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Lighting Features Affecting the Well-Being of Able-Bodied People and People with Physical Disabilities in the Park in the Evening: An Integrated and Sustainable Approach to Lighting Urban Green Areas

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Abstract: This study focuses on the analysis of lighting in night conditions to explain what lighting in parks should look like and how parks should be lit from the point of view of people's perceptions. It addresses the impact of the lighting configuration of urban parks on preference, safety, mystery, legibility, and contact with the environment. The feelings of wheelchair users and able-bodied people were measured. The respondents assessed park landscapes presented in visualisations that varied in terms of lighting features and spatial contexts. This research showed, inter alios, that the participants rated evenly lit spaces more highly than those featuring spot lighting. In unevenly lit spaces, the lighting of the surroundings turned out to be crucial import for able-bodied people, while for the disabled respondents, a combination of lighting of the surroundings and of paths was significant. For evenly lit spaces, path lighting is less important for disabled people than for those without disabilities. These insights can help researchers to look at lighting solutions in a more human-centered way and take into account the environment in which they are used. This allows the design of night lighting in parks to be socially sustainable and promotes access to urban green spaces for all citizens. The study emphasises that the provision of sustainable lighting in parks should take into account different social groups, making light a common good.

Keywords: human-centric lighting; disabled people; lighting design; night landscape; lighting features; park lighting; sustainable night environment; environmental psychology

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1. Introduction

The aim of the study is to diagnose and understand how people experience lighting in park landscapes through the prism of two types of park visitors: people with motor disabilities and able-bodied people [1]. In all likelihood, every individual who decides to take a walk in the evening first considers the level of risk [2], as well as environmental factors [3]. So, feeling safe is a relevant factor, because it should be assumed that the more confident people feel, the more likely it is that they will venture out for a walk [4,5]. According to research, the decision to take an evening stroll is significantly influenced by the presence of lighting [6,7].

Increasingly, analyses of safety are extended to include the impact of lighting on human behaviour and social interaction [8,9]. Light now also tends to be considered a social medium, since the designer is required not only to follow lighting standards, but also to understand how, in which circumstances, and for which reasons people will move around, which features of the environment they value, need, and use, and how they experience the identity and atmosphere of certain spaces [10,11]. This approach is also determined by international agendas and models of ecological, economic, and cultural development (Sustainable Development Goals, New European Bauhaus, and the LUCI Declaration for

the future of urban lighting). Public spaces are meant to be inclusive, and lighting should be adapted to the needs of citizens, as well as the urban and natural contexts [12]. Only by understanding how light may be used to achieve these goals can lighting effectively and efficiently benefit everyone [13]. It should also be noted that nightscape design should be an integral part of city planning and an important element of sustainable lighting policy. In this context, lighting should help to build social inclusiveness and civic life in urban spaces, creating places that are accessible and comfortable for all who share them.

In order to explain how parks should be lit and what should be illuminated, as well as to analyse the park as a social space, two groups of park visitors were involved in our study. These groups can be divided into able-bodied people and people with motor disabilities—wheelchair users. We assumed that by discovering the perceptions of park lighting that are shared (or not) by able-bodied and disabled people, we could work towards more inclusive lighting design in urban green areas. We also felt that if two groups of park users were to examine differently lit park scenes, this would lead to a better understanding of their preferences. We also felt that this would help to identify obstacles [14] that may limit evening activities.

2. Literature Review

2.1. Park Lighting Methods and Their Impact on Safety and Preference

Lighting plays a key role in how safe parks in the evening are perceived, as well as in the overall assessment of the attractiveness of a given space—preference [15–17]. In-depth research on this issue by comparing the feelings of different visitors—able-bodied and disabled people—can deliver not only knowledge, but also a better understanding of the relationship between people and the night environment and help to develop a more equal, active, and social space [18].

The analysis of research and experiments in particular [6,19–23] allows us to assume that three elements combining features of lighting and space will have the greatest impact on the visitors' preference and sense of safety in a park after dusk:

- The layout and distribution of lighting;
- The lighting location;
- The spatial context, including the extent to which the landscape is open.

2.1.1. Lighting Arrangement and Distribution

Studies on light distribution have proven that the question of whether pedestrians feel confident and decide to venture out for a walk after dark [22] is related to spatial brightness [24,25]. Furthermore, Fotos and Liachenko-Monteiro [22] demonstrated that the spatial distribution of light may be more relevant than the amount of light. Their findings from field studies on pedestrian routes suggest that uniformity of lighting or minimum lighting intensity are better predictors of pedestrian confidence than average lighting intensity. Similar observations were recorded by Wu [21], who showed that uniformity of lighting (even at low levels) is more desirable and has a positive impact on safety than lighting with high heterogeneity (light and dark spots). He argued for this observation by saying that in low light, the distribution of shade is very even, which offers people better control over their visual environment. These findings were also confirmed by the scientific experience of other researchers [6] who noted that optimising the uniformity of lighting distribution minimises contrast and shade, which might otherwise affect the perception of perspective and concealment, as well as, by consequence, whether the area is evaluated as safe. Converging and interesting findings emerged from studying human experiences related to different lighting proportions in urban spaces [20]. Using a combination of laboratory and field studies, researchers revealed that low brightness contrast between the observer and the surroundings enhanced the perception of the area as relaxing and harmonious. Additionally, their measurements showed that poorly but evenly lit terrain boosted feelings of connection with the spatial and social environment, thereby increasing perceived safety.

It can therefore be assumed that the spatial arrangement and distribution of light triggers a specific reaction from the observer, visually expanding or limiting the depth of view and directing the gaze through space in accordance with the brightness relationship between the illuminated objects or area and other objects [17,21]. However, although brightly lit surroundings expand perceived space and spaciousness [26], having reached the optimal level, or plateau [27], they may begin to have a negative effect [8,28].

2.1.2. Placement of Lighting

Park research tends to focus on path lighting [29,30]. Many studies have confirmed the impact of such lighting on physical and social safety due to ease of movement without fear of falling and collisions, as well as the easy recognition of other people's faces [31,32]. Moreover, pedestrian road lighting is important because it facilitates direction and navigation, and it assists movement along a designated route. Furthermore, the method of lighting is often determined by local law or the applicable standard in a given country [33]. At the same time, a number of studies indicate that lighting of the surroundings has a greater impact on sense of safety and preference than the lighting of paths themselves [15,16,34]. The possibility of observing the local environment provides an opportunity to see prospects and facilitates orientation, while making the landscape interesting and offering an insight into what is to come [24,35,36]. Additionally, it enables us to make contact with, and relate to, the landscape in our vicinity [37]. Lynch [38] also pointed out that a distinctive and legible environment ensures safety and increases the potential depth and intensity of human experience, while being able to see multiple prospects may affect comfort and safety in nighttime situations. Other studies also emphasise the relevance of prospects, while highlighting the impact of concealment and entrapment in the process of assessing safety after dark [6,24,36]. According to these research findings, spaces offering visible prospects of the vicinity are perceived as safe, whereas if the surroundings are insufficiently lit to be evaluated, a sense of imprisonment and a drop in perceived safety ensue.

Lis et al.'s [15] comparative study of lighting in parks is also worthy of examination. In the eyes of the study's respondents, the lighting of surroundings made them more legible, which in turn influenced the respondents' sense of safety, while foreground lighting, including the lighting of paths, had the opposite effect. The same relationship was observed in terms of preference—lighting of the surroundings had a positive impact on preference, whereas lighting in the immediate vicinity reduced the appeal of the nightscape.

This research review and analysis indicate that the placement of lighting can have a significant impact on sense of safety and preference and affect park users in various ways.

2.1.3. The Context of Space, Including the Extent to Which the Landscape Is Open

In a nightscape, the same lighting forms may affect people in different ways, depending on spatial circumstances, topography, and land cover [17,39]. Research conducted after dusk indicates that attributes of the environmental context correspond significantly to preference and safety. Typically, pedestrians perceive that paths with an open view are safer, and they prefer these to ones where the view is obscured by plants or other elements that reduce light transmission [3,19]. Moreover, an experiment by Lis and colleagues [19] conducted in a botanical garden after night had fallen confirmed that landscape openness, structure, and coverage turned out to be key factors in terms of how safety and landscape preference were assessed, and they may correlate with the amount and spatial distribution of lighting. Moreover, scientists showed that landscape openness is directly related to how the brightness of the natural sky impacts perceptions of lighting uniformity, as well as the amount of artificial lighting. This led them to identify the features of park space and lighting that affect the attractiveness and safety of parks. The characteristics that influence attractiveness include wide prospects, diversified structure, and varied ground cover with a small amount of light, ensuring semi-darkness. In turn, according to Lis and colleagues' research, people perceive that they are safer and feel more confident in semi-open spaces, with a moderately diverse structure and ground cover, and evenly lit paths [19]. Other

research also highlights the relationship between context and lighting, arguing that lighting design and spatial context influence the lighting experience and that lighting influences the entire spatial context [39]. Scientists conducting research in cities also reach some interesting conclusions. Their reports indicate that the minimum lighting levels required to achieve a feeling of safety vary depending on the geographical location of the city. These levels are different in inland, dry environments compared to coastal areas. [23]. Research suggests that the geographical location of a site and landscape openness, structure, and cover, in combination with the amount and spatial distribution of lighting, may be relevant factors when assessing landscape safety and preference.

2.2. Related Feelings—Legibility, Mystery, and Contact with the Environment

Research on the impact of lighting methods on park visitors' feelings increasingly transcends the analysis of preference and sense of safety, and expands the scope of interest to include additional affective and cognitive experiences of space [25,37,40,41].

A study by Lis and colleagues [15] revealed that some variables related to preference and sense of safety, such as legibility, mystery, or sense of privacy, may explain the impact of lighting methods on the perceived safety and attractiveness of space in park nightscapes. Therefore, we decided to expand our study with some additional variables.

One of the most important theories regarding landscape preference, Kaplan's theory [42], assumes that landscape preference is a function of understanding and exploration. If we consider space in terms of how of a person on the move (3D dimension) visually experiences an illuminated environment [11,43], then, according to this theory, the exploratory function should be influenced by the mystery of the landscape, while understanding will be affected by its legibility.

In research on daytime landscapes, mystery—defined as the promise of fresh impressions and information that may be revealed upon venturing deeper into the landscape [42]—is primarily associated with parts of the space that are hidden. This concealment encourages exploration, which leads to the discovery of unseen places and the chance to experience something new. Therefore, the variables that affect mystery turned out to be primarily related to visibility: openness [44], pathway curvature/bends in paths [44,45], viewing barriers [46], pathway border visibility [45], visual access [45,47], pathway width [45], vertical depth [48], and vegetation density [49]. For all these variables, the less visible the landscape was, the greater the mystery. The influence of light and shade [48] on mystery was also examined, and it turned out that obscuring some information in shade also had a positive effect on the mystery of a park landscape during the daytime. The mystery of nightscapes is still little understood [15,19], but we can assume, according to Lis and colleagues [15], that visibility will play different roles in this regard. In nighttime landscapes, unlike during the day, most information is concealed by darkness. Therefore, given the definition of mystery as a combination of uncertainty (concealment) and promise (visible forms suggesting further attractions and information to be revealed after venturing further into the landscape), one might assume that in daytime landscapes, the former will play a key role, while in nightscapes, the latter will be more relevant. If the landscape remains completely invisible (with minimal or no lighting), there is no promise and no encouragement to explore the landscape that remains under the cover of the night. Therefore, it seems likely that increasing the number of light points (offering promise), especially in the surroundings, may enhance the impression of mystery in the landscape.

The second aspect that explains landscape preference in Kaplan's theory is understanding, which, in terms of 3D perception, is responsible for landscape legibility. Like mystery, legibility in daytime landscapes is also related to visibility, and the following proved to be positively correlated: visual access [47] and openness [50]. This is because the concept of legibility is defined in relation to orientation in space [42], which depends on available information regarding spatial organisation [38]. A few studies on the legibility of nightscapes have confirmed the positive impact of visibility, when related to the distribution and uniformity of lighting, on perceived legibility [15,19–21]. We might assume

that this involves the lighting of both paths and surroundings, creating edges, areas. and landmarks [38]. Both of these structures play an important role in how a given space is imagined in the form of mental maps.

Taking into account the above-described aspects regarding how park lighting impacts mystery and legibility, one may conclude that an important role in this regard is played by contact with the environment. This offers a promise of impressions to come (mystery) and facilitates orientation (legibility), so it may be linked with the appraisal of landscape appeal (preference). It may also be connected with sense of safety by offering prospects [51]. Therefore, we included this additional variable in our study.

2.3. City Parks from the Viewpoint of People Whose Mobility Is Dependent on a Wheelchair

Research and reports indicate that people with limited mobility, including those in wheelchairs, present reduced levels of physical activity [52]. This also applies to activity performed in public spaces, including city parks. This leads, on the one hand, to impaired physical performance and an increase in body fat [53] and, on the other, to reduced participation in social life and a lower quality of life [54]. Apart from physical activity in a group, home-based exercise, and physiotherapy programs [55], the simplest form of physical activity available to such people is related to everyday mobility and the use of recreational areas, including urban parks [56]. When thinking about making city parks accessible for people with physical disabilities—designing inclusive parks [57] in accordance with the principles of universal design [58,59]—the focus tends to be on eliminating physical barriers [60,61]. The needs and experiences of people in wheelchairs beyond those directly related to mobility (physical access) are rarely taken into account. However, failure to meet the requirements of the disabled, which may differ in some aspects from those of able-bodied people, may turn a public park into a less popular or even exclusive space [62]. One of these requirements, related to the specific conditions of people in wheelchairs, seems to be safety.

Research and reports show that the disabled are more likely to be attacked. Although few studies have demonstrated a lack of a declared sense of danger related to disability among respondents [55], most studies indicate an increased level of anxiety in this group of park users [63]. This is explained by research, theories, and concepts regarding susceptibility to falling victim to crime [64,65], indicating that people who feel unable to defend themselves, either because they cannot run quickly, or because they lack the physical prowess to ward off attackers, might be expected to fear crime more than others [66]. For example, Killias [67] indicates that in a given space, sense of safety is undermined by the assessment of the situation and the perceived risk of being a victim, the consequences that might be incurred, and the possibility of being able to control the situation. People with a low sense of safety tend to score low in these indicators. Such people include those who cannot effectively escape in the event of an attack [66]—such as people who are wheelchair-bound.

3. Research Aims

Taking into account the above issues, we can make some assumptions about the differences between how disabled and able-bodied people perceive lighting in parks on paths and in surroundings.

The first assumption is that for disabled people, intense (high intensity) and even path lighting are desirable and more relevant than for able-bodied people. This is because for people who are wheelchair-bound, any obstacle along the path—unevenness, puddles, bumps, etc. [55]—may seriously impede movement. This may translate into a lower sense of safety related to potential falls. Hence, park routes may need to be more visible than is necessary for able-bodied people. As a result, one may expect that for disabled people, compared to the able-bodied, path lighting will play a greater role, and that the lighting of the surroundings will be less relevant.

The opposite assumption can be made by analysing the need for safety based on a concept proposed by Fisher and Nasar [36], which proposes that this feeling arises from three factors: view of the surroundings (and the related potential control over the situation), places of concealment (offering the possibility to hide), and the chance of escape. While there is no evidence to suggest that the first two factors may be experienced differently by able-bodied and disabled people, the third factor may evoke varied reactions. A person in a wheelchair has such limited mobility that the question of escape probably does not play a major role in their assessment of safety. On the other hand, an able-bodied person may assess path lighting as relevant for escape, and this may have a stronger impact on their sense of safety than the lighting of the surroundings. A disabled person, disregarding the possibility of escape, may consider lighting of the surroundings as more important. Indeed, this would be more conducive to appraising safety [51] by offering a more effective and earlier chance to spot a potential threat.

Taking into account these two possible ways of analysing the potential variations between how the lighting of paths and surroundings impacts able-bodied and disabled people, it is difficult to predict exactly what these differences will be. However, we can acknowledge that such differences are likely to occur.

Research hypotheses

Taking into account the above premises, we formulated the following research hypotheses:

(H1). *People's feelings towards a night landscape (sense of safety, preference, legibility, mystery, contact with the environment) are differentiated by lighting location (path vs. surroundings vs. path plus surroundings) and the distribution of light in terms of its spatial distribution (even vs. uneven).*

(H2). *The impact of lighting location and distribution of light on feelings differs between an open space and a space with a narrow viewing window (corridor).*

(H3). *The influence of lighting location and distribution of light on feelings differs between disabled and able-bodied people.*

4. Materials and Methods

4.1. Research Plan

We based the study on experimentation involving intra-group factorial planning, whereby the respondents would evaluate the park landscapes presented in the visualisations according to five dimensions: preference, safety, legibility, mystery, and contact with the environment. The visualisations differed in terms of spatial features, which constituted predictors (independent variables): lighting location, lighting distribution, and type of space. The assessment was performed separately by two groups—people with physical disabilities and people without. As a result, we used a four-factor mixed scheme $2 \times (2 \times 3 \times 2)$: 2 (groups: disabled, able-bodied) $\times$ 2 (light distribution: even, uneven) $\times$ 3 (lighting location: paths, paths + surroundings, surroundings) $\times$ 2 (space: open, corridor). The research plan is presented in Figure 1.

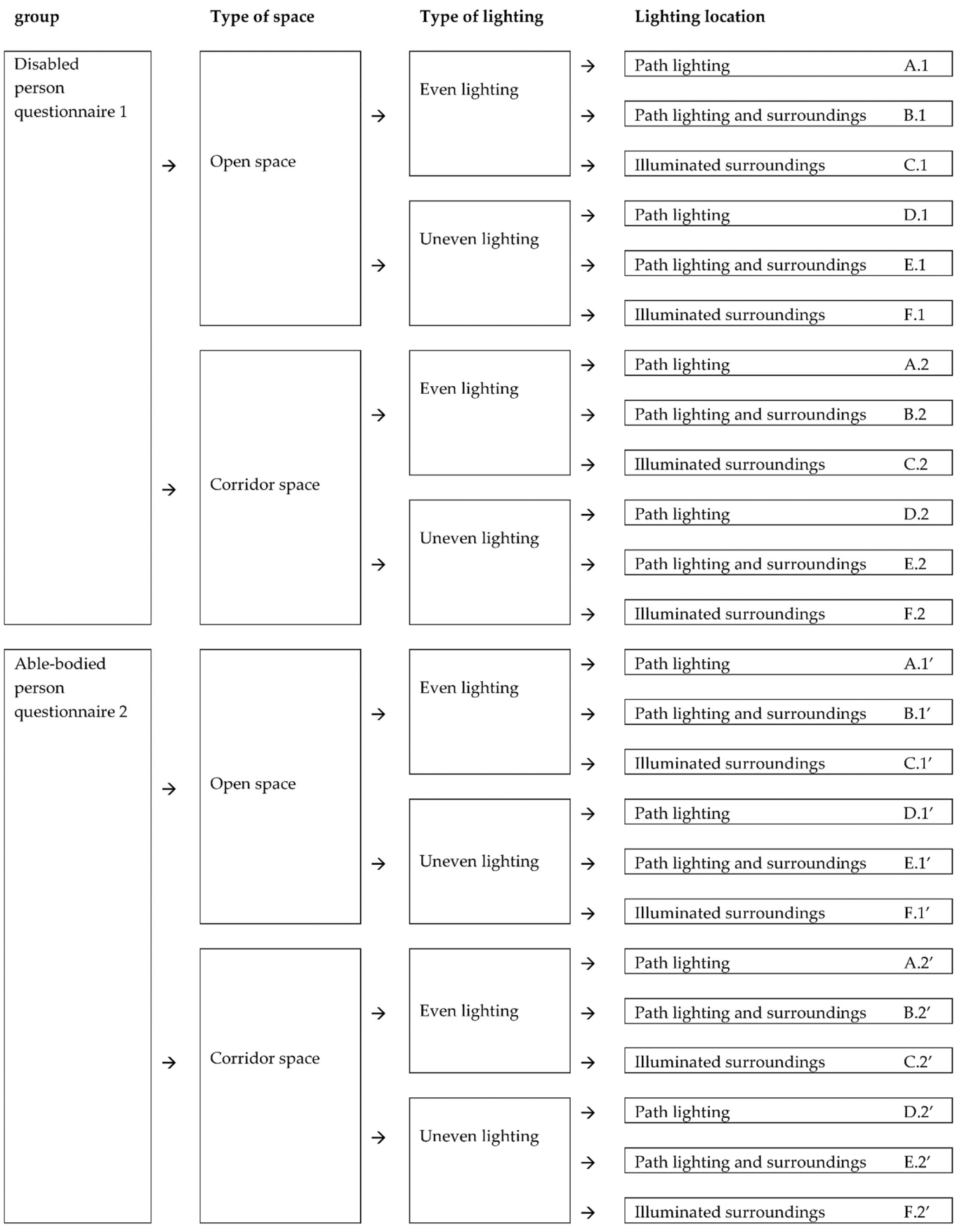


Figure 1. Research plan flowchart.

4.2. Survey Design

A survey was constructed according to the adopted research plan and included 12 visualisations of park nightscapes assessed in terms of preference, safety, legibility, contact with the environment, and mystery. The base scenario was a park nightscape featuring a path, some small architecture, and vegetation. This was then adapted by introducing some independent variables:

(1) Type of scenery divided into open space and corridor space;
(2) Type of lighting: even or uneven;
(3) Lighting location: path, path and surroundings, and just the surroundings.

The manipulation proceeded as follows:

First, we generated two groups of landscapes that differed in the arrangement of their vegetation—in one, medium-sized vegetation was located further away from the path (open space), and in the other, medium-sized vegetation was located close to the path (corridor space).

Next, we added lighting in six variants according to the research scheme (Figure 1). In the first variant, the landscape was illuminated evenly, while the lighting location was different (path lighting vs. path and surrounding lighting vs surrounding lighting). In the second variant, the landscape was illuminated unevenly and the lighting location was differentiated analogously to the first variant.

Finally, an observation point was added to the model. In the database for assessment by disabled people, it was located at the eye level of a person sitting in a wheelchair (1.20 m), while in the database for people without disabilities, it was at the eye level of a standing person (1.65 m).

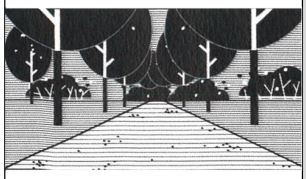
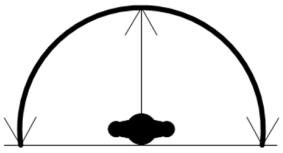
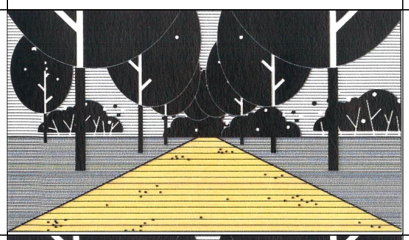
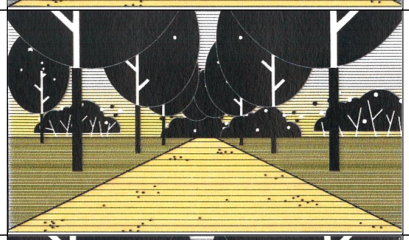
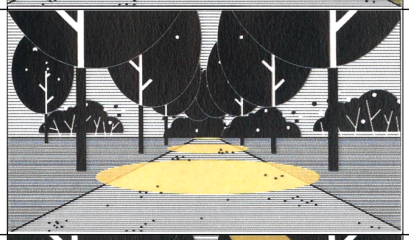
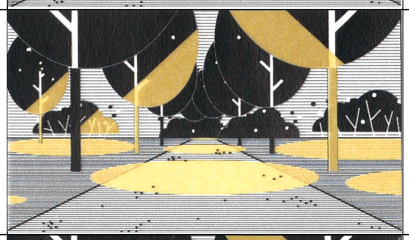
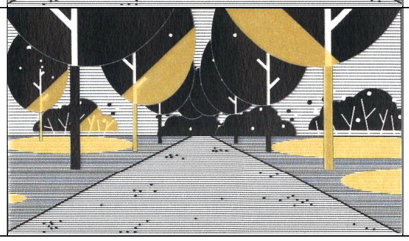
This resulted in two visualisation databases, which were used to create two surveys, differing only in terms of the height of the observation point.

A graphical diagram of the research plan is presented in Figure 2a,b.

Each survey contained 60 slides (5 × 12 visualisations) that were rated according to 5 variables (12 slides for each variable). The first one was designed for disabled people in wheelchairs, the second one for able-bodied people.

The survey was constructed as follows: The first part contained basic information about the purpose of the research and the conditions for conducting the survey, which were that it should be completed on computers with a minimum screen size of 15 inches in a dark room. Participants were informed that they could withdraw from the study at any stage. Next, the participants were asked whether they had ever experienced anything negative or traumatic in a park. If so, the participant was automatically eliminated from the study and blocked from answering further questions. The second part contained questions about age (given in numbers) and gender (male vs. female vs. other/I do not want to say). The survey itself was an assessment of the landscapes presented in the visualisations. It consisted of five parts—in each of them, the respondents assessed the landscapes in terms of one of five variables. Each landscape was presented on a separate slide with a question. The view of the landscape took up about 60% of the screen. The landscapes were arranged randomly in each part of the survey. The survey offered the possibility to return to and correct previous assessments. The survey could only be sent by the respondent after completing all the questions—partial completion was inadmissible.

The visualisations were initially made via Sketchup 2023, which created the park model. Next, the model was exported to Luminon 2023, where various lighting settings were rendered (Figure 3) in accordance with the research plan (Figures 1 and 2).

Type of space	Type of lighting	Lighting location	Spatial situation	Model number Disabled person Horizon line height 1.2m	Model number Able-bodied person Horizon line height 1.65m
 Open space 	Even lighting	Path lighting		A.1	A.1′
		Path lighting and surroundings		B.1	B.1′
		Illuminated surroundings		C.1	C.1′
	Uneven lighting	Path lighting		D.1	D.1′
		Path lighting and surroundings		E.1	E.1′
		Illuminated surroundings		F.1	F.1′

(**a**)

Figure 2. *Cont.*

Type of space	Type of lighting	Lighting location	Spatial situation	Model number Disabled person Horizon line height 1.2m	Model number Able-bodied person Horizon line height 1.65m
Corridor space	Even lighting	Path lighting		A.2	A.2′
		Path lighting and surroundings		B.2	B.2′
		Illuminated surroundings		C.2	C.2′
	Uneven lighting	Path lighting		D.2	D.2′
		Path lighting and surroundings		E.2	E.2′
		Illuminated surroundings		F.2	F.2′

(**b**)

Figure 2. (**a**) Graphical diagram showing the research plan for the open space (perspective and arrangement of lighting for a disabled person moving in a wheelchair and able-bodied person). (**b**) Graphical diagram showing the research plan for the corridor space (perspective and arrangement of lighting for a disabled person moving in a wheelchair and able-bodied person).

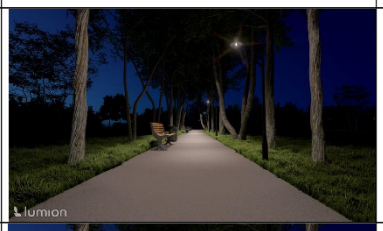
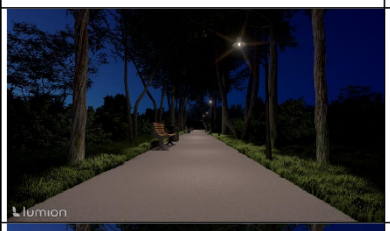
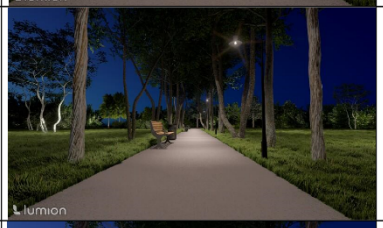
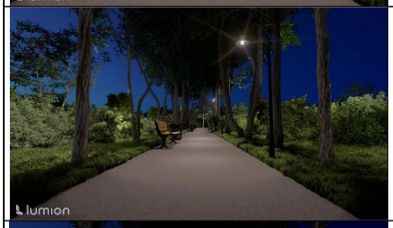
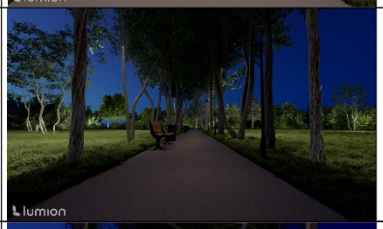
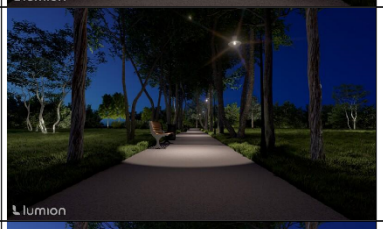
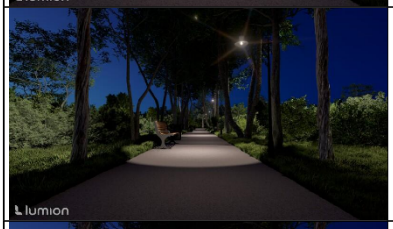
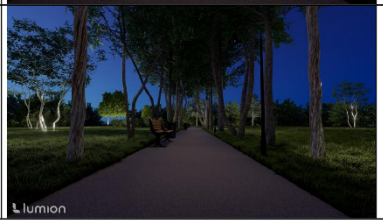
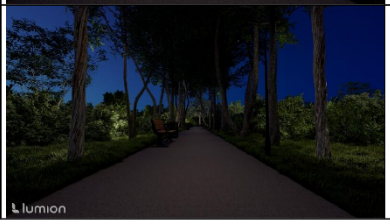
Type of space	Type of lighting	Lighting location	Spatial situation VISUALISATION	Model number Dis -abled person	Type of space	Spatial situation VISUALISATION	Model number Dis -abled person
Open Space	Even lighting	Path lighting		A.1	Corridor Space		A.2
		Path lighting and surround -dings		B.1			B.2
		Illumin -ated Surround -ings		C.1			C.2
	Uneven lighting	Path lighting		D.1			D.2
		Path lighting and surround -dings		E.1			E.2
		Illumin -ated Surround -ings		F.1			F.2

Figure 3. The set of all visualisations for a wheelchair-bound person, with the height of the horizon line assumed to be 1.2 m.

The measurement of dependent variables was based on the perceptual assessment of landscape visualisations made by study participants. Each participant evaluated the landscapes in terms of five variables: preference, safety, legibility, contact with the environment, and mystery, rated on a 5-point Likert scale, with 5 being the highest rating for each variable and 1 the lowest [15,44].

The questions were formulated based on operational definitions established in this area of research [68–73]. The exact wording of the questions is presented in Table 1.

Table 1. Definitions of rating variables used in the study.

Safety	Assess how safe this place is. Mark your answer on a scale from 1–5, where 1 = very dangerous and 5 = very safe.
Preference	Assess how much you like this place. Mark your answer on a scale from 1–5, where 1 = I do not like it, and 5 = I really like it.
Contact with surroundings	Assess to what extent you have contact with the surrounding landscape (besides the route you are moving along). Mark your answer on a scale from 1–5, where 1 = I do not have any contact, and 5 = I have a lot of contact.
Mystery	Assess to what extent this place 'promises' to reveal more the further you go. Do you think it invites you to explore further? Mark your answer on a scale from 1–5, where 1 = it is not inviting at all, and 5 = it is very inviting.
Legibility	Assess how easy it would be for you to orient yourself in this space? How easy would it be to say where you are at a given moment or find the way back to a certain point in the landscape? Mark your answer on a scale from 1–5, where 1 = very difficult, and 5 = very easy.

4.3. Sampling Method

Our study involved two groups of respondents. The first consisted of wheelchair-bound people, recruited in cooperation with the Ładne Historie Foundation using the Foundation's address database as a link to a form. The second included able-bodied people, recruited by an external company—Centrum Badawczo Rozwojowe Biostat—via a registered database of respondents. The participants had not experienced mental trauma and had no mental health disorders, including traumatic experiences related to park spaces. The research was approved by the ethics committee of the Wrocław University of Environmental and Life Sciences, Resolution No. 12/2023 of the Rector's Committee for Scientific Research Ethics of 15 June 2023.

Consent to participate in the study was given voluntarily. Before starting the study, all participants were informed that they could withdraw from the study at any time. Completing the survey took the participants about 15 minutes. The invitation to complete the survey was sent to 170 disabled people and 239 people without disabilities. In the case of the former, the survey was completed by 56% of those invited, and by 41% of the second group. Consequently, 193 volunteers (114 females and 79 males) took part in the study—98 people without disabilities (age range: 20–69 years; Mage: 37.31; SDage: 11.36) and 95 people with disabilities (age range: 21–63 years; Mage: 41.81; SDage: 11/03). We performed tests to check whether age and gender biased the test results, and they turned out to be statistically insignificant (Supplementary S1).

5. Results

5.1. Assumptions

The statistical analysis performed included analyses of variance (ANOVA) in a mixed scheme 2 × (2 × 3 × 2): 2 (groups: disabled, able-bodied) × 2 (light distribution: even, uneven) × 3 (lighting location: paths, paths + surroundings, surroundings) × 2 (space: open, corridor).

Before analysing the variance, we checked the basic assumptions for the within-group and between-group designs. For this purpose, we conducted an analysis of descriptive statistics along with the Shapiro–Wilk test (Supplementary S2). The Shapiro–Wilk test

turned out to be significant in all the conditions, although the skewness and kurtosis with an absolute value of less than 2 led us to conclude that the distributions did not deviate significantly from the norm. One exception was the open space scenery, with path and surroundings illuminated with even lighting—here, the kurtosis in the preference assessment was 2.73, because this situation was rated highest by a large number of people.

We then checked the homogeneity of the variances using Levene's test (Supplementary S3). In about half of the cases, this assumption was not true. However, since we used large samples in the study, and of equal size (98 people without disabilities and 95 people with disabilities), the failure to meet the condition of variance homogeneity should not have exerted a significantly negative impact on the veracity of the F-test results.

The final assumption we examined concerned sphericality (Supplementary S4). In situations in which this assumption failed, we performed analyses using the Greenhouse–Geisser correction. The significance of the differences between the means in the analysed results was assessed based on post hoc tests (Supplementary S5).

5.2. Hypothesis 1

In order to test hypothesis H1, we checked the main effects for the 'location and (lighting) distribution' factors (Tables 2 and 3), which turned out to be statistically significant and strong for all the variables. These effects were clarified by the interaction effects (Table 4).

Regardless of the lighting distribution, for all the variables, scenes with uneven lighting were rated lower than those with even lighting. However, the research revealed some differences in the assessment of scenery with different lighting locations for individual variables.

When it came to safety, mystery, and contact with the environment, scenery with lighting of the path and surroundings was rated the highest, while scenery with lighting of the surroundings was rated the lowest, and the scenery with the lighting of the path was rated the lowest. This was the case with both even and uneven lighting distribution (i.e., the amount of light did not matter).

Table 2. The main and interactive effects for all variables.

	Preference			**Safety**			**Legibility**			**Mystery**			**Contact with Surroundings**		
	F	***p***	η^2_p	***F***	***p***	η^2_p	***F***	***p***	η^2_p	***F***	***p***	η^2_p	***F***	***p***	η^2_p
Place	114.05 ^	<0.001 ^	0.37 ^	159.14 ^	<0.001 ^	0.45 ^	172.78 ^	<0.001 ^	0.47 ^	200.41 ^	<0.001 ^	0.51 ^	190.21 ^	<0.001 ^	0.50 ^
Place GROUP	2.20 ^	0.118 ^	0.01 ^	1.02 ^	0.350 ^	0.01 ^	9.16 ^	<0.001 ^	0.05 ^	7.13 ^	0.001 ^	0.04 ^	2.14 ^	0.124 ^	0.01 ^
Distribution	240.32	<0.001	0.56	488.88	<0.001	0.72	429.53	<0.001	0.69	272.65	<0.001	0.59	320.70	<0.001	0.63
Distribution GROUP	14.14	<0.001	0.07	1.65	0.200	0.01	15.27	<0.001	0.07	5.69	0.018	0.03	13.86	<0.001	0.07
Space	102.39	<0.001	0.35	55.91	<0.001	0.23	178.06	<0.001	0.48	121.27	<0.001	0.39	165.38	<0.001	0.46
Space GROUP	10.64	0.001	0.05	28.38	<0.001	0.13	0.15	0.699	0.001	0.51	0.477	0.003	0.001	0.982	0.00
Place Distribution	54.49	<0.001	0.22	64.48	<0.001	0.25	61.99	<0.001	0.25	56.94	<0.001	0.23	68.57	<0.001	0.26
Place Distribution GROUP	16.42	<0.001	0.08	28.90	<0.001	0.13	23.88	<0.001	0.11	23.38	<0.001	0.11	17.09	<0.001	0.08
Distribution Space	19.00	<0.001	0.09	1.33	0.251	0.01	7.19	0.008	0.04	0.28	0.596	0.001	14.02	<0.001	0.07
Distribution Space GROUP	2.66	0.105	0.01	25.17	<0.001	0.12	5.12	0.025	0.03	0.72	0.398	0.004	4.74	0.031	0.02
Place Space	46.30 ^	<0.001 ^	0.20 ^	13.35 ^	<0.001 ^	0.07 ^	89.98 ^	<0.001 ^	0.32 ^	76.92	<0.001	0.29	48.93 ^	<0.001 ^	0.20 ^
Place Space GROUP	4.33 ^	0.015 ^	0.02 ^	37.60 ^	<0.001 ^	0.16 ^	2.86 ^	0.064 ^	0.01 ^	7.25	<0.001	0.04	6.14 ^	0.004 ^	0.03 ^
Place Distribution Space GROUP	4.50 17.10	0.012 <0.001	0.02 0.08	23.95 39.20	<0.001 <0.001	0.11 0.17	5.67 10.06	0.004 0.002	0.03 0.05	2.08 6.64	0.127 0.011	0.01 0.03	0.83 ^ 13.12	0.429 ^ <0.001	0.004 ^ 0.06

^ the assumption of sphericity not met—Greenhouse–Geisser correction applied. NOTE: values for columns *F*, *p*, and η^2_p do not have physical dimensions.

Table 3. Estimated marginal means (main effects).

	Conditions	Preference		Safety		Legibility		Mystery		Contact with Surroundings	
		Mean	SE	Mean	SE	Mean	SE	Mean	SE	Mean	SE
Type of space	open	3.31	0.0496	3.35	0.0387	3.33	0.0363	3.17	0.0376	3.19	0.0354
	corridor	2.92	0.0556	3.05	0.0446	2.83	0.0442	2.74	0.0469	2.74	0.0429
Lighting location *	path	2.84 $_{a}$	0.0625	2.76 $_{a}$	0.0549	2.73 $_{a}$	0.0501	2.33 $_{a}$	0.0602	2.30 $_{a}$	0.0596
	path and surroundings	3.63 $_{b}$	0.0480	3.73 $_{b}$	0.0380	3.68 $_{b}$	0.0404	3.57 $_{b}$	0.0422	3.57 $_{b}$	0.0427
	surroundings	2.88 $_{a}$	0.0669	3.11 $_{c}$	0.0512	2.83 $_{a}$	0.0540	2.97 $_{c}$	0.0524	3.03 $_{c}$	0.0512
Distribution	even	3.45	0.0446	3.64	0.0350	3.42	0.0350	3.26	0.0375	3.28	0.0344
	uneven	2.78	0.0612	2.76	0.0476	2.74	0.0434	2.65	0.0466	2.65	0.0437
Group	able-bodied	2.91	0.0689	2.97	0.0517	2.97	0.0502	2.86	0.0532	2.84	0.0495
	disabled	3.32	0.0699	3.43	0.0525	3.19	0.0510	3.05	0.0541	3.09	0.0502

* means that do not share a letter index (with different letter indexes) differ statistically significantly at $p < 0.05$.
NOTE: values for columns MEAN and SE do not have physical dimensions.

Table 4. Interactions between lighting distribution and lighting location for all variables.

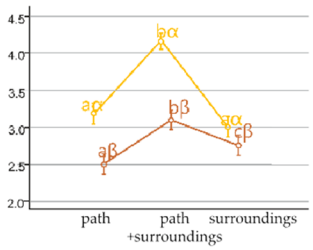
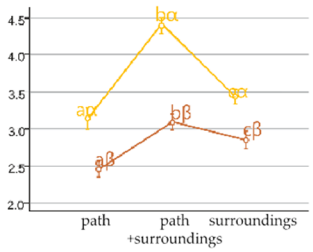
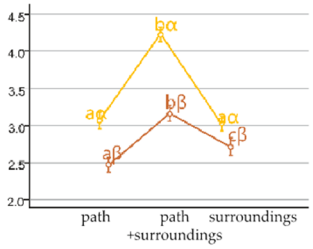
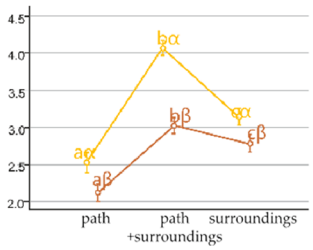
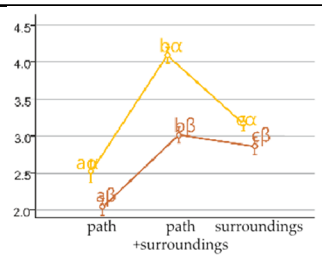
Preference		Place: main effect aba (path = surroundings < path + surroundings) The main differences in effect in terms of location occur with uneven lighting—scenes with illuminated surroundings were rated higher than those with path lighting ($p < 0.001$)
Safety		Place: main effect abc (path < surroundings < path + surroundings) No differences in terms of -main outcome
Legibility		Place: main effect aba (path = surroundings<path +surroundings The main differences in effect in terms of location occur with uneven lighting—scenes with illuminated surroundings were rated higher than those with path lighting ($p < 0.001$)
Mystery		Place: main effect abc (path < surroundings < path + surroundings) No differences in terms of main outcome

Table 4. *Cont.*

Contact with surroundings		Place: main effect abc (path < surroundings < path + surroundings)
		No differences in terms of main outcome

Lighting distribution: main effect αβ (uneven < even) for all conditions—all interactive effects consistent with this main effect. Lighting distribution: even; uneven. simple effects—means that do not share a letter index (with different letter indexes) differ significantly: $p < 0.05$ level. markings for comparison: location variable—a, b, c; light distribution variable—α, β.

In the case of preference and legibility, the assessment of scenery with different lighting locations differed according to the lighting distribution. In scenes with uneven illumination, the lighting of the surroundings was rated higher than path lighting. With even lighting, the scenes where the surroundings were lit were rated similarly to the scenes with the path illuminated, in terms of both preference and legibility.

In summary, uniform lighting was rated higher than nonuniform lighting in all the conditions—in all the dimensions (variables). Furthermore, the respondents generally rated the path lighting scenes with ambient lighting the highest. Other lighting variants differed for individual variables, as illustrated by the hierarchical diagram showing the respondents' ratings for the different conditions (Figure 4).

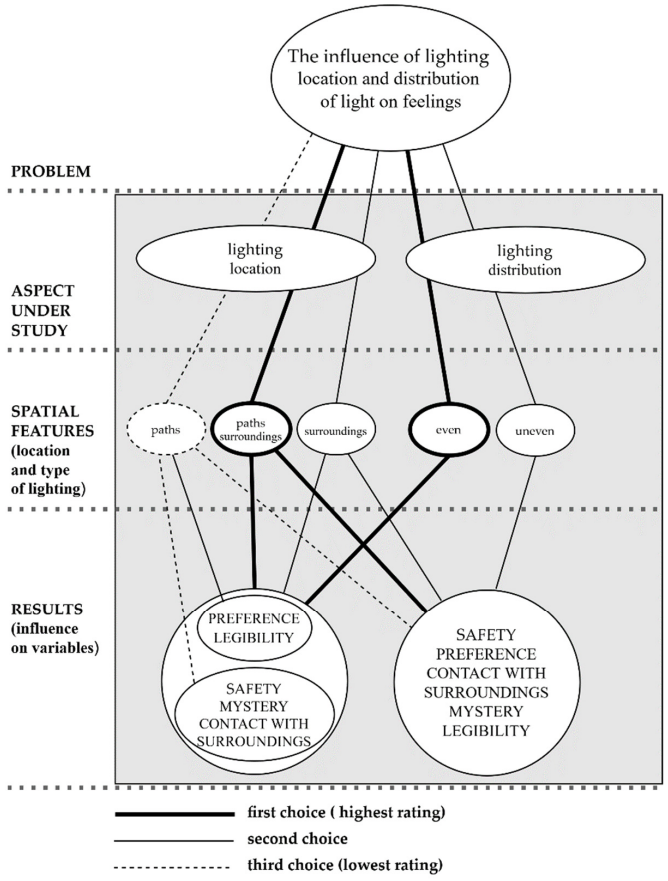


Figure 4. Interactions of light distribution and lighting location—hierarchical model of respondents' ratings.

5.3. Hypotheses 2 and 3

To determine how the influence of the lighting distribution and location on individual variables differed between the type of space (open vs. corridor) (Hypothesis H2) and the type of user (able-bodied vs. disabled persons) (Hypothesis H3), we conducted an analysis of the interactive effects.

In order to test hypothesis H2, we checked whether the simultaneous impact of location and lighting distribution on individual variables was differentiated by the type of space. The main effect of the space type variable shows that open was rated higher than corridor space, and the effect was strong for all the variables. Moreover, the space type differentiated the place ratings in certain conditions (Table 5).

Table 5. Interactions of space type with lighting location and lighting distribution for all variables.

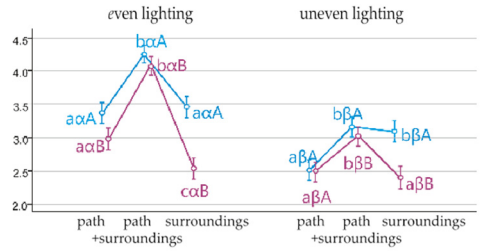
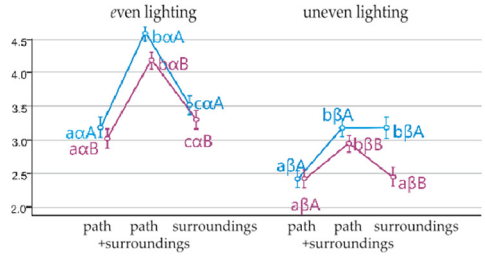
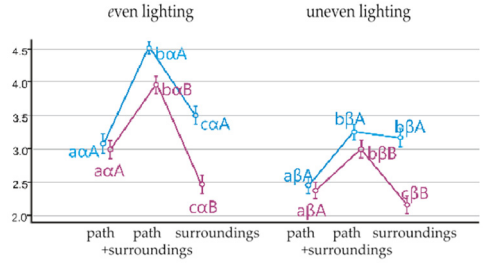
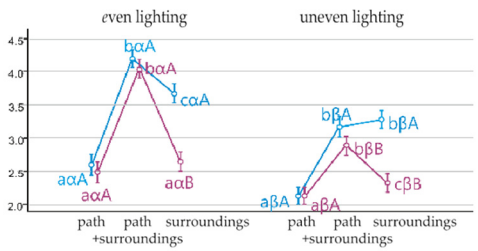
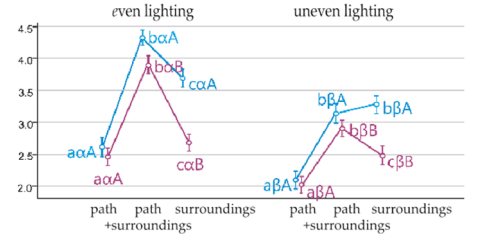
Preference		Place: main effect aba (path = surroundings < path + surroundings) Lighting distribution: main effect αβ (uneven < even) Differences from the main effect: Open space: - for unevenly lit space, scenery with illuminated surroundings was rated higher than scenery with path lighting and was rated similarly to scenery with lit path + surroundings Corridor space: - for evenly lit space scenery with illuminated surroundings was rated lower than scenery with a lit path
Safety		Place: main effect abc (path = surroundings < path + surroundings) Lighting distribution: main effect αβ (uneven < even) Differences from the main effect: Open space: - for unevenly lit space, scenery with illuminated surroundings was rated similarly to scenery with illuminated path and surroundings Corridor space: - for unevenly lit space, scenery with a lit path was rated similarly to scenery with illuminated surroundings
Legibility		Place: main effect aba (path = surroundings < path + surroundings) Lighting distribution: main effect αβ (uneven < even) Differences from the main effect: Open space: - for evenly lit space, scenery with a lit path was rated lower than scenery with illuminated surroundings - for unevenly lit space, scenery with illuminated surroundings was rated higher than scenery with a lit path and similarly to scenery with a lit path and surroundings Corridor space: - scenery with a lit path was rated higher than scenery with illuminated surroundings—this rating was similar for even and uneven lighting

Table 5. *Cont.*

Mystery		Place: main effect: abc (path < surroundings < path + surroundings) Lighting distribution: main effect αβ (uneven < even)
		Differences from the main effect: Open space: - for spaces with few lighting fixtures scenery with illuminated surroundings was rated similarly to scenery with a lit path and surroundings Corridor space: - for spaces with multiple lighting fixtures scenery with a lit path was rated similarly to scenery with illuminated surroundings ($p = 0.075$)
Contact with surroundings		Place: main effect: abc (path < surroundings < path + surroundings) Lighting distribution: main effect αβ (uneven<even)
		The interaction effect is statistically insignificant.

Lighting distribution: open space; corridor space. simple effects—comparisons between means differing in terms of one condition—means that do not share a letter index (with different letter indexes) differ significantly: $p < 0.05$. markings for intra-group comparison: distribution variable—α, β; location variable—a, b, c, space variable—A, B.

For all the variables, it turned out that for unevenly lit open space, the participants rated the scenes with illuminated surroundings higher than those with path lighting. At the same time, they did not rate scenery with illuminated surroundings and paths higher than scenery with just the surroundings themselves lit—such assessments were only given for the corridor space and in both types of space when they were evenly lit. For the evenly lit open space, the only difference from the main effect occurred in the case of legibility. This means that the scenery with illuminated surroundings was rated higher than the scenery with path lighting.

Differences in terms of effect also occurred in the case of corridor spaces. In unevenly lit spaces, legibility and safety were evaluated differently. Legibility in scenery with illuminated surroundings was rated lower than in scenery with lit paths and surroundings. For both types of scenery, safety was assessed similarly. More differences emerged in evenly lit scenes. In the cases of preference and legibility, scenery with a lit path was rated higher than scenery in which the surroundings were illuminated, and in the case of mystery, both types of scenery were rated similarly. However, in the case of safety and contact with the environment, scenery with illuminated surroundings was rated higher (similarly to the main effect).

In summary, the comparison of the ratings of the different lighting methods in the open space and corridors primarily revealed differences in the ratings of the lighting of the paths themselves compared to the surroundings. The path lighting was rated higher in the corridor than in the open space, while the ambient lighting was rated higher in the open space than in the corridor. A detailed diagram of the comparison in the hierarchical model is shown in Figure 5.

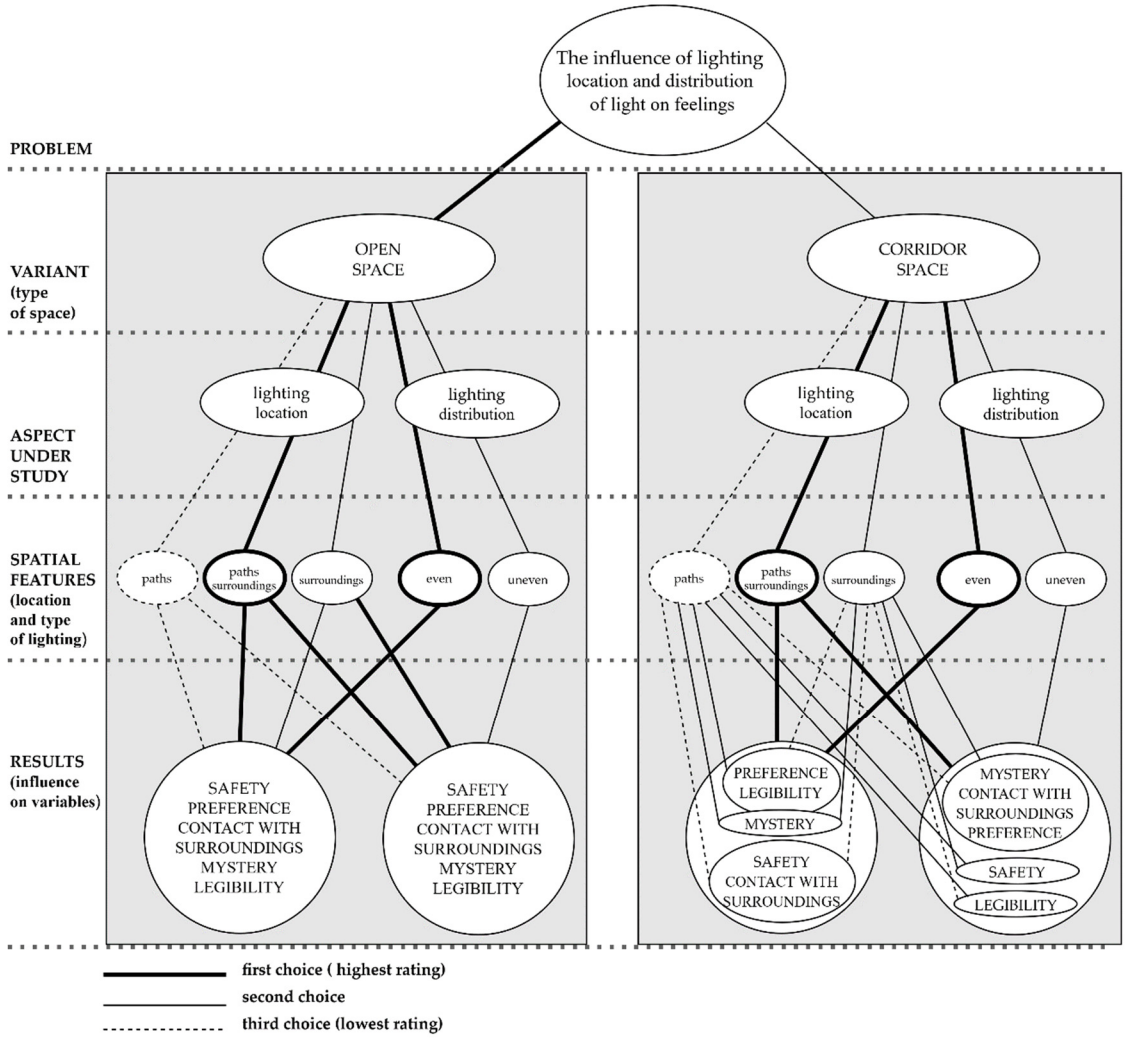
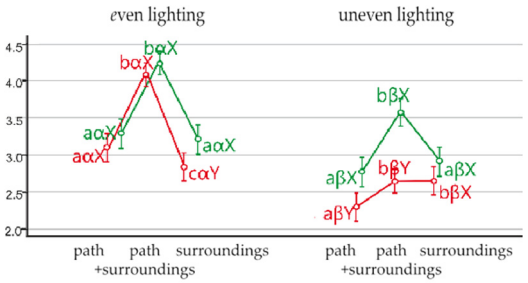
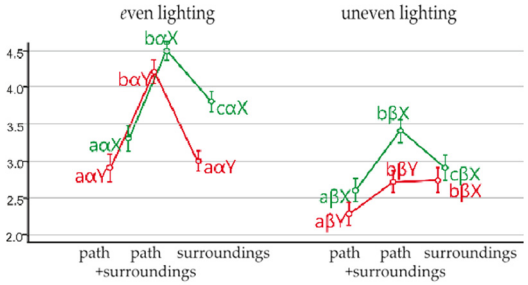
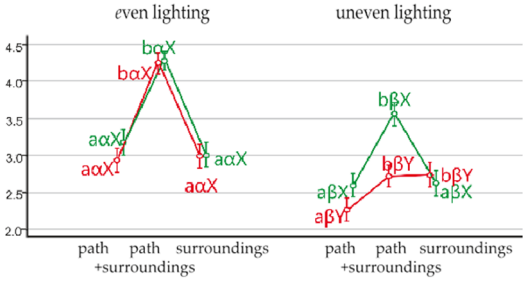
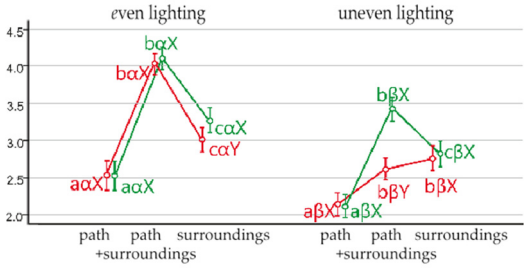
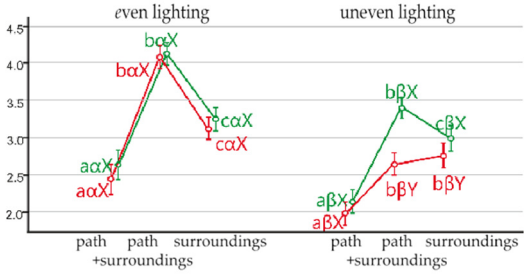


Figure 5. Interactions of space type with light distribution and lighting location—hierarchical model of respondents' ratings.

Secondly, we checked whether the simultaneous impact of location and lighting distribution on individual variables was differentiated by the type of park visitor (hypothesis H3). It turned out that only the able-bodied people gave different ratings with respect to the main effects (Table 6). For all the variables concerning unevenly lit spaces, the ratings given by this group of respondents for the scenery with illuminated paths and surroundings were similar to their ratings for the scenery with only illuminated surroundings—not higher, as the main effect indicates. For evenly lit scenery, the ratings only differed from the main effect in the cases of safety and preference. Safety was rated similarly for scenery with illuminated path and surroundings, while preference for scenery with path lighting turned out to be higher than that for illuminated surroundings. In other cases, the compared means led to similar conclusions as the results of the main effects.

In summary, the comparison of the ratings of different lighting variants made by the disabled and able-bodied people showed that, counterintuitively, the importance of path lighting did not increase for the people with mobility impairments. In the cases of some variables, including safety, the lighting of the path itself was rated even lower than the ambient lighting by those with mobility requirements—in contrast to the ratings given by the able-bodied people, for whom these two forms of lighting were equivalent in terms of safety. A detailed scheme of the comparisons for all the variables tested in the hierarchical model is presented in Figure 6.

Table 6. Interactions of the inter-group factor (park user type) with lighting location and lighting distribution for all variables.

Preference		Place: main effect aba (path = surroundings < path + surroundings) Lighting distribution: main effect αβ (uneven < even) Differences from the main effect only occur in the case of able-bodied people: - for unevenly lit space, scenery with illuminated surroundings was rated similarly to scenery with lit path and surroundings - for evenly lit space, scenery with a lit path was rated higher than scenery with illuminated surroundings
Safety		Place: main effect: abc (path < surroundings < path + surroundings) Lighting distribution: main effect αβ (uneven < even) Differences from the main effect only occur in the case of able-bodied people: - for unevenly lit space, scenery with illuminated surroundings and a lit path was rated similarly - for evenly lit space, scenery with illuminated surroundings was rated similarly to scenery with illuminated path and surroundings
Legibility		Place: main effect aba (path = surroundings < path + surroundings) Lighting distribution: main effect αβ (uneven < even) Differences from the main effect only occur in the case of able-bodied people: - for unevenly lit space, scenery with illuminated surroundings was rated similarly to scenery with illuminated path and surroundings
Mystery		Place: main effect: abc (path < surroundings < path + surroundings) Lighting distribution: main effect αβ (uneven < even) Differences from the main effect only occur in the case of able-bodied people: - for unevenly lit space, scenery with illuminated surroundings was rated similarly to scenery with illuminated path and surroundings
Contact with surroundings		Place: main effect: abc (path < surroundings < path + surroundings) Lighting distribution: main effect αβ (uneven < even) Differences from the main effect only occur in the case of able-bodied people: - for unevenly lit space, scenery with illuminated surroundings was rated similarly to scenery with illuminated path and surroundings

Lighting distribution: disabled person; abled-bodied person. simple effects—comparisons between means differing in terms of one condition—undivided means of the letter index differ significantly: $p < 0.05$. markings for intra—group comparison: distribution variable—α, β; location variable—a, b, c. markings for intergroup comparison—X, Y.

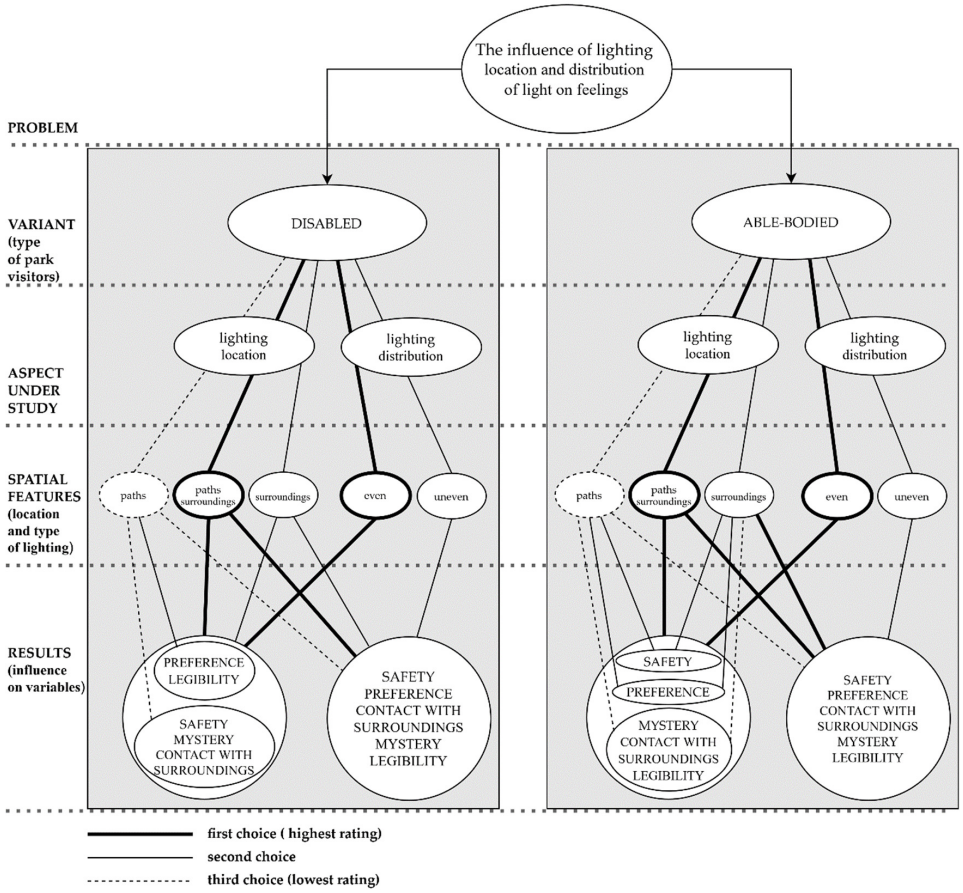


Figure 6. Interactions of intergroup factor (park user type) with lighting location and lighting distribution—hierarchical model of respondents' ratings.

A list of the average ratings for the individual variables in all the conditions (simple effects) is presented in Table 7.

Table 7. Set of average ratings for individual variables for all conditions.

Preference						
Lighting Conditions			**Group**			
Space	**Lighting Location**	**Distribution**	**Able-Bodied**		**Disabled**	
			M	**SE**	**M**	**SE**
open	path	even	3.24	0.12	3.49	0.09
		uneven	2.31	0.12	2.73	0.09
	path + surroundings	even	4.32	0.10	4.18	0.07
		uneven	2.77	0.13	3.56	0.08
	surroundings	even	3.40	0.13	3.53	0.10
		uneven	2.98	0.13	3.21	0.10
corridor	path	even	2.91	0.13	3.05	0.10
		uneven	2.22	0.12	2.77	0.09
	path + surroundings	even	3.85	0.12	4.29	0.07
		uneven	2.48	0.11	3.57	0.08
	surroundings	even	2.22	0.11	2.86	0.11
		uneven	2.24	0.12	2.57	0.11

Table 7. *Cont.*

Safety						
Lighting conditions			**Group**			
Space	**Lighting location**	**Distribution**	**able-bodied**		**disabled**	
			M	**SE**	**M**	**SE**
open	path	even	2.91	0.11	3.47	0.10
		uneven	2.27	0.09	2.56	0.09
	path + surroundings	even	4.55	0.07	4.64	0.05
		uneven	2.82	0.09	3.55	0.08
	surroundings	even	3.57	0.11	3.47	0.09
		uneven	3.21	0.11	3.15	0.10
corridor	path	even	2.90	0.11	3.15	0.10
		uneven	2.23	0.09	2.61	0.09
	path + surroundings	even	3.94	0.10	4.44	0.06
		uneven	2.59	0.10	3.29	0.07
	surroundings	even	2.42	0.11	4.18	0.08
		uneven	2.23	0.10	2.66	0.10
Legibility						
Lighting conditions			**Group**			
Space	**Lighting location**	**Distribution**	**able-bodied**		**disabled**	
			M	**SE**	**M**	**SE**
open	path	even	2.92	0.11	3.24	0.08
		uneven	2.24	0.09	2.66	0.07
	path + surroundings	even	4.55	0.07	4.48	0.07
		uneven	2.83	0.09	3.68	0.07
	surroundings	even	3.58	0.11	3.43	0.08
		uneven	3.22	0.11	3.12	0.08
corridor	path	even	2.91	0.10	3.07	0.08
		uneven	2.24	0.09	2.51	0.08
	path + surroundings	even	3.91	0.10	4.02	0.07
		uneven	2.59	0.11	3.41	0.07
	surroundings	even	2.37	0.11	2.57	0.09
		uneven	2.21	0.10	2.11	0.09
Mystery						
Lighting conditions			**Group**			
Space	**Lighting location**	**Distribution**	**able-bodied**		**disabled**	
			M	**SE**	**M**	**SE**
open	path	even	2.45	0.11	2.74	0.11
		uneven	2.08	0.09	2.16	0.09
	path + surroundings	even	4.22	0.09	4.15	0.10
		uneven	2.71	0.10	3.62	0.08
	surroundings	even	3.59	0.11	3.73	0.09
		uneven	3.27	0.11	3.27	0.08

Table 7. *Cont.*

Mystery						
Lighting conditions			**Group**			
Space	**Lighting location**	**Distribution**	**able-bodied**		**disabled**	
			M	**SE**	**M**	**SE**
corridor	path	even	2.62	0.12	2.33	0.10
		uneven	2.19	0.11	2.05	0.09
	path + surroundings	even	3.92	0.11	4.13	0.07
		uneven	2.52	0.10	3.26	0.08
	surroundings	even	2.45	0.10	2.83	0.09
		uneven	2.26	0.09	2.37	0.09
Contact with Surroundings						
Lighting conditions			**Group**			
Space	**Lighting location**	**Distribution**	**able-bodied**		**disabled**	
			M	**SE**	**M**	**SE**
open	path	even	2.47	0.10	2.76	0.10
		uneven	1.96	0.10	2.23	0.09
	path + surroundings	even	4.31	0.09	4.33	0.07
		uneven	2.68	0.09	3.60	0.08
	surroundings	even	3.72	0.11	3.65	0.08
		uneven	3.22	0.11	3.33	0.08
corridor	path	even	2.41	0.11	2.51	0.10
		uneven	2.00	0.10	2.04	0.08
	path + surroundings	even	3.86	0.11	3.94	0.10
		uneven	2.59	0.09	3.22	0.08
	surroundings	even	2.51	0.10	2.85	0.08
		uneven	2.31	0.11	2.65	0.11

6. Discussion

6.1. Area or Point (Even or Uneven Lighting)

After comparing the respondents' assessments of the scenes with different lighting distributions, it turned out that, in general, evenly lit spaces were rated higher in all the conditions.

This may mean that people prefer lighting to be spread throughout an area rather than focused on particular points [22,24,25], since more information is then revealed. This enhances contact with the environment (the size of the visible area). At the same time, it can provide a clearer promise of interesting experiences to be had in different places and, thus, increase mystery [45,49], as well as facilitating orientation, thereby enhancing legibility [47,50]. Additionally, people feel safer when they have a larger area under control [15,36,70,74]. As a result, a space lit in this way is preferred. The role that even lighting plays in the perception of a given space was also confirmed by the fact that the respondents rated the illuminated paths and surroundings the highest (compared to lit paths or illuminated surroundings alone). This may indicate that balanced brightness levels enrich spatial and visual experiences and, consequently, the sense of connection with the environment, thus increasing the perceived safety and comfort of being outdoors [20].

Nevertheless, it is worth noting that there was generally little lighting in the assessed landscapes. Although a number of studies indicate that an increase in brightness and

uniformity of lighting have a positive effect on people's feelings, especially in terms of sense of safety [75], some studies have also yielded different results. In an experiment conducted by Lis et al. [19], in which the participants made a multidimensional assessment of a park nightscape, the ratings given by two groups were compared. One group evaluated park landscapes with additional illuminated surroundings, and the other evaluated those without. The ratings did not particularly differ—the additionally lit areas were not rated higher. This discrepancy between our findings and those of Lis et al. indicates that the relationship between lighting level (and the resulting increase in illumination uniformity) and feelings may not be linear [76]. It is likely that when the lighting level is low (as was the case in our research), the presence of more light, resulting in more even distribution, is perceived positively, but only up to a certain point, at which the addition of lighting points ceases to be important, and the effect plateaus [27]. It is likely that adding additional lighting once optimal levels have been reached will begin to have a negative effect in the sense that the area will appear overexposed, even with uniform levels of brightness, less inviting, and, therefore, less safe [8]. In our opinion, in subsequent studies, it may be worth checking whether our assumptions are correct by arranging a wide set of landscapes and controlling the scale of the uniformity and brightness of lighting in order to diagnose the lower and upper limits of preferred lighting.

6.2. Area or Road (Surroundings or Path)

While illuminated surroundings and paths were rated the highest (or among the highest) in terms of all the variables and in all the situations, regardless of other conditions, when the lighting of the path and the lighting of the surroundings were compared individually, different results were found, depending on the variable and the situation. These ratings were influenced by the lighting distribution and the type of space.

An open space illuminated unevenly clearly differs from other situations. Here, the introduction of lighting in the surroundings seems to be of crucial importance—the scenery with illuminated surroundings was rated much higher than the scenery in which just the path was lit, and the introduction of additional path lighting did not give higher (but instead, similar) ratings. It seems that large spaces with delicate lighting are perceived differently from well-lit open spaces or corridor spaces—corridor spaces turned out to be preferred when both forms (the surroundings and the path) were lit. Perhaps open spaces, lit only in certain points, function primarily as places and not as transit spaces. As a result, we expect them to offer interesting viewing impressions, and a lack thereof is not compensated by information about the transit route. On the other hand, path lighting is not as important in such spaces—gentle illuminated surroundings combined with open space— and, as a result, a lack of shaded, inaccessible spots seems to be sufficient [19]. The above-mentioned study by Lis and colleagues [19] offers an interesting insight into the division between safe and pleasant spaces. Areas preferred in terms of safety did not turn out to be preferred in terms of other feelings related to spending time in them. Comparative analyses of three scenarios showed that the structure and cover of the landscape together with the degree of openness, natural sky brightness, and spatial distribution of lighting model other features. These are variables that influence the perception of space as attractive, in which it is worth spending time (places), and as suitable for communication (paths). Natural, even twilight with a small amount of light may be perceived as a value of a space, and disruption in the form of contrast may be perceived less favourably [16].

It is worth noting that the findings of research on how path lighting affects people's feelings (including safety and preference) are ambiguous. Although most studies indicate a preference for well-lit paths [31,32], there are also studies indicating that illuminated surroundings are more relevant and have a stronger impact on sense of safety, landscape preference, and legibility [15,16,34]. Our research confirms the ambiguity of the relationship between illuminated paths and surroundings and feelings, which change depending on the landscape (type of scenery) that creates the spatial context.

The situation was different in open, evenly lit spaces. In these cases, illuminated surroundings were also rated higher than scenes with path lighting alone (in the cases of all the variables except preference, for which the ratings were statistically insignificant). However, at the same time, these ratings were clearly lower than those for scenery in which these two lighting methods were combined. Each of these forms of lighting appears to play a different role. Path lighting facilitates the discernment of obstacles, interpersonal assessments, and escape plans [32,36,77], as well as navigation [33] and orientation within the entirety of a particular space [6,16]. As a result, both forms of lighting influence the understanding of a given space [24,42], together with legibility [15,34]. It is not entirely clear why this effect is different from that in unevenly lit spaces. Perhaps more brightly illuminated surroundings obscure the path area through the effect of contrast, and vice versa—a brightly lit path makes dark surroundings illegible. This effect does not occur when there is little light—as a result, dimly lit surroundings without path lighting are sufficient for park visitors.

A comparison of the assessments made in the corridor space revealed that it is perceived differently in the context of lighting. According to the respondents, mystery and contact with the environment were stronger in scenery with illuminated surroundings than with lit paths. Both these variables refer to something beyond the immediate vicinity. Mystery expresses a promise of fresh experiences upon venturing further into the landscape [42]; for this promise to be understood, there must be some signals of what might be located further on in the surroundings. Such information, presented in illuminated forms, announces the promise of impressions even if they are somewhere in the distance, behind a partial curtain. Similarly, contact with the environment in the case of a corridor space may only occur when tall forms, not shielded by corridor vegetation cover, are illuminated. So, it makes sense that mystery and contact with the environment were rated low in the absence of illumination in the vicinity.

In the corridor spaces, legibility and preference were given the opposite evaluation. For the respondents, path lighting was more relevant to these variables. Perhaps this was because the paths were the most accessible places in the corridor spaces. Lighting points in the surroundings, only partially visible from behind the curtain of plants located along the path, may arouse curiosity (enhancing mystery and contact with the environment), but they will not significantly affect orientation in space, which is maintained mainly thanks to the visible route. Perhaps this aspect determined preference, since the corridor spaces without path lighting were the least attractive for the park users.

An interesting and unexpected finding was obtained by comparing the safety ratings for differently lit corridor spaces. Path lighting is most often considered to be the cornerstone of a safe area [78,79]. This would appear to be especially relevant in corridor spaces, where paths and their immediate surroundings constitute the basic elements of the situation to be controlled. Nevertheless, the respondents rated the spaces without path lighting similarly in unevenly lit scenery and higher in evenly lit scenery compared with the spaces with path lighting. Perhaps it was not direct control over the immediate transit route, but awareness of what was happening further afield that was more important [51]. The contrast effect could also have had a part to play here because when a path is especially brightly lit, the surroundings are shrouded in perturbing darkness while the walker is fully exposed. Asymmetrical surveillance can result in a greater sense of danger and a strong feeling of being a sitting target [20]. A more complete picture of how safety is perceived in various spaces was provided by analysing the ratings while taking into account the differences between the groups (disabled vs. able-bodied).

6.3. Disabled and Able-Bodied People

When comparing the ratings given to scenes with different lighting spots by two groups of people (disabled and able-bodied), the main differences occurred in the assessment of unevenly lit spaces. For the able-bodied people, illuminated surroundings turned out to be of key relevance for all the variables. Adding path lighting did not change these

feelings—scenery with illuminated surroundings only and scenery with illuminated path and surroundings were rated similarly. However, it turns out that only the able-bodied gave such evaluations, whereas the results were different for the people with disabilities. While is true that illuminated surroundings have a more positive impact on feelings than path lighting, the combination of these two types of lighting is definitely preferred and more highly rated in all dimensions. In unevenly lit spaces, path lighting is not important for people without disabilities, but the opposite is the case for the disabled. This is understandable considering that sufficient lighting of the transit route is crucial when it comes to comfort of movement and safety for disabled people [55]. It is probably so important that the lack of such lighting affects all other feelings—including those not directly related to it, such as mystery and contact with the environment. This is explained, among others, by Gibson's affordance theory [80], according to which perceptions and, as a result, the assessment of a landscape are closely related to the reception of its functional features (affordances).

Much less obvious and unexpected findings came from comparing the assessments of scenery with different lighting locations for people with and without disabilities in evenly lit spaces. Differences occurred in the ratings of two key variables: safety and preference. In both cases, path lighting is less important for disabled people than for the able-bodied. While it is true that both groups gave the highest rating for scenery with lighting that covered the path as well as the surroundings for all the variables, the evaluations of the scenes with path lighting or illuminated surroundings only varied. In terms of preference, the able-bodied respondents rated scenes with lit paths higher than those with illuminated surroundings, whereas the disabled participants rated these two types of lighting similarly. When it comes to safety, both types of lighting are equally safe according to the able-bodied, while the disabled people rated spaces with illuminated surroundings as safer than those with path lighting. Although these results are quite surprising, they can be explained. It is possible that path lighting is only important for disabled people up to a certain point. When there is enough light to make the path clearly visible, spatial awareness begins to play a key role. It is difficult to say why this mechanism works to a lesser extent for people without disabilities. It is possible that they move faster in well-lit spaces than in poorly lit ones, and that they need better lighting on the path so that the entire transit route is visible. It is also possible that for the able-bodied, paths are not only natural routes for transit, but also, possibly, routes for quick escape. In dimly lit spaces, escape will be difficult even if the path is dimly lit—a better escape option would be to safely retreat to the side and hide in the shadows. In well-lit spaces, the path is the escape route. Therefore, its illumination is more relevant in evenly lit spaces than in unevenly lit spaces, where there is little light. For disabled people, conditions for a swift escape are not relevant because they cannot escape effectively anyway. So, other aspects may turn out to be more important for their perceptions of space. In a poorly lit space, normal movement should be comfortable (sufficient illumination of the path), whereas in a well-lit space, where the path is visible anyway, an understanding of the space is necessary (sufficiently illuminated surroundings).

6.4. Limitations

This study had several limitations:

- The use of visualisations, which eliminated the impact of actual environmental stimuli, so the respondent does not feel the weather conditions [81] and temperature [82], hear sