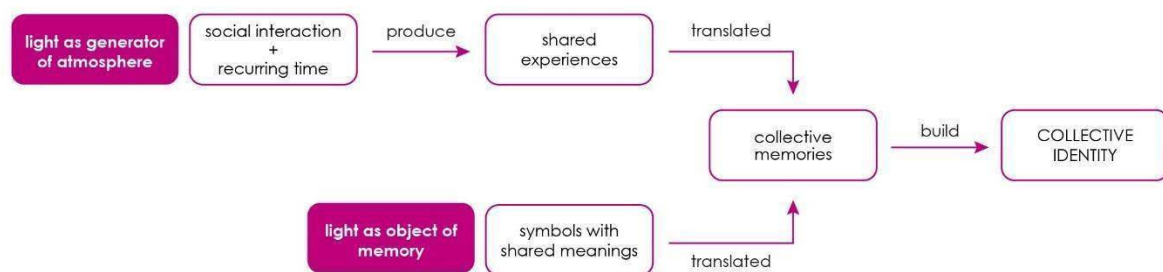


Figure 1. Proposed sense of belonging model

Light can sustain this process when intended in two different approaches:

4.1.1. Light as generator of atmosphere. By providing the proper atmosphere, lighting can set the optimal conditions to encourage social interaction, resulting in a more attractive space for people to return and spend more time (recurring time). The experience in place creates meaning. Consequently, the atmosphere of a place can sustain the development of shared experiences. In this way, new memories of the place and social interactions that took place in it are created over time, sustaining SOB. The design for Exchange Square in London by Speirs Major [28] is a good example of light as a generator of atmosphere. An intimate ambience that encourages easy social interaction is preserved by supporting intuitive wayfinding and low-height lighting.

4.1.2. Light as object of memory. The light itself can have a symbolic value when it has been assigned meaning through personal, group, and cultural processes. When the meaning is shared due to a common cultural background, the symbolic value of light reflects collective memories. These memories can either be past memories evoked by a meaning that is already assigned to the light, or new memories that are built by assigning new meanings over time. For instance, the same glowing star at the top of the Christmas tree which is used for a family year after year acquires an emotional meaning for the members of that family. In this case, we talk about personal memories. *Sankthans* fire that is made for the summer solstice is a type of lighting that everybody knows and has a memory of in Denmark. In this case, light is part of a shared and collective memory, mediated by culture. New memories are developed when the light is so unique and characteristic to be remembered. Meaning can be given when the light starts to be an identifier of the space, becoming symbolic and representative of it, even if initially it does not hold meaning. A good example of that is the lighting design made by

Arup for the University of Sheffield [29]. The bridge of the university is lit by dynamic coloured light, with a different palette provided for each day representing the branding of the student event within the Students Union. With its uniqueness and symbolic value, the lighting becomes a strong identifier of the university and its life. It is assigned meaning and remembered.

4.2. *Hierarchy of urban belonging*

Inspired by Maslow's hierarchy of needs, a hierarchy of SOB in urban spaces is developed (see Figure 2). The knowledge acquired during the previous Literature Review and mentioned interviews with lighting designers, along with information from the chapter *The Human-Scale Urban Lighting Experience* in Casciani's book [5] and Boyce's journal article *The benefits of light at night* [30], is interpreted, discussed and structured in two pyramids of needs. Pyramid A organises a hierarchy of urban belonging, while Pyramid B translates those needs into lighting requirements and considerations. The hierarchy consists of four main levels and 5 sub-levels. The three first levels are the same as the ones described by Casciani when defining the criteria for a good place: functionality, comfort and sociability. A place can still be well-designed and not necessarily sustain belongingness, therefore a fourth level is added. The lighting pyramid (B) distinguishes between "good lighting" and "lighting that sustains belongingness" as well.

Accessibility. It is identified with the functionality of the space: does the place have the minimum conditions to get into and be used? In terms of outdoor lighting, related factors such as visibility or visual acuity are shown at the bottom of Pyramid B.

