



AALBORG UNIVERSITY
DENMARK

Aalborg Universitet

Lighting design for diversity

Learning from low-vision rehabilitation

Øien, Turid Borgestrand; Frandsen, Anne Kathrine

Published in:
IOP Conference Series: Earth and Environmental Science

DOI (link to publication from Publisher):
[10.1088/1755-1315/1099/1/012054](https://doi.org/10.1088/1755-1315/1099/1/012054)

Creative Commons License
CC BY 3.0

Publication date:
2022

Document Version
Accepted author manuscript, peer reviewed version

[Link to publication from Aalborg University](#)

Citation for published version (APA):
Øien, T. B., & Frandsen, A. K. (2022). Lighting design for diversity: Learning from low-vision rehabilitation. *IOP Conference Series: Earth and Environmental Science*, 1099(1), Article 012054. <https://doi.org/10.1088/1755-1315/1099/1/012054>

General rights

Copyright and moral rights for the publications made accessible in the public portal are retained by the authors and/or other copyright owners and it is a condition of accessing publications that users recognise and abide by the legal requirements associated with these rights.

- Users may download and print one copy of any publication from the public portal for the purpose of private study or research.
- You may not further distribute the material or use it for any profit-making activity or commercial gain
- You may freely distribute the URL identifying the publication in the public portal -

Take down policy

If you believe that this document breaches copyright please contact us at vbn@aub.aau.dk providing details, and we will remove access to the work immediately and investigate your claim.

Lighting design for diversity: Learning from low-vision rehabilitation

T B Øien^{1*} and A K Frandsen¹

¹Department of the Built Environment, Aalborg Universitet, A. C. Meyers Vænge 15, 2450 Copenhagen, Denmark

*Corresponding author tuo@build.aau.dk

Abstract. Science understands and handles a phenomenon from different perspectives. Light is handled as daylight, artificial light, task light, and general light, as physics, electrical technology, or safety aids. However, as part of people's everyday lives, the different characteristics of the phenomena fluxes and blend, as people's needs and preferences to lighting differ across a day, in different situations, and not least across a lifetime. Current societal agendas as Leave No One Behind or the sustainable development goals, stress the need for a more holistic approach in design: For the built environment to support wellbeing, comfort, and quality of life, for all.

Disabilities have traditionally been defined in relation to abilities and the normal-bodied, with special aids for special needs, and special spaces for the 'other'. Niches for the other is seen in the field of lighting as special solutions for visually impaired, and correspondingly, lighting is a niche in low-vision services, that has been guided by diagnostics and recommendations of specific lux levels. Thus, more holistic and interdisciplinary initiatives within low-vision rehabilitation that have explored the rehabilitative role of lighting as support of the visually impaired individual in their everyday life, show that individualizing and optimizing the individual's domestic lighting can improve their quality of life. Can the findings from low-vision rehabilitation be translated into the field of lighting design, informing a qualitative approach, and work as an incubator for more diverse user perspectives?

The interactions of the low-vision consultants, visually impaired participants, and their domestic lighting, have been studied in a case study of the role of lighting in low-vision rehabilitation. Participatory observations of 15 consultations and interviews with 17 visually impaired participants form the basis for an analysis of the dynamic human environment interaction at stake, using the theoretical frameworks of affordance and usability. The analysis contributes to a more situated and dynamic understanding of light: The experience of light is context dependent, and lighting needs and preferences are diverging regardless of diagnosis but rather constituted by the dynamic interactions. Consequently, this calls for user involvement and a more diverse user perspective in design processes, which could support more useful designs.

This study implies a promising potential within the intersection of research paradigms and practice: Between quality of life, lighting quality, architectural quality, and user perspectives closer to people's complex and changing needs and preferences.

