

Light across disciplines and times: Walking seminar as a method at the 1928 Stockholm Public Library.

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Abstract. Lighting in buildings today is a multi-disciplinary task. Increased complexity and specialization have led to a split process where coordination between disciplines is lacking. Despite extensive technical development, daylight and electric light are still planned in separate processes, resulting in over-lit environments where energy savings, health and spatial potentials of daylight are not fully utilized. To address these problems, this paper introduces the walking seminar as a method to bridge and increase knowledge across disciplines in the field of lighting. The seminar held at the Stockholm Public Library, invited participants with different professions and expertise: an architect, an electrical consultant, a lighting designer, a librarian, a caretaker, and an architectural historian to share perspectives on light. Based on the seminar, findings relevant for today's practice are presented, both for the specific case in itself, a listed building and an active library, and at a more general level concerning lighting standards and the interaction of daylight and electric light). The main future task for the building sector is to preserve and develop our existing building stock, which includes lighting. Sustainable and longterm solutions require that daylight, electric light and spatial lighting design are planned as an integrated whole, based on the characteristics of the specific building. Findings from the walking seminar presented in this paper point at the importance and potential in transdisciplinary dialogue to enable the development of long-term lighting solutions in our existing and future buildings.

Keywords: integrated lighting design, walking-seminar, dialogue methods

Methods for inclusive design processes at the early stages of a research project in School Environments

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Abstract. This paper explores the use of participatory methods prior to designing interventions within a research project at a primary school in central Sweden. The approach presented in the paper is based on the principles of participatory design (PD), to enhance the use of these methods within the areas of educational research (ER), lighting, and architecture. This approach aims to include participants of educational spaces and incorporate their views prior to design interventions. Two workshops were designed to support teachers' participation through hands-on activities. Twenty-eight teachers participated in the workshops. Scale models corresponding to two of the school's classrooms were used to initiate discussions regarding the interconnection between spatial layouts, lighting, and learning activities. The workshops' data collection analysis assisted the research group in understanding the school's spatial and learning characteristics. The information gathered from the workshops provided additional knowledge and informed the research project in a way that allowed for further development and changes within the project related to the additional variables measured along with light. According to the analysis, there is a correlation between the activity and the desired layout of the space, while the type of equipment also varies according to the task.

A Framework for Optimizing Lighting in Animal Shelters for Domestic Cats

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Abstract. In this project, we aim to enable designers to optimize lighting conditions for domestic cats in animal shelters. Specifically, we developed an optimization framework that controls the spectral power distribution (SPD) of light sources and returns the effect on feline visual perception. In our model, we used standard light source SPDs and predicted light reflected from different surfaces within an animal shelter. The reflected SPDs were combined with the known brightness sensitivity of domestic cats across the visible light spectrum to develop an understanding of cats' visual experience in the shelter under different lighting conditions. The optimization framework then minimizes the difference between a desired lighting effect (here, daylight) and a modeled effect using a set of light source SPDs. Initial results demonstrate that by using slightly more advanced lighting design and control, shelters can potentially improve the visual experience for cats.

Pain-Relieving Light – (How) Is it Possible?

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About 15% of the population suffer from migraines (Stovner et al., 2010) and it is estimated that about 40% of all people with migraines would benefit from preventive treatment, but only 3–13% use it. (Knowledge management in health care, 2021). Migraine is a huge burden for society and individuals (Linde et al, 2012; Linde & Dahlöv, 2004). Migraines can be intensified by light, and some patients need to stay in a dark room until the attack is over. People with this type of photosensitivity show a clear preference for light color, specifically the color green which have been shown to be more comfortable and even pain relieving in some cases (Nosedá et al, 2016; Nir et al, 2018). We will present a feasibility study with the aim of preparing a series of experiments to investigate if regular short-term green-light-exposure can prevent migraines. We will present findings from the literature, developed light equipment and plans for future testing of migraine friendly light solutions.