Comfort. It is organised into two sub-levels. On the first sub-level, safety and security perception and reassurance are placed. On the second sub-level, an appropriate atmosphere and urban beautification are placed. These aspects are especially connected to emotions and they can motivate visiting or spending more time in a place. To set the appropriate atmosphere for the different activities in an outdoor space and make people feel comfortable, all the qualities of light (colour spectrum, luminance, distribution, etc.) should be balanced. Using different lighting layers and designing from the point of view of the user (human-scale lighting) contribute to a more pleasant atmosphere. The use of smart lighting to excite or adjust the atmosphere depending on the activities, times or seasons can be also helpful.

Sociability. Certain atmospheres can contribute to social interactions, from passive to active ones. Besides facial recognition, setting up a pleasant ambience to make people feel relaxed can contribute to making social interactions easier. Dimmed light levels and warm CCT can lead to a relaxed atmosphere. Not feeling overexposed and providing different conditions, since not everyone feels comfortable in the same situations, must be taken into account. Interactive installations use lighting as a way of communication and motivate people to mingle.

Belongingness. The development of a collective identity gives extra value to a place. There is a great interplay with the previous level since belongingness is deeply dependent on social interactions. However, it is considered a different level since some places can sustain spontaneous and sporadic social interactions and still not strengthen the collective ties among citizens. Time, symbols and shared experiences are determinant factors. A new term, *Belonging Lighting*, has been adopted to define the urban lighting that sustains belongingness. The characteristics of this belonging lighting will be explained in the next section. Nevertheless one might wonder if it can be possible to develop SOB even without covering the foundation levels of the hierarchy. Indeed, it can be argued that it is possible in certain cases. We all can think of deprived areas, which are unsafe or lack an appropriate atmosphere and their inhabitants still feel part of a community. It can be deduced that if the social bonds are solid, they can compensate for the shortages. Similarly, the recurring time factor can supply them. We all probably have grown up using some "ugly" or not idoneous spaces but we still feel a connection with them because they were on the way to our school or because strong memories related to friends or family take place in them.

Environmental issues have not been included in this hierarchy because, although important for human well-being, it has been considered that there is no explicit relationship with SOB.