1. Background

In modernity, the human body has been measured, calculated, and translated into average dimensions, proportion principles, and standards for rational and industrial building construction. Light has similarly been handled as a scientifically measured and standardized object of physics. The Danish Building Regulations require lighting conditions in buildings that ensure persons' comfort, safety, and health, and

that the light is sufficient in relation to its intended use. The lighting standards for work environments cover recommendations for the quality of light and stress the importance of the variation of light in design considerations, due to its effect on people's mood, emotions, and mental alertness [1]. Informed by the positivist traditions of lighting research [2] literature on lighting quality often refer to non-visual responses as the effect on the human biology and physics. However, to explore the role and use of lighting in diverse and sometimes more complex issues, the qualitative concern needs to include the social and psychological effects and interactions at stake. Furthermore, even though the situated, contextualized, and perceived light has been explored in academia, through psychology and humanities [3, 4, 5, 6], this understanding of light has only to a limited extent been operationalized in the field of lighting design. More significantly, the diversity of the human body has not been represented in these studies, nor in common lighting principles and standards.

Analytical frameworks can support the investigation of marginal groups, as demonstrated by Lid [7], that explores how heterotopias in situated practices characterize and shape one another. She argues that recognizing the other can enable inclusion, space for human diversity, and participation. The concept of heterotopia is described as a displacement, the 'other' in relation to the 'regular'. "Heterotopias provide an avenue for distance. Isolated yet accessible, heterotopias represent a space that can show us the landmarks of thought by distancing us from those landmarks" [8, p. 66]. As a social space, the heterotopia, engage a continuous dialogue with its 'normal', maintaining powerful positions [9], where the multiple and shifting relational definitions could support social change [10]. As a space of encounter, where the sites are confronted with each other's 'otherness' and potentially changed by the very interaction – a dialogical approach to heterotopia could constitute niches where "difference and strangeness are allowed to remain" [9 p 36]. The clash of difference can render visible new knowledge of both sites, and sometime reorder or reconstitute them, as seen in the dialogic encounters that characterize innovation and interdisciplinary collaboration in our professional practices.

This kind of dialogic encounter was enabled in a pilot project in low-vision rehabilitation, entitled Better Light Better Living (BLBL), from 2017 – 2019. Two low-vision consultants at the Centre of Special Education (CSU) in Slagelse, turned to the field of lighting design, and supported by the new knowledge acquired, they developed and tested, in 60 visually impaired participants, a new methodology for lighting assessments in their services [11]. Traditionally, lighting assessments were practiced based on a scheme of overall recommended lux values for different diagnostics, measures of preferred light levels when seated in a fixed distance of a chart or arrangement of objects in the clinic, and by providing special lighting for special needs. However, compared to the hands-on experience and practice knowledge from working with the visually impaired and with the move to a more user-centered care, a less instrumental and more qualitative approach was needed. The new approach included: a) an individualized lighting assessment in the home, b) a lighting intervention in the lighting lab, and c) a follow up, assessing the changes which had been implemented by the participants themselves.

Exploring and optimizing their own practice by encountering and interacting with the field of lighting, a heterotopia to the field of vision rehabilitation, the low-vision consultants have innovated and moved both their understanding and use of light in their services. Using the parameter of light to recognize and understand the needs and motivation of the clients, and to improve the output of their service, by improving the client's quality of life. The question in this paper is whether we can establish a counterpart of this dialogic encounter within the field of lighting, and whether this can be unfolded as a heterotopia informing or challenging existing design practices? How can the findings from low-vision rehabilitation be translated into the field of lighting design? Can knowledge on lighting from the context of low-vision rehabilitation be seen as a critical case for informing approaches to more holistic lighting design, embracing the diversity of experiences and practices where the light is situated, and work as an incubator and a heterotopia of inclusion?

2. Theoretical framework

To explore and understand the user perspectives embedded in BLBL, between the professionals and the visually impaired, and between the participants and their lighting, we have employed a set of theories