Situating the light: Methodology for sensory and spatial fieldwork

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Abstract. Sensory perceptions are a novel point of departure for lighting research, where human factors have long been approached through isolated variables and controlled environments. However, informed by philosophy and social sciences and supported by ethnographical methods, researchers and practitioners are gaining new ground in understanding human-environment relations by approaching user perspectives in empirical inquiries. Situating the lighting in spatial settings and sensory experiences is crucial when exploring the dynamics of the changing visual perception of aging and vision loss, and how these phenomena can affect everyday life. Although spatial and sensory perceptions have typically been approached from different positions represented by architects or anthropologists, the following question remains: How can we develop a methodological framework for exploring entwined sensory and spatial experiences? This paper presents the method development process for our upcoming sensory and spatial fieldwork in the project “The role of light when vision changes.” The process is described in autoethnographic narratives, analysis of the technological frames, approaches, and understandings of light represented in the project, and the knowledge gained from testing the developed tools and schemes hands-on in a home environment. The initial findings indicate that both spatial and sensory experiences are interactional, as experiences situated in a specific body interacting with the specific environment it is situated in. Furthermore, in addition to the changes in visual perception, the spatial and luminous characteristics of the indoor and outdoor environments are also dynamic and changing, making the aspects of transitions and thresholds relevant for our upcoming fieldwork. Our hypothesis is that the shared technological frame developed in the project includes the relevant qualitative and quantitative measures that will allow us to make the knowledge of visually impaired participants explicit in ways that will inform and improve future lighting design.

Keywords: Field work, everyday life, domestic lighting, incipient vision loss, methodological framework

Lighting assessment in low-vision rehabilitation: Implementing N-Lited

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Abstract. Lighting assessments have been part of low-vision rehabilitation for decades, but more structured and evidence-based approaches have emerged in recent years. In Denmark, a mixed-method semi-structured protocol for lighting assessment was developed and tested as a pilot study from 2017–2019, and it showed promising results, in that it improved the visually impaired participants' quality of life. Innovations are often developed in pilot studies, but implementing new approaches across communities of practice poses difficulties due to both individual and organizational norms. N-Lited is an implementation project that entails the dissemination of knowledge and instructions as well as practical trials, and its protocol has been implemented in seven low-vision centers from 2022–2023. Based on participants' observations, document analysis of the framework, and a midway evaluation that assessed the potential for scalability and diffusion, this paper discusses the learning and change processes in the interpretation and role of the lighting measurements and lighting assessments in this project. Beyond mere instrumental learning, the findings reveal that it is crucial to address how individuals learn how to explore and question the difficulties that reveal mismatches or reconfigurations of values, norms, and assumptions to ensure a successful implementation of the method. The changing role of lighting measurements, from instrumental to more reflective, also illustrates the importance of the practical application and learning-by-doing aspects that are essential for learning how to reflect and “think with the metrics.” Furthermore, metrics and tools are an important part of the community of practice's shared language. The uncertainty of navigating between the uniformity of the protocol and the flexibility needed for incorporating the method into individual professionals' practices and the various organizational contexts emphasizes the relevance of the process of learning how to manage methodological innovations in practice.

Keywords: Lighting assessment, low-vision rehabilitation, home environment, practical application, implementation & learning process

Exploring daylight in two different hemispheres: *Sweden and Uruguay: a comparative study of daylight as a formgiver and its impact on visual comfort*

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Abstract. Daylight's critical significance for both the built and natural domains underscores its potential to enhance energy efficiency and environmental sustainability in architecture. This study presents a careful exploration, using a tailored case study, to reveal diverse strategies for leveraging daylight's inherent attributes as a building material. Integrated climate adaptation serves as the bedrock of architectural projects, fostering regenerative development as well as liveable and sustainable spaces. This research delves into daylight's complexities, positioning it as a primary input in early architectural stages. Through comprehensive analysis in Uruguay and Sweden, this study highlights the interplay of daylight's effects. An experimental cabin serves as a focal case study, bolstered by Climate Studio software, yielding a thorough daylight analysis across these locations. The synthesis of academic and practical approaches underscores daylight's pivotal role in shaping sustainable built environments.

The Influence of Urban Lighting on the Sense of Belonging

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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 lightscapes 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.

Light formed through urban morphology and different organism groups: First findings from a systematic review.

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Abstract. The prevailing implementation and usage of contemporary lighting technologies and design practices in cities have created over-illuminated built environments. Recent studies indicate that exposure to electric lighting effects formed through spatial characteristics has visual, physiological, and behavioural effects on both humans and non-humans, such as wildlife. In order to gain a better understanding of the impact that electric lighting has on space and different organism groups, a comprehensive literature review was conducted applying PRISMA 2020 systematic review guidelines. Results of the searches from various databases, such as Web of Science, PubMed and Scopus, identified 5260 related studies. A total of 55 papers connected to four themes: (1) urban morphology; (2) human visual impressions; (3) ecological impacts; and (4) design approaches and methods were analysed with a focus on urban morphology. The review provided the following general findings: lighting properties alone are inadequate to depict visual impressions of pedestrians, patterns formed through light interacting with spatial characteristics can contribute to understanding how spaces are visually perceived and help characterising the exposure of wildlife organisms to potential disturbances.