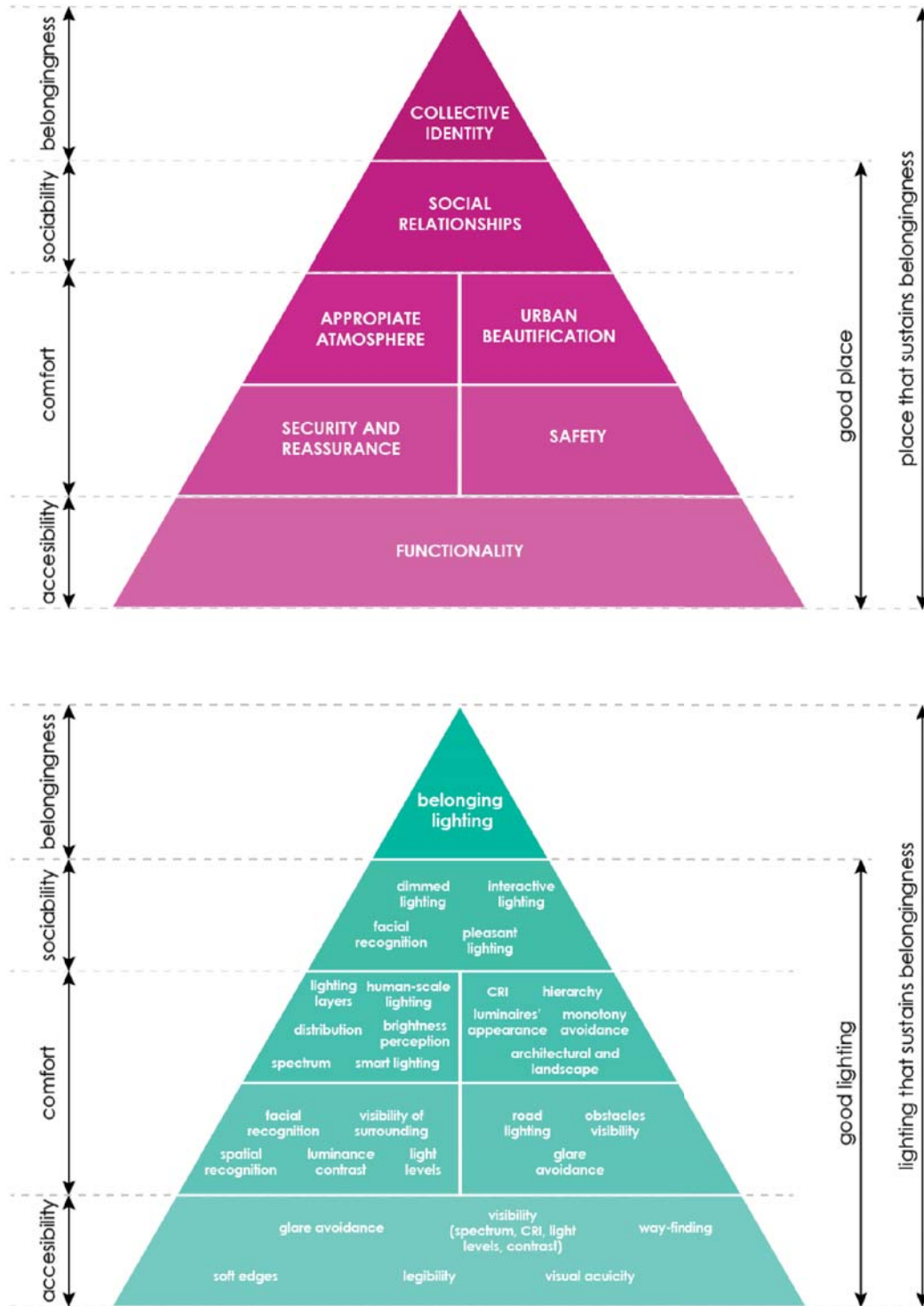


Figure 2. Hierarchy of SOB in urban spaces at the top (A) and its translation into lighting requirements and considerations at the bottom (B).

4.3. Design principles: *Belonging Lighting*

Three design principles that a lighting design should follow in order to sustain SOB are introduced: unique, meaningful and social. They are developed from the concept expressed in the SOB model and the hierarchy of urban belonging previously presented.

4.3.1. Unique lighting. Lighting is singular, giving the space a distinctive identity. A unique design should consist of innovation, such as the design for Ishøj Station by ÅF Lighting [31], with gobo projections reinterpreting water waves, or the Van Gogh Path by Studio Roosegaarde [32], made of thousands of twinkling stones. If standardised fixtures are planned, these must at least be used in an ingenious way, being perceived as something non-seen before.

4.3.2. Meaningful lighting. Lighting has shared recognizable meanings related to memories and reflects the identity of the community. A lighting solution can be singular and not found anywhere else and still not necessarily related to the identity of a place. A good example of an urban element that can have both qualities at the same time is the Torèt, a standpipe with more than 800 reproductions spread throughout the whole city of Turin in Italy [33]. The dispensing spout has the shape of a bull's head, recalling the animal icon of the city, which is also present on the official city symbols. They have become a symbol and strong identifier of the city and people have developed a sense of affection towards them. They are inextricably linked not only to the satisfaction of needs (functional attachment) but often also to childhood memories and sentimental events (emotional attachment). Also, streetlights as urban elements can be unique and meaningful and become a symbol and identifier of the city, strengthening SOB. In the conversation with Lisbeth Skindbjerg Kristensen, she said that the Copenhagen street luminaire produced by Philips "*makes you recognize the street as being your home and it belongs to your city or your neighbourhood*". Speirs Major's lighting design project for the Sheikh Zayed Grand Mosque in Abu Dhabi [34] is a good example of a lighting concept with symbolic value. The colour of the façade lighting changes according to the lunar cycle on which the Islamic calendar is based. This way, the design is endowed with a cultural and religious meaning. Another example is catenary lights, which are used in many cultures and, although with different local meanings, they are universally associated with moments of social celebrations.