that opens to the human-environment interaction at stake. *Usability* has been a key term in product design, describing effectiveness, efficiency, and satisfaction “with which specified users can achieve specified goals in particular environments” [13], as a property of the interaction between the product, user, and a task [14]. Disability is listed as one of the user characteristics associated to usability, along with experience, domain knowledge, cultural background, age, and gender. “...by paying attention to the needs of those with disabilities, it is possible to provide opportunities for the disabled which might otherwise be restricted”. These designs could also benefit able-bodied users, demonstrated by handsfree telephones, ball-point pens, and remote controls. The space for maneuver, both literally and metaphorically affects the interaction, where abilities and disabilities can be understood in relation to the concept of *affordances*. The perception of affordances is described as what the properties of the environment offer to the individual, as well as the personal abilities to identify, recognize and act on the properties offered [15]. Affordances are spatially and temporally situated [16], enmeshed in dynamic processes where perception and abilities to act can change, both temporally and during a lifetime. To be actualized, affordances need to be identified and recognized by the individual [17]: Don Norman describes affordances as an important parameter in product design as the way a device presents itself - the bunch of apparently unrelated affordances that the user should be able to understand and learn how to use with a minimum of effort [18]. He argues that technology built from a machine-centered point of view, would benefit from a design-approach that involves the user needs to ensure the proper affordances.

3. Methods

In 2018, BLBL was accompanied by an ethnographic action research study, conducted by one of the authors. BLBL formed an instrumental case study for investigating the current practice of low-vision rehabilitation, and CSU’s innovative use of lighting in their service [19]. The empirical material used in this paper includes field notes from the participating researcher’s observations of 15 BLBL consultations conducted by the low-vision consultants during the winter season of 2018/19. These consultations were both in the lighting lab of CSU and in the homes of the participants. The sample included both private and rented homes, apartments in multi-storey houses, terraced houses, and detached single-family houses, of 57 – 175 m², 2 – 7 rooms, and built from 1927 - 1999. Consequently, both typology and orientation of the buildings differed, as well as window composition and distribution, causing different lighting scenarios. Some participants had themselves been involved in decisions regarding the existing artificial lighting in their home, while for others, this was fully or partly decided by previous owners, or included in a lease. Observations focused on the activities and conversations of the intervention, including the participants descriptions of their experience and use of the light in their everyday, the consultant-facilitated assessments and demonstrations conducted in relation to the chosen activities. In 2020, visits and interviews were conducted with 17 participants that had implemented all or some of the recommended changes. These visits were organized without the consultants, and with an objective to map the changes made by the participants as part of the project, or changes caused by the intervention on their mind-set and approach to lighting. Observations also included physical traces of the participants’ use of the space, and the results of the intervention seen in adjustments or adaptations of spaces, arrangements, or practices. A semi-structured interview guide supported the visit, covering both the activities and lighting issues processed in the intervention, the overall approach of BLBL, and their personal learning or change process. The interview was partly conducted while moving across the living space, addressing the specific activities and associated lighting scenarios, and partly seated, in a place supporting the conversation, such as at a dining or coffee table. The questions involved their general use and perception of light in their home; the implemented changes and their user-experiences of these, including enabling and disabling aspects; and the role of the assessment and intervention for enabling the changes.

Notes, photos, and sketches were produced in the actual setting, as the photos in Figure 1, while digital field notes were produced immediately after each encounter. Both participatory observations and

the visits were documented by rich descriptions, describing both conversations, interactions, and scenarios.



Figure 1. Photo documentations of the intervention: The consultants facilitating the participant's testing of alternative lighting arrangements for a chosen activity.

An analytically focused categorization was conducted in the empirical material, across the individual consultations, to identify and describe a) the visually impaired participants' understanding, perception and use of light in their everyday settings, b) experience of abilities and disabilities regarding their impairment in the specific settings and activities, c) the role of the assessment and intervention on this relation and d) the professional consultants' articulation of and approach to light and the individual. The following analysis was supported by the theoretical frameworks of affordances and usability to unfold and conceptualize the dynamic interactions of the human-environment relation.

Recognizing the relational and interactional aspects of light, focusing on the usability and affordances of the light, we hope to provide insights of the role of light in peoples everyday life of value for lighting design.

4. Findings

While previous analyses have investigated the co-design process within BLBL [20] and the role of lighting in the rehabilitation process [21], the findings here focus on the role of lighting in a more general human environment relation. Based on the personal narratives and settings, yet looking beyond the diagnostics of disability, we aim in this section to get a better understanding of the situatedness of light, intertwined between humans and environment. The case of BLBL show that light is situated in multiple concerns: as part of the physical and social context of the participants, the abilities of the individual, and attuned in the collaborative process around problem shooting and solving at stake in the lighting adjustments and optimization in the specific activities. These three main findings will be unfolded in the following sections.

4.1. Situated as part of the everyday physical and social context

An important aspect of BLBL compared to their previous practices of lighting assessments in low-vision rehabilitation has been to situate the consultation in the physical context of the participant. In the 60 participants, there was cases concerning work environments or school environment, however most participants were elderly, and with issues concerning their everyday life in their home environment. The consultants describe their first encounter with a participant's home environment as a subconscious scanning [19]. This initial inquiry of light, was a patchwork of information and observations, starting with the neighborhood area and close surroundings, and of the typology of housing, before entering the interior space. Any light was situated spatially, for natural light, this spatiality was often related to the light's changing character and movement throughout the space and on the different surfaces, while artificial light was more characterized by its position and orientation. Beyond the interior spaces and surfaces, the different light sources assembled with materials and colors of walls, floors, ceilings, and

furniture arrangements. As the consultant was following the participant around the living space, identifying, and discussing issues and possibilities regarding the current lighting, the situatedness was often articulated. In a case where the participant described her problem with insufficient light at her dining table, the consultant examined and described the relation of the light source, the lamp, its size, shape, position and orientation, in order to suggest that the light source was probably good enough, but the many metal shades reflecting the light reduced the amount of light at the table to a degree, which was not optimal for this participant. Another issue stressed by the participant was the transition between the spaces of the apartment, that was determined on the current condition of natural light. For this participant, the sunlight was of great support during the day, while an overcast sky or at night, entering the living room felt like “walking into a wall of light”. She had been granted special ceiling light panels but explained that she never used them, as the light was uncomfortable and annoying. The consultant recognized the issue and assessed the specific light, its correlation to the room, and the other luminaires, and summarized based on the descriptions, that due to the scattered and diffuse character of the light, the light did not reach the surfaces, and consequently caused the feeling of entering a ‘wall of light’. The suggestion from the consultant was to test different arrangements to get to know the specific issue closer.

The social context of the participants was also impacting the use and perception of light in the home environments. For the participant described above, her social context, was constituted by her eight-year-old son, and friends visiting. Besides her own physical preferences, she also wanted the lighting to fit for social gatherings, meaning that her lighting preferences included both physical and social needs.

4.2. Situated as part of the more-or-less-able bodies' everyday life

The criteria for participating in BLBL included both visual impairment and photosensitivity. One of the hypotheses was that preferences and needs regarding light were not nearly as linked to diagnosis as previously assumed. The results from the BLBL showed no association between the diagnostics and the preferred lighting across the different participants, actual the same individual could choose different types and levels of lighting for different types of activities and in different environmental settings [11]. In fact, for many of the participants, their visual function was not steady, but changing due to their physical condition and conditions in their environment: “I see everything and nothing... you see, it is really hard to describe... it depends, for example, on the light, on the contrasts, and on whether I am tired, or whether I know the place and have been there before...”. For some, light was a key to their residual vision, which was illustrated quite clear in a visit to one of the participants. The 50 lux provided by the daylight was all darkness to her, while the 2050 lux measured on the table from the suspended light fixtures she got installed, enabled her to see me and the things on the table.

For most of the visually impaired participants, the vision could not be restored and for many, the process would eventually result in blindness. Conversely, participants suffering from concussion typically experienced the opposite progress, of recovering or regaining a normal condition and a ‘normal’ everyday life. In this group, the issue was not the visual function, but usually directly related to the experience of lighting: A sensitivity to light and flicker, where luminance differences and contrasts by large were disabling aspects. This could be glare directly from a particular luminaire or from reflections in blank surfaces. Several of these participants preferred the softer twilight hours, and for many it meant different degrees of avoiding light. One participant described her coping as an act of balancing between very little light and darkness, in dialogue with her husband. To get used to the dim morning light in her bedroom, she usually stayed in bed for 45 minutes before she could get up. She described the impact of the light like this: “not as pain, but as a discomfort, like a noise, filling everything in my head”. She kept the curtains shut, used a cap and sunglasses indoor, and most artificial lighting were turned off. She tried to manage the everyday with as little light as possible.

Another example from this group of participants showed a more creative approach to the lighting. She used the daylight quite a lot in her everyday life, however with an aim to avoid contrasts. When we moved around the house, she stopped in one of the rooms where a cone of light appeared from behind a blackout curtain: “For me, it has never been about my vision, however I can be in pain, and so it is a

physical challenge... just a glimpse of light, like this from behind the blackout curtains, the huge contrast causes problems. From dark to light, can bother me, and from light to dark, I get tired.” Transitions between dark and lit spaces was a major disabling issue for many. Illustrated in one participant with reduced flexibility of the only functioning eye, that explained how the adaption from lighter to darker spaces, or the other way around, as a very slow and painful process. A rheumatic disease further increased the sensitivity to light during the periods when the disease was in outbreak. However, when the light was dim, she used much more effort to adjust her eye to see anything at all, which then caused serious migraine. On the one hand, she was happy for and depended on the light, and on the other hand, it could cause great discomfort.

The empirical material shows that the light afforded both disabling and enabling situations. The individual and diverse needs of the participants, from nearly no light at all to far beyond lighting levels for normal vision, were also illustrated in the lighting measures from the follow up, ranging from < 10 -10.000 lux and above [19], which outmatch the normal lighting recommendations (100-1500 lux) for indoor environments [22].

4.3. *Situated in complex and dynamic human-environment relations and processes*

Where lighting assessments previously had been based on the visual impairment and adjusting illuminance in relation to visual acuity in a fixed position in the clinic, the BLBL embraced the situatedness of the light in the participants everyday lives. Departing from activities and situations of the participants own choice and motivation, engaged the participants beyond their mere visual function, and enhanced the interaction of the individual and the physical and social context.

Facilitated by the lighting intervention in the clinic, where the participants, with guidance and demonstration of the low-vision consultants, tested and compared alternative lighting arrangements for the activities at stake, new knowledge and realization supported the recommendations to be brought back home.

Lighting changes typically involved rearranging existing luminaires and settings or purchasing and installing new, recommended luminaires. As seen in Figure 2, this could be changing and repositioning the light under the cabinets to support activities on the kitchen, such as preparing food or managing the dishes. Or adding indirect lighting by illuminating the wall and ceiling above the cabinets, to optimize the general lighting.



Figure 2. Visuals from one of the homes visited. The photos show: 1) the researcher observing the interaction of the consultant and participant in the lighting assessment, 2) the consultant measuring light and documenting the scenarios, 3) the existing scenario, and 4) the scenario after the recommendations have been implemented.

Where the directed light supported the visually impaired participant in practical activities, the indirect light was primarily used in social occasions. All in all, these were often small adjustments, but they had enabled larger transformations: helping the participants to see other opportunities, recognizing the two-sidedness of affordances where their way of using the light could be adjusted as well. Even participants

that had not made any changes to their lighting or physical context reported that their mind-set had changed, resulting them in using a luminaire in a new way, moving the light or moving the activity, or coordinating to the more optimal setting of the natural light if this was the case. In the 60 participants, performance, and satisfaction with the activities, as well as near activity, independency, and self-reliance improved with BLBL [11]. Resuming to activities where they previously had been dis-able due to insufficient lighting and regaining this ability were appreciated.

Actualization of affordances, the processes of complementing environmental opportunities with personal abilities was seen in workarounds and new ways of approaching the everyday practices, and due to the decreased scope of activity caused by the impairment, the activity within this scope became all the more important for well-being and quality of life.

5. Discussion

In BLBL, the low-vision consultants challenged the dominant technical understanding of lighting in their field of rehabilitation and embraced the situatedness and everyday life of the participants by expanding the approach and understanding of light. Aspects of usability, of specific users with specific goals in specific environments [13] seem to be a better fit for qualifying the everyday, than quantifiable measures of averages. The human environment interaction is represented in models of occupational therapy [22] that is somehow embedded in the processes of rehabilitation. The reconfiguration, reintegration, or reinterpretation of abilities in a given context, is the core of the low-vision consultants work, and why approaching the light from different angles seems obvious. They use the light to understand the everyday struggle and motivation of the participant, and to work with this relation to support the participants themselves to engage.