A review study of space perception and navigation of people with low vision: is simulated low vision a reliable methodology?

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Abstract: The inclusion of visually impaired participants in research protocols concerning their perception of space and navigation is essential for the reliability of the results, given the strategies developed by the people concerned in everyday life. However, the diversity of visual impairments, the scarcity of participants and possible safety issues due to obstacles in the physical space induce limitations and prompt researchers to look into alternative methodologies. Simulated low vision is seen as an option. This method involves sighted participants wearing goggles with customized filters or watching processed image in virtual environments. The objective of this study is to investigate the reliability of simulated low vision as a research method to describe the space perception and navigation of people with visual impairment. We conducted a literature review and identified 36 quantitative studies on low vision spatial performance involving multiple user groups. Simulated low vision proved effective in small-scale spatial ability evaluation, such as object detection and distance estimation, but remained challenging regarding large-scale capacity, such as navigation with mobility requirement. Advances in virtual environments suggest that they are a good alternative to goggles and screen displays because of their precision in mimicking ocular problems in simulation settings. Finally, the use of HMD by people with real low vision could open up the possibility of greater testing in safer and controlled conditions, but requires confirmation of the validity of the protocols.

Role of lighting and color in microeconomics: preference and purchase intent

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Abstract. Lighting and color are key factors under the control of lighting designers that can significantly impact shoppers' perceptions and actions in the context of culinary and retail environments. Previous studies have examined the effects of color and lighting on preference and purchase intent, but results are often conflicting due to confounding variables, and a strong connection between these phenomena remains unexplored. To bridge this gap, two visual experiments were conducted, revealing that lighting can indeed influence consumers' perception of products. Participants perceived the changes in objects under different color gamut and illuminance levels. Further research is needed to better understand the mechanisms of purchase intent, particularly across different price and product types.

URBAN ILLUMINATIONS - LIGHT ART

ACTIVATING THE PUBLIC REALM

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Abstract. How can contemporary light art installations impact the sensorial perception of the urban context to modify and reinterpret urban space? In Robert Irwin's words, how can they provide "...an extended way of looking at the world"? In this paper, we examine how temporary light installations may impact the public realm by modifying citizens' perceptions of moments in the city: a habitual urban passage is interrupted with a temporal experience, changing the way the urban space is experienced. We explore how site-specific light installations create unique intersections of audience and spatial perception through the artists' intent of creating new urban atmospheres through an experiential layer added onto the urban fabric during light festivals. To do so we analyze and discuss two light installations that we designed and executed, which were shortlisted for the 2022 [d]arc awards. Both projects took part in larger urban light festivals and were located within urban passages. "Reflecting on Troy" [Author 1 - Troy Glow Light Festival] created a temporal light graffiti in an urban alley, while "Riddle 102" [Authors 2,3 - Nobel Week Lights], a dynamic lighting installation in a 231m pedestrian tunnel, created an immersive environment that alters the perception of the tunnel's physical dimensions. Through reflections, as well as visitor and curator reviews, we unpack the intent and impact of the works on the perception of the urban context. We discuss and analyze the similarities and differences between the two urban settings, identify the design processes and principles pertinent to site-specific light installations [materials, lighting fixtures, testing] and address the impact darkness and over-lit spaces have over spatial perception. Lastly we discuss the impact a temporary light installation may have on the collective memory of the city, perceived in person or online.

Light Activism: alternative urban nightscapes

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Abstract. Since their beginnings, artificial lighting technologies have been used as a tool by those in power to express their authority and ensure their control of cities. State and commercial hegemony determine urban lighting, which has a substantial spatial, semiotic, emotional, and physiological effect on us. Lighting conditions imposed from the top down inform our bodily experience of the night. LED technology is revolutionizing artificial public lighting. Nevertheless, critical inquiry about its potential uses is sorely lacking. This research will explore the capacity of collective light interventions to turn public spaces into more inclusive nightscapes. It will focus on community-driven projects where the use of lighting contributes to the production of alternative urban experiences. The research engages methodological issues by asking how lighting tools can potentially contribute to community empowerment. Can lighting actions in public spaces propose other ways of interacting and other ways of experiencing the night? This paper revolves around critical lighting practices. It shows how the use of light can foster citizen engagement and ignite new nocturnal imaginaries as the perception of the night is reshaped to restore communities' right to the city. My intention is to bolster critical awareness regarding the use of light and the power underpinning its instrumentalization. This text will also shed light on the effect ephemeral collective light interventions have on public spaces and its perception.

Daylight Diagram – A Method to Map and Analyse the Temporal Conditions of Daylight Intensity

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Abstract. This study proposes and examines a new method and diagram for revealing and analysing temporal and transitional daylight conditions based on computational modelling and simulations. For a human to experience and decipher the world, daylight is a predominant resource to engage with the surroundings. With humans spending the prevalent time inside buildings, it is important to understand and design the daylight environments in the early phases of design processes. The aim is to retain and reveal the information of high-resolution simulations and to explore, test and verify the capacities of the method in comparison to Illuminance, Daylight Factor and Daylight Autonomy values. The research design uses digital modelling and representation techniques combined with computational simulation methods for daylight analysis, evaluation and communication. Eight digital test cases show that the proposed Daylight Diagram enables the observation of temporal daylight dynamics. The proposed method and diagram employ existing simulation systems, allowing a fast integration and use in earlyphase design processes as a key instrument to design advanced daylight phenomena and conditions focusing on transitional and temporal daylight intensities.

Spatial planning for dark hours in Sweden – conditions and proposal for action

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Abstract. The purpose of this study was to investigate how the absence of daylight are handled within spatial planning in Sweden, and to propose measures for action. The study includes a review of spatial planning documents, interviews with planning officers, and an overview of how outdoor lighting is included within the Swedish Planning and Building Act (PBL). The result shows that planning documents according to the PBL generally present few specific analyzes and proposals linking to the design and the use of outdoor environments during dark hours, such as lighting. Instead, outdoor lighting is often managed within lighting masterplans, that lack a common methodology and a formal planning status. Possible consequences include that spatial planning provides limited support for how different public interests should be weighed against each other in a nocturnal context, and that citizens have little formal influence over strategic decision on outdoor lighting. As proposal, we suggest developing spatial planning for dark hours ('nattstadsplanering' in Swedish), that integrates the use, the design, and the outdoor lighting within the same planning process, using the PBL as a framework. The proposal includes clarification of lighting regulations, methodology development, and knowledge dissemination, which requires further research and investigations.

Uniform vs. uneven lighting: Accommodation of multiple users' preferences in study rooms

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Abstract. Uniform lighting in public spaces like study rooms in libraries, is still a common practice. However, uniformly lit spaces are unable to simultaneously meet the needs of multiple users and can create dull environments. The objective of this research is to analyze users' behavior under different lighting conditions in study rooms and investigate whether alternative lighting designs, which step away from uniformity, could be more beneficial than uniform lighting, from a human performance and well-being perspective. A uniformly lit study room in the library of KTH was chosen as the main case study of this investigation and was thoroughly analyzed and evaluated through qualitative and quantitative research. Under the initial hypothesis that the lighting in this study room does not meet its users' needs and fails to create an inspiring and comfortable environment, three additional study rooms in different Swedish libraries were comparatively analyzed through observations, interviews, and questionnaires, so as to better understand individual users' needs and lighting preferences in study rooms. The research revealed the existence of various types of users with different personal preferences regarding lighting in order to feel comfortable and alert. A new conceptual lighting proposal is presented for the study room in KTH library, following an uneven lighting approach that utilizes different lighting zones to accommodate individual needs and affect the sense of comfort, alertness, and ultimately, the well-being of multiple types of users.

The Use of Immersive Light-Based Art for Well-Being

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Abstract. This paper presents the findings of 'Waiting Room - Immersive Art for Wellbeing,' an exhibition of various dynamic light art installations that investigated the potential impact of this work on viewers' sense of well-being in a mock healthcare setting.

Research shows that exposure to art impacts human health, improving overall healthcare experiences, resulting in shortened hospital stays, improved recovery time, and reduced need for pain management. The purpose of this study was to determine if exposure to dynamic light art has an impact on overall well-being. Qualitative data were collected using electronic questionnaires associated with 11 different dynamic light art installations. Open-ended questions explored how participants perceived and valued the presence of and engagement with dynamic light art installations and captured their views on the potential benefit of exposure.

Visitors took part in questionnaires to obtain feedback on user experience, the length of exposure/engagement, and the effect the experience had on them. Overwhelmingly, users reported a sense of "calm" and "peacefulness" after spending time with the dynamic light art. One hundred ninety-five responses were collected. This study allowed us to gain a better understanding of how dynamic light art may be used to ameliorate stress and anxiety in spaces where users are confined for periods, as well as identifying key areas for future research, such as particular aspects of the installations or sub-populations that may particularly benefit from this type of intervention.

This investigation leads to further studies exploring how exposure to dynamic light art may impact patients, visitors, and family members in various healthcare settings to determine if the perceptions and experiences vary by type of installation. Additionally, this work will inform future explorations of adaptations to dynamic light art, i.e., dynamic and interactive technologies on viewer experience.

Poetic Daylight – a pavilion for the perception of daylight

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Abstract. Daylight provides us with an understanding of time and space, specifying where we are in the world, every day. We delight in experiencing the changeability of daylight – from morning to evening perceiving how light and darkness affect the spaces surrounding us. This paper highlights daylight as one of the central elements in architecture, by emphasising its qualitative potentials: creating healthy, aesthetic, and poetic spaces. The setting for this survey is a 1:1 pavilion, Poetic Daylight, built for the UIA Conference in Copenhagen. Presenting studies of scale models 1:10 and studies of the built 1:1 pavilion, this survey lays out the possibilities and potentials in the use of scale models when designing spaces, with a focus on the qualitative appearances of daylight. Bearing the distinction laid out by Vitruvius in mind, i.e. firmitas, utilitas and venustas, the pavilion focuses on venustas (beauty or delight) in order to form spaces where the atmosphere and the beauty of daylight can be perceived and experienced. The Vitruvian concept of beauty, together with J. J. Gibson's definition of the perception of an environment, constitutes the theoretical framework. The analysis and the description of the three different spaces in the pavilion are based on Anders Liljefors' seven variables for describing daylight quality and Sophus Frandsen's definition of the four different kinds of shadows. The methodology involves the development of models, observations, and representations. This survey shows that using 1:10 scale models in the design process to include qualitative aspects of daylight is practicable and effective, producing tangible and transferable knowledge that will influence the experience and perception of daylight in the built 1:1 pavilion, Poetic Daylight.

How to illuminate indoor plants sustainably? Tipps and tricks to bridge the gap between research and design.

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Abstract. The increasing popularity of biophilic design in architecture and interior design has led to a widespread integration of indoor ornamental plants and green walls. While numerous studies have demonstrated the benefits of such integration for people, only a few have focused on the well-being of the plants themselves. Our latest research project aims to address this gap by exploring suitable lighting conditions for indoor plants, seeking an optimal spectral composition that ensures their well-being, robust growth, and visual appeal, while also optimizing maintenance. Building upon previous applied research, we conducted experiments to analyze the lighting requirements of four species of ornamental plants commonly used indoors.

Seven identical room boxes were employed, each illuminated with different light spectra falling within the CCT range of 2800K-5000K. The specific light spectra were meticulously tuned with a focus on the red/blue and red/green ratios, while keeping the photosynthetic photon flux (PPFD) and average illuminance consistent. As a result of this research project, practical guidelines were developed to help lighting designers navigating the intricate world of indoor ornamental plants effectively. By carefully considering the lighting spectrum in the suggested ranges, architects and interior designers can create spaces that not only benefit human occupants but also provide an optimal environment for the well-being and flourishing of indoor plants.

Skynative – brings daylight into the depths of buildings

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Abstract. There are various ways of directing daylight into the interior of a building or a room. In cooperation with BASF, Bartenbach has developed a novel concept of a horizontal daylight duct integrated into the suspended ceiling that efficiently transports daylight from the outside into the underexposed "core" of a building. "Skynative" is the name of the system, named after BASF spin-off Skynative® UG, which is working on market integration as well as continuous improvement of the system in an open research collaboration with Bartenbach. In this paper, the system concept development, simulation-based application studies as well as the setup of a real-scale mock including results from a long-term performance monitoring at the premises at Bartenbach are presented. First potential application projects are shown, and the system efficiency is discussed.

Darker Cities due to the Energy Crisis and the need for context-specific urban lighting

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Abstract. Outdoor lighting has been dimmed or turned off in European municipalities due to the energy crisis. Dimming of outdoor lighting levels led to energy savings, advantages for biodiversity and less light pollution. But the dimming also triggers the basic human assumption that bright light is connected to safety and darkness is connected to fear. To discuss this basic assumption, human experience of dimmed lighting and perceived safety is explored through three case studies. One study explores human experiences of dimmed street lighting during energy crises, the second study investigates dimmed lighting levels around public transportation and the third study is an example of a context-specific adaptation of street lighting in a residential area. The case studies reveal that dimmed lighting levels, minimized contrasts and context-specific lighting can lead to an increased connectedness to the spatial and social urban context and an increased feeling of perceived safety. Thus, more light doesn't always lead to more perceived safety. With a dimmed general lighting level, it is possible to introduce additional subtle lighting layers, structured in a lighting hierarchy to further enhance spatial and social qualities in outdoor contexts in the dark hours.

People's conceptual environmental appraisals of urban space in daylight and electric light

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Abstract. Urban spaces should be resilient, inclusive and safe for all residents including, children, elderly and vulnerable groups. This implies that urban planning, management and design should provide public spaces that support human needs of active mobility, social interaction and psychological restoration across seasonal and diurnal variation in natural light. Environmental psychology postulates that an understanding of how people experience or appraise an environment is a critical component in the relationship between urban design and human behaviour. In this conceptual paper we propose and discuss overarching (visual) impressions of the environment (environmental appraisals) that could be utilized to deepen the understanding of how people experience urban green spaces under different lighting conditions. In a certain setting, people respond to specific components of the environment, such perceived molecular environmental qualities make up the overall impression of the setting, and shape critical human-environment transactions fundamental to human well-being. The perceived stimuli are considered to act together to form the perceptual basis for higher order, molar aspects, so called conceptual environmental appraisals. We introduce Küller's human-environment interaction model and Brunswik's lens model to describe conceptual environmental appraisals. Recognising urban forests as important settings for physical active mobility, social interaction and psychological restoration we outline the theoretical underpinnings of three conceptual environmental appraisals: prospect – refuge pertaining to the perceived safety of the environment, environmental preferences, and the perceived restorative potential of the environment. The appraisals have been shown to be relevant in studies on electric lighting in urban space, and possible to assess by means of observer-based assessments also among children, elderly and vulnerable groups. Assessment outcomes may inform discussions on conflicting goals for sustainable development with regard to people's health and well-being, energy use, light pollution and the welfare of other species in urban planning, management and design.

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

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Abstract. Women and marginalised groups are experiencing unwanted attention in the public realm worldwide. This produces a gendered fear, which results 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 marginalized 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

Empathic Lighting Design for Healthcare Environments

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Abstract. Light has the powerful capacity to generate a certain quality and atmosphere within a room. However, lighting design specification is often only characterized via quantitative metrics. In healthcare institutions, such as care homes, hospitals and rehabilitation centres, the use of lighting design may support a positive atmosphere, and potentially also support the health and wellbeing of patients. When people are hospitalised, they are in a difficult and often stressful situation, in which they meet nurses, physicians and relatives within new, unfamiliar surroundings. These situations call for supportive architectural spaces with atmospheres that help people relax and feel safe. Nevertheless, these spaces often lack a lighting design that supports this intent. The objective of this study is to implement two different lighting scenarios and investigate how they affect patients in a psychiatric affective healthcare unit at Copenhagen Psychiatric Centre. Two different lighting scenarios are implemented and tested in a SW-facing group therapy room, during one winter period (November 2022–March 2023). In all, the study includes 12 patients. Through questionnaires, the patients are asked how they perceive the luminous environments of two lighting scenarios, one in the existing healthcare lighting vs. a new lighting setup. The patients indicate their preferences and how the lighting design affected and supported their therapeutic session. The two lighting scenarios are: a) Four high-positioned LED-luminaires (H=2,65 m) in the ceiling; and b) Two low-positioned LED-luminaires suspended above the meeting table (H=1,50 m). The results of the survey show that patients overall prefer the low-positioned, non-uniform lighting, which score a total of 60 points in the semantic analysis, compared to 35 points for the high-positioned, uniform lighting. In addition, from a sustainability viewpoint, energy consumption for the low-positioned lighting scenario is only 21 W, compared to 140 W for the high-positioned lighting scenario, providing an 85% reduction in total energy consumption.

Coping with darkness: residents' experience of reduced outdoor lighting in neighbourhoods