4.3.3. Social lighting. Lighting sustains the atmosphere for developing social experiences, either by creating the conditions or by making people interact. Social lighting can sustain the atmosphere for developing social experiences by setting the atmosphere and creating optimal conditions to encourage social interaction. The lighting proposal of Light Follows Behaviour for Terry Spinks Place [35] increases the dwell time and activates it through the help of bold geometries and graphics, vibrant colours, shapes and sounds. On the other hand, social lighting can directly encourage people to interact with each other. In most cases, this is achieved with interactive lighting installations as in The Pool by Jan Lewin [36] or BruumRuum! by Artec Studio [37].

4.4. Design process: *public participation*

As has been seen before, the method is revealed as important as the final design: citizen engagement is a powerful tool to generate SOB but also to educate people about the role of lighting. An understanding of the inhabitants and social dynamics is as crucial as an understanding of the physical space. Public participation strategies enhance the local sentiment in a double way, as Martinez mentioned during the conversation. On the one hand, citizens feel more identified with these places because they have contributed to making them possible and they reflect their needs and decisions. On the other hand, the participation itself helps to strengthen the community bonds, since it gives the opportunity to meet your neighbours.

The tools for community involvement can be divided into two big groups: passive and active. Passive methods are centred on gathering information by observing and collecting data without direct

interaction with the users. The information can be registered and systematised by strategies such as counting, behavioural mapping, tracing, tracking or shadowing, looking for traces, keeping a diary, photographing or filming, drawing, or in-situ or digital observations by the resource of the flâneur [5, 38-41]. Among the tools for active participation, it can be listed: night walks, talks, interviews, on-site questionnaires, collaborative maps, personas, workshops, guerrilla lighting, or a combination of the previous methods. Different practices and organisations carry out placemaking activities within the lighting field. These initiatives are sometimes part of a larger design project and sometimes just actions to educate citizens about the culture of light or to engage the community. Among others, can be mentioned: Lighting Detectives, NightSeeing™, Light Follows Behaviour, Configuring Light / Staging the Social, Social Light Movement.

Traditionally, these kinds of methods have been mainly used during the pre-design process to gather data. However, there is potential to introduce them at other design stages by conducting a process of co-design together with citizens. Smart lighting and new control technologies allow also adjusting some parameters after new inputs of the community or changes in the use of the space. The role of municipalities and local associations is indispensable, but the lighting designer, together with sociologists, can plan and guide this participatory process.

5. Limitations and discussion

The study has certain limitations that are hereinafter considered and discussed. Some of them are intrinsic to the method employed in structuring the study since the exploratory research method is not meant to lead to conclusive statements. Its purpose is, in fact, to open a discussion in the lighting and urban design practice by providing a possible answer to what is the influence of urban lighting on SOB. The findings of the work can serve as a foundation upon which further research and investigation are drawn. Another aspect of exploratory research is that it provides qualitative data. Interpretation of such information does not follow a strict cause-and-effect relationship, due to its nature, and it is subject to an inference process that can be biased, also due to a lack of preexisting knowledge on the topic. As a production of knowledge that follows a qualitative method, the results are not directly verifiable and reproducible. The topic itself, SOB, concerns dimensions such as identity, emotions, atmospheres and memories which can hardly be generalised and considered universally valid. Finally, it must also be noted that lighting has limits in relation to the topic. There are many other factors that affect the generation of urban belongingness, and lighting is probably not among the most affecting ones. Given the complexity of the topic and the many disciplines involved, a transdisciplinary perspective in partnership with experts in urbanism, sociology or anthropology, among others, could lead to more significant and comprehensive results.