The practice of situating the light in the everyday social and physical context of the participant was informed by knowledge on light concerning our sensory experience of light, but also the use of light. As part of the pilot project, the consultants gained new knowledge on lighting through a series of courses focusing on the use and perception of light, arranged by an architect and lighting designer. This knowledge, of the experience of light, was, opposed to the scientific isolation of a phenomenon in single factors, acknowledging that the factors were perceived simultaneously and interacting. They learned how to observe, experience, and assess the light as part of the context, initially by their own sensory experience, described as an overall evaluation of the light in the room, assessing whether the luminance distribution felt suitable, as a subconscious scan [20], with particular attention on anomalies, things out of place. This knowledge on the situated lighting also included an awareness of the diversity of lighting features needed in different activities and in different spatial configurations.

In the cases of the visual impaired, the experienced and perceived light, was much more differentiated than we know it for normal sighted. On the one hand, glare, flickering, or high luminance contrasts could cause discomfort and constitute huge barriers or disabling conditions. On the other hand, and far beyond the luminance specification per diagnostics, lighting was through the intervention a key for enabling the residual vision for some of the participants. We have used the notion of affordances to help recognize this interdependency between the possibilities afforded by the environment, including the lighting, and the personal abilities to identify, recognize, and act on the properties offered [15]. In the process of BLBL, the participant's understanding and approach to lighting was transformed, in a way enhancing their abilities to appreciate and exploit the potential affordances – for their specific visual function, body, and situation in the given context. The process was further enabled by focusing the lighting assessment on activities and thereby assess the usability. Here effectiveness, efficiency, and satisfaction [13] were asserted in a different scale and pace than the normal-bodied, as endline measures compared to baseline measure of the individual before and after the intervention [11]. In this way the assessment supported an actualization of affordances [17], which is essential in rehabilitation, where the individual needs to create strategies to cope with the abilities and disabilities associated with a functional or cognitive impairment.

The objective of the consultants has been to find lighting appropriate for the individual (optimizing visual function), in the specific tasks, and that could accommodate varying needs by different or flexible/

adjustable lighting. There was an overall need for flexibility regarding lighting, both in relation to the different needs of the visually impaired participant, dependent on the daily or seasonal variations, changes in the impairment, and the needs and preferences of the family members or other in the home. Compared to the previous diagnostic or medical approach to the lighting assessment, the participants were seen as complex individuals with multiple and sometimes contradicting preferences. Lighting preferences could be based on visual performance, social settings, or the level of comfort. The body and the vision were not understood as static diagnosis, but as a dynamic entity that could mobilize change. The notion of shaped affordances helps us illustrate the interrelation of the individual and its context, where either of the parameters can change - in the intervention both the lighting, the use of light, or the understanding of light could help shape new affordances.

5.1. Lessons learned from BLBL and this study that can inform the field of lighting:

1. Light is contextualized, and seen as a qualitative aspect it stretches across architectural quality, to lighting quality and quality of life. Light, both natural and artificial, is particularly important for comfort and wellbeing of visually impaired. The appropriate light is found in the specific relation why mock ups and post-occupancy evaluations would be of great value.
2. The general need of different lighting for different activities, and the different personal preferences, applies to all, not just the visually impaired. Consequently, this diversity calls for user involvement, where focus on usability can support the design process.
3. Beyond usability, the interaction of human and their environment is reciprocal – our understanding and use of an object can affect our understanding of it, as well as our understanding of it can affect our use. This goes both for the designer and the user, and the concept of affordance could potentially scaffold methodological considerations for how to operationalize this relation.

Beyond the mere lighting specifications, all practices working with light employ layers of tacit knowledge. Whether it is the embodied knowledge of end-users, embedded knowledge in lighting technologies, or practice knowledge of lighting designers. As the field of low-vision rehabilitation has recognized the pivotal role of light in their practices and services, we argue that the role of a more diverse user perspective, including low-vision can qualify the field of lighting design. As the before mentioned handsfree telephones, ball-point pens, and remote controls [14], lighting products and technologies have already worked across the heterotopias and several of the special-aid products within lighting are moving into ordinary consumer goods. Everyone may at some point experience challenges with their vision or discomfort from lighting, where a multiple and dynamic approach to lighting can accommodate a more diverse understanding of the user – putting user needs to the point [18]. Incorporating usability studies or the concept of affordance in design practices could ensure qualitative aspects and lighting more sufficient to its use, while linking performance and impact measures to quality of life would be a statement of prioritizing the user perspective. Both could enhance the user perspective in quality of lighting, still missing in the guidelines and standards.

As illustrated in Figure 3, this study has explored the role of lighting in the field of low-vision and low vision within lighting.

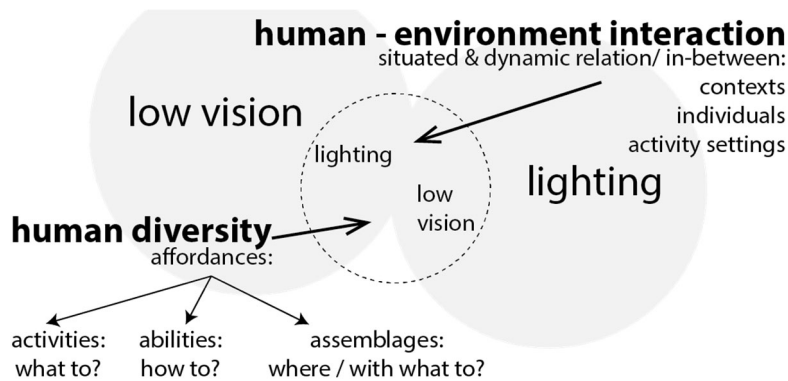


Figure 3. The overlap of lighting and low vision, unfold both diversity and dynamic interaction, of humans and environments. A niche that can be operationalized by the concept of affordances.

Working across these heterotopias, the analysis has identified usability and affordances, as suitable framework for investigating human diversity within the human-environment interaction at stake in BLBL. Investigating the cases regarding the assemblages of lighting technologies and physical and social contexts, the abilities of the individual in the setting of specific activities. This affords to a more holistic, situated, and dynamic understanding of light: The experience of light as multiple and constituted by the dynamic interaction between the individual and the environment, making the abilities of the individual relational and dynamic. This approach requires the time and resources for assessment, exploration, and for including the users in co-design processes as they are the experts in their everyday life, preferences, and perception. Identifying affordances require reflections of the individual on how the surroundings and assemblages enable or disable the specific situation or activity, experienced in use.

There are essential differences between rehabilitation and design. In rehabilitation, the focus is on specific individuals in existing contexts, while in design it is often for an unknown or general user and a yet to come environment. Looking into the experiences of visually impaired and the role of lighting in low-vision rehabilitation, emphasize a much broader user perspective than the ‘regular user’ of both architectural and lighting design. As stressed by one of the participants: “...working with low vision, it concerns the specific and individual settings. We do not fit a specific lux level, you must test the specific lighting...”.

The other way around, designers will seldom have the opportunity of working as closely with individual users as seen in this inquires, but a more diverse user perspective could accommodate and reach more of us. We have outlined learnings from the field of rehabilitation which we believe could qualify lighting design in meeting the call for social inclusion, in creating inclusive and safe environments, leaving no one behind.

6. Conclusion

In this study, low vision and lighting have been investigated as each other’s heterotopia, as counter-sites. The approach to and understanding of lighting in low-vision rehabilitation has been reconstituted to fit the purpose of the rehabilitation of visually impaired in their everyday settings and practices, embracing a situated and contextualized lighting. In this paper we try to turn the tables and direct the dialogical approach of heterotopia to reorder the user perspective in the field of lighting.

Supported by the concepts of usability and affordances we have translated and discussed the findings to the field of lighting design, however, not as lighting characteristics or measures, but as a methodological approach. The examples from the everyday of the visually impaired show light as a) contextualized, in social and physical contexts, b) that lighting needs and preferences diverge independently of visual conditions, why use and activities are important entrance points to optimized lighting, and c) that the relation between users and light is dynamic and affected by the actual interactions between the two and the overall context.