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Abstract. Despite ongoing replacement of old lighting installations with new energy-efficient light emitting diodes, energy crisis has led to the implementation of adaptation strategies for reducing energy use for public outdoor lighting in neighbourhood environments. This would save money and reduce light pollution; however, the situations should be evaluated from the residents' perspective. This paper presents a pilot study, which aimed to explore how residents experience and respond to reduced outdoor lighting in their neighbourhoods during dark hours, by applying the adapted Human-Environment Interaction model to understand the relation between outdoor lighting quality, neighbourhood quality and local independent mobility from the residents' perspective. The pilot study was based on a short questionnaire (N = 76, 29 males, 47 females, Mage = 66.66 years) and telephone or online interviews (N = 13, 5 males, 8 females, Mage = 68.08 years) with the residents living in the neighbourhood areas, in Southern Sweden, where adaptation strategies were employed in reducing the use of public outdoor lighting. Data were collected between February and March 2023. Overall, the results affirmed the important role of outdoor lighting quality in residents' experience of neighbourhood environments and local independent mobility (i.e. the ability of residents to walk or move around on their own in their neighbourhood area) whereas the effect of reduced outdoor lighting was rather insignificant. The interviews further showed different experiences of the reduced outdoor lighting and how the residents coped with the lighting conditions by using solutions (i.e. headlamps, flashlights, bike lamps and reflectors), and that high-level perceived safety from crime in the neighbourhoods was found to play an important role in local independent mobility during dark hours. The adapted conceptual model allowed for the evaluation of outdoor lighting conditions considering both internal and external factors from the residents' perspective, and could provide a basis for discussion about potential changes in public outdoor lighting.

Keywords: outdoor lighting, experience, local independent mobility

Indirect lighting in Contemplative Spaces – an Endless Depth

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Abstract. This paper explores the relationship between indirect lighting and contemplative spaces. Through an examination of notable architectural works, the study identifies a consistent preference for hidden light sources in contemplative spaces across various religions and eras. The research begins by defining the fundamental aspects of contemplation and its correlation with architecture. This is followed by a bibliographic survey of indirectly illuminated contemplative spaces. Within this investigation, three approaches to understanding these spaces are considered. Firstly, the conceptual ideas that architects sought to infuse into their creations; secondly, sensory descriptions provided by experts aimed at elucidating the luminous atmospheres of these locations. Lastly, the study delves into these diverse themes through the lens of phenomenology, highlighting perceptual peculiarities such as the predominance of sight, the significance of peripheral stimuli, and hapticity. This offers insights into the relationship between specific attributes of indirect lighting and transcendental architectural experiences. The consistent suggestion of perceiving endless depth in contemplative spaces prompts a brief discussion on the essence of our perception of depth. This study underscores light's significance as a tool to connect with architectural spaces, transforming them into realms of imagination and awe.

Light and Emotional Architecture: an embodied experience

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Abstract. The presented explorative research focuses on the phenomenological relationship and emotional impact of light within architectural spaces, grounded both in a pilot study and literature review. Serving as the foundational framework for a PhD, this study aspires to decipher the role of light in Emotional Architecture—a term introduced by the German artist Mathias Goeritz in his 1953 architectural manifesto crafted in Mexico. This multidimensional pilot study employs experiential observation and in-depth interviews, complemented with qualitative and quantitative documentation, all anchored by literature-based insights. Set in the Barragán House, which served as both the studio and residence for the renowned Mexican architect Luis Barragán since 1948, the study endeavours to elucidate how architectural nuances—like form, materials, colours, and arrangements—affect lighting conditions, subsequently shaping human emotions and experiences. Through twenty-two interviews, the research captured perceived atmospheres and the inherent intentionality of affordances in architecture, revealing a strong correlation between spatial impact on observers and light-related experiences. The interplay between these elements suggests a compelling avenue for implementing Emotional Architecture conducive to both individual and societal sustainable development.

Theoretical Foundations of Designing for Darkness

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Abstract. This paper sketches the theoretical foundations of designing for darkness. Drawing from (lighting) design theory, philosophy of technology, and environmental ethics, it argues that we have an opportunity to re-examine the meaning and experiences of darkness, exploring why and how we should protect or re-introduce darkness into urban nightscapes – not as a constraint, but a constructive goal for urban lighting. It is further positioned as a formative, not prescriptive, framework: bounding and guiding a flexible design process, and able to inform different strategies and approaches. Framed in this way, three core principles are outlined that serve as moral and aesthetic goals for urban lighting. The first is aspirational, situating ‘darkening cities’ as a type of urban (ecological) restoration akin to greening cities. This requires seeing urban darkness as a critical natural infrastructure that can bring both material and social benefits. The second is evaluative, specifying the value-level design requirements to be fostered in urban nightscapes. Lighting strategies should, as a *prima facie* obligation, promote and preserve the values of darkness. The third principle is experiential, exploring how strategies can create the conditions for positive experiences of – and engagement with – urban darkness through creative approaches to rewilding nocturnal atmospheres. In combination, they offer a means to specify darkness as a design requirement, as well as a reflexive tool to assess and refine the overarching theory of designing for darkness.