6. Conclusions

The findings of the study propose that artificial lighting can sustain and strengthen SOB in urban environments. This happens when it has the qualities that characterise Belonging Lighting, as defined in the hierarchy of urban belonging. Belonging Lighting has the potential to generate shared memories that sustain a collective identity in the urban space according to the process delineated in the sense of belonging model. Lighting can in fact act as a generator of atmosphere, propitiating social interactions and shared experiences in the outdoors, or as an object of memory when it acquires the character of a symbol. Both qualities contribute to building a collective identity and SOB as a consequence. Lighting, like other layers of urban design, cannot however force the social interactions by itself but it can contribute to creating the right conditions for them to happen.

Moreover, it can be contended that both the lighting project and the design process employed have a role in sustaining an SOB. A lighting design supports belongingness if it follows specific design principles: it is unique and meaningful and it sustains social interaction in the space. On the other hand, the design process must be participatory by bringing neighbours together and making them

connect to have an active role in shaping the design. Group activities strengthen collective ties and having contributed to the design makes people identify more with the space thus strengthening a collective identity.

Acknowledgements

We thank Leni Schwendinger, Luciana Martinez, Lisbeth Skindbjerg Kristensen and Anna Lykke Thorup for sharing their experiences and reflections, which enriched this research. We also acknowledge Mette Hvass for her supervision, advice and encouragement during the completion of our Master's Thesis at Aalborg University as well as the preparation of this article.

References

- [1] Maslow, A. H. (1943). 'A theory of human motivation'. *Psychological Review*, 50(4), 370-396.
- [2] Gehl, J. (2010). *Cities for people*. Island Press.
- [3] Dohna, F. z., Schwendinger, L., & Arup. (2015). *Cities Alive. Rethinking the Shades of Night*. Arup.
- [4] Narboni, R. (2016). 'From Light Urbanism to Nocturnal Urbanism'. *Light & Engineering*, 24(4), 19-24.
- [5] Casciani, D. (2020). *The Human and Social Dimension of Urban Lightscapes*. Springer International Publishing AG.
- [6] Calvillo Cortés, A. B., & Falcón Morales, L. E. (2016). 'Emotions and the Urban Lighting Environment'. *SAGE Open*, 6(1)
- [7] Hvass, M., Waltorp, K., & Hansen, E. K. (2022). 'Lights out? Lowering Urban Lighting Levels and Increasing Atmosphere at a Danish Tram Station'. In S. Sumartojo (Ed.), *Lighting Design in Shared Public Spaces* (pp. 152-172). Routledge.
- [8] Entwistle, J., Bordonaro, E. & Slater, D. (2018) 'The social study of urban lighting'. In: Davoudian, N, (ed.) *Urban lighting for people: evidence based lighting design for the built environment*. RIBA Publishing, London, UK.
- [9] Casciani, D., Rosso, M. (2012) 'ELSE, Experience of Lighting Sustainability in the Environment'. *Cumulus Conf. Northern World Mandate –Towards Open and Participative Cities* 24–26.
- [10] Allen, K., Kern, M. L., Rozek, C. S., McInerney, D. M., & Slavich, G. M. (2021). 'Belonging: a review of conceptual issues, an integrative framework, and directions for future research'. *Australian Journal of Psychology*, 73(1), 87-102.
- [11] Singh, K. (2007). *Quantitative social research methods (1. publ. ed.)*. SAGE.
- [12] Stebbins, R. A. (2001). *Exploratory research in the social sciences*, Vol 48. SAGE
- [13] Escalera-Reyes, J. (2020). 'Place attachment, feeling of belonging and collective identity in socio-ecological systems: Study case of pegalajar (Andalusia-Spain)'. *Sustainability (Basel, Switzerland)*, 12(8), 3388.
- [14] Baumeister, R. F., & Leary, M. R. (1995). 'The need to belong: Desire for interpersonal attachments as a fundamental human motivation'. *Psychological Bulletin*, 117(3), 497–529.
- [15] Maslow, A. H. (1968). *Toward a psychology of being (Second ed.)*. Van Nostrand Reinhold Company.
- [16] Gehl Architects, The Techno Anthropology Lab (Aalborg University), Visual Methodologies Collective (Amsterdam University of Applied Sciences), Service Design Lab (Aalborg University), Center for Digital Welfare & Public Data Lab. (2022). *The Urban Belonging Project*. Available at: <https://urbanbelonging.com/> (Accessed: 4 August 2023)
- [17] Tuan, Y. (1977). *Space and place, The perspective of experience*. Edward Arnold.
- [18] Scannell, L., & Gifford, R. (2010). 'Defining place attachment: A tripartite organizing framework'. *Journal of Environmental Psychology*, 30(1), 1-10.

- [19] Manzo, L. C. (2005). 'For better or worse: Exploring multiple dimensions of place meaning'. *Journal of Environmental Psychology*, 25(1), 67-86.
- [20] Lynch, K. (1960). *The image of the city*. Technology Press.
- [21] Böhme, G. (2017). *The Aesthetics of Atmospheres*. Routledge.
- [22] Bille, M. (2019). *Homely Atmospheres and Lighting Technologies in Denmark: Living with Light*. Taylor and Francis.
- [23] Bille, M. (2015). Lighting up cosy atmospheres in Denmark. *Emotion, Space and Society*, 15, 56-63.
- [24] Seuntjens, P. J. H., & Vogels, Ingrid M. L. C. (2019). *Atmosphere creation: the relation between atmosphere and light characteristics*. Zenodo.
- [25] Edensor, T. (2015). 'Light Art, Perception, and Sensation'. *The Senses & Society*, 10(2), 138-157.
- [26] Ellery, P. J., & Ellery, J. (2019). 'Strengthening Community Sense of Place through Placemaking'. *Urban Planning*, 4(2), 237-248.
- [27] Project for Public Spaces. (2007). *What is Placemaking?*
Available at: <https://www.pps.org/article/what-is-placemaking> (Accessed: 4 August 2023)
- [28] Speirs Major (2022) *Exchange Square*.
Available at: <https://www.smlightarchitecture.com/projects/2972/exchange-square> (Accessed: 4 August 2023)
- [29] Arup UK (2020) *University of Sheffield Concourse*.
Available at: <https://www.arup.com/projects/university-of-sheffield-concourse> (Accessed: 4 August 2023)
- [30] Boyce, P. R. (2019). 'The benefits of light at night'. *Building and Environment*, 151, 356-367.
- [31] ÅF Lighting (2015). Ishøj Station.
Available at: <http://www.urbanlightscares.net/ishoj-station-by-af-lighting/> (Accessed: 4 August 2023)
- [32] Studio Roosegarde (2018) *Van Gogh Path*.
Available at: <https://www.studioroosegarde.net/project/van-gogh-path> (Accessed: 4 August 2023)
- [33] Museo Torino (2021) *Torèt*.
Available at: <https://www.museotorino.it/view/s/4bead4cf54f744f4831feae465b9f057> (Accessed: 4 August 2023)
- [34] Speirs Major (2008) *Sheikh Zayed bin Sultan al Nayhan Mosque*
Available at: <https://smlightarchitecture.com/projects/536/sheikh-zayed-bin-sultan-al-nayhan-mosque> (Accessed: 26 November 2023)
- [35] Light Follows Behaviour (2018) *Terry Spinks Place*.
Available at: <https://lightfollowsbehaviour.com/portfolio/terry-spinks-place-canning-town/> (Accessed: 4 August 2023)
- [36] Jan Lewin (2022) *The Pool*.
Available at: <https://www.jenlewinstudio.com/portfolio/the-pool/> (Accessed: 4 August 2023)
- [37] Artec Studio (2014) *BruumRuum!*.
Available at: <https://artecstudio.net/BruumRuum/> (Accessed: 4 August 2023)
- [38] Gehl, J., & Svarre, B. (2013). *How To Study Public Life*. Island Press/Center for Resource Economics.
- [39] Cullen, G. (2012). *The Concise Townscape*. Taylor and Francis
- [40] Sumartojo, S., Edensor, T., & Pink, S. (2019). 'Atmospheres in Urban Light'. *Ambiances (En Ligne)*, 5(5)
- [41] Pink, S. (2013). *Doing visual ethnography (3. ed. ed.)*. SAGE.