Whether this initiative succeed in enabling a dialogic encounter of diversity in the field of lighting design, and inform or challenge existing design practices, remains to be seen. We hope that it sparks

reflections in lighting design practitioners, where a dynamic and relational understanding of the human environment interaction can flourish.

References

- [1] Dansk Standard 2021 *Light and lighting - Lighting of work places - Part 1: Indoor work places* DS/EN 12464
- [2] Kelly K 2017 A different type of lighting research—A qualitative methodology *Light. Res. Technol* **49** 8 pp 933-942
- [3] Böhme G and Thibaud J P (eds.) 2016 *The aesthetics of atmospheres* (New York: Routledge)
- [4] Bille M, Bjerregaard P and Sørensen TF 2015 Staging atmospheres: Materiality, culture, and the texture of the in-between' *Emot Space Soc* **15** 1 pp 31-38
- [5] Ingold T 2011 *Being alive. Essays on movement, knowledge and description* (Oxon: Routledge).
- [6] Pink S and Leder Mackley K 2016 Moving, making and atmosphere: Routines of home as sites for mundane improvisation *Mobilities* **11** 2 pp 171-187
- [7] Lid IM 2017 Medborgerskap i spennet mellom ekskludering og inkludering [Citizenship in between exclusion and inclusion] *Rom og etikk: Fortellinger om ambivalens* ed IM Lid and T Wyller (Oslo: Cappelen Damm Akademisk) pp 35-54
- [8] Topinka R J 2010 Foucault, Borges, heterotopia: Producing knowledge in other spaces *Foucault Studies* pp 54-70
- [9] Meininger H P 2013 Inclusion as heterotopia: Spaces of encounter between people with and without intellectual disability *Journal of Social Inclusion* **4** 1 pp 24-44
- [10] Hetherington K 1997 *The Badlands of modernity. Heterotopia and social ordering* (London: Routledge)
- [11] Øien TB, Jacobsen AM, Tødten ST, Russotti T, Smaakjær P and Rasmussen RS 2021 Lighting Assessment and Optimization in Low Vision Rehabilitation Improves Participation and Quality of Life in Individuals with Vision Loss *Occup Ther Health Care* pp 1-18
- [12] Christiansen AB 1995 Hvilke lystekniske parametre er viktige for synet? [What lighting parameters are of importance for the vision?] *Fakta om lys* **8** 1 pp 6-13
- [13] International Organization for Standardization 2015 *ISO DIS 9241-11: Ergonomics of human-system interaction — Part 11: Usability: Definitions and concepts*
- [14] Jordan PW 1998 *An introduction to usability* (London: Taylor Francis)
- [15] Gibson JJ 1979 *The Ecological Approach to Visual Perception* (Boston: MA: Houghton-Mifflin)
- [16] Chemero A 2003 An outline of a theory of affordances *Ecol. Psychol.* **15** 2 pp 181-195
- [17] Moore RC and Cosco NG 2007 What makes a park inclusive and universally designed?: a multi-method approach *Open space: People space* ed CW Thompson and P Travlou (London: Taylor & Francis) pp 105-130
- [18] Norman DA 2016 *Living with complexity* (Cambridge: MIT press)
- [19] Øien TB 2022 *Belysning i synsrehabiliteringen. Et casestudie* [Lighting in low-vision rehabilitation. A case study] (Copenhagen: BUILD)
- [20] Øien TB 2022 A Study of Environmental Factors in Low Vision Rehabilitation *Front. Rehabil. Sci.* **113**
- [21] Kunstig belysning [Artificial lighting], Arbejdstilsynet [The Danish working environment authorities], accessed 9 August 2022, <https://at.dk/regler/at-vejledninger/kunstig-belysning-a-1-5/>
- [22] Øien TB 2021 Housing and low-vision rehabilitation – across theories, practices and everyday settings *Proc. from the 4th Conference on Architecture Research Care & Health* **8** 1 ed J van der Zwart, SM Bakken, GK Hansen, E Støa and S Wågø pp 113-119

Acknowledgments

The study has been funded by the Velux Foundation.