Exploring Simulation Workflows, Tools, and Metrics for Beyond-Vision Effects in Multi-Objective Optimization: A Scoping Review

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Abstract. Lighting in the built environment affects different aspects, ranging from building performance in terms of costs and energy consumption to human well-being in terms of thermal comfort, visual effects, and beyond-vision effects. Buildings optimised for specific performance metrics rarely consider different aspects simultaneously, leading to sub-optimised, unbalanced, or non-trade-off solutions. Therefore, multi-objective optimisation has commonly been used to overcome conflicting performance objectives. Recently, light effects beyond vision gained more interest in building design but it is unclear if and how they are integrated with other existing building performance metrics and simulation workflows. A scoping review investigated the state-of-art in multi-objective lighting design optimisation regarding building performance and human well-being focusing on performance metrics, simulation workflows, and the overall information flow. Results show that metrics for beyond-vision effects are not integrated with other human well-being and building performance metrics. The simulation workflows included multiple steps and computational tools in multi-objective optimisation. This process has limitations such as a long simulation time, no ubiquitous integrated tool, and a reduced information flow.

Co-designing safe and sustainable darkness for northern urban places

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Abstract. The technological development, quantitative increase and qualitative design of urban lighting have succeeded in improving the safety and comfort of urban spaces. In this context, dark and dimly lit places appear as undesirable, even dangerous. However, the disadvantages of overlighting are increasingly being identified. On the other hand, darkness has well-being effects and aesthetic values in urban environments. The Safe and Sustainable Darkness project studies the frameworks for dimmer urban lighting: how to find room for lower lighting levels and darker places, respecting the diverse use of spaces and the values and experiences of city residents. In the article, we present participatory process for design and implementation of safe and sustainable urban darkness. The expertise and understanding of two different groups is of interest. Interviews of various professionals in the city organization reveal how illuminated and un-illuminated places are perceived from an administrative perspective. Inhabitants and users of urban space share their insight of the meanings, potential and context of the existing and future dark places. By combining the research material from interviews, crowdsourcing, workshops and evaluated pilot installation, we propose a design methodology that utilizes the understanding of professionals and place users to create enjoyable dimly lit and un-illuminated urban spaces.

Embedding sustainability into the design of street lighting

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Abstract. Light pollution is an increasing problem and artificial light at night affects nature in many ways. The Norwegian Road Authorities (SVV) initiated a collaboration with the Norwegian Institute for Bioeconomy (NIBIO) and the University of South-Eastern Norway (USN) to find measures that can help reduce the negative impacts of road lighting on the environment and nature. While USN has looked more generally at sustainable lighting design and ways to reduce the negative effects of road lighting, NIBIO has focused on how road lighting affects insects. We study how the light from roads contributes to light pollution, with the final aim to know more about what measures most effectively reduce the negative effects of road lighting. In this pilot study of light levels in two transects beside a road, the results show that the light levels decreased relatively fast as the distance to the light source increased. Thus, the direct light from the road lighting might not be the most prominent addition to the light pollution in the open landscape. On the other hand, the measurements showed some light influence from the road up to around 160 meters from the road, although the levels were low. While the light was below the detection limit, the light source was visible as a point source at a very large distance. This observation addresses the question of whether organisms are influenced by the average light energy per area, or the intensity of a source as observed from a distance (irradiance vs. radiance). Additional sources of light pollution may affect the result, such as unshielded private light sources and sky glow. This project aims to find measures that can help reduce the negative impacts of road lighting on the environment and nature. We study how the light from roads contributes to different components of light pollution, like skyglow, light trespass and luminance from the light source.

Mechanisms of Aesthetics: On the Perception of Materials and Their Properties.

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Abstract. The visual perception of material surface qualities holds immense importance in our daily lives, serving as the foundation for various environmental interpretations and behavioural adaptations. These encompass critical safety aspects, like assessing floor safety or food freshness, to appreciating intricate sculptural illusions, such as delicately draped fabric in marble statues. Particularly for products with high aesthetic value, perceived properties play a significant role in subjectively attributing material worth. Given the vast array of material surfaces and the pivotal role of lighting in the overall visual perception process, this presents a major challenge for lighting planners and designers. Currently, the achievement of aesthetic effects in architectural spaces heavily relies on the opinions and experiences of professionals, as there are no specific guidelines for combining materials with different lighting concepts. Hence, decoding the connection between physical properties and their subjective interpretations becomes crucial in facilitating the objective planning of materials. In this study, more than 600 materials were systematically examined to explore the interaction between perceived material properties and the resulting aesthetic effects. The resulting perception model establishes a direct link between objectively assigned and subjectively perceived material properties. These findings hold promise in contributing to both a more accurate evaluation and prediction of material appearances in the long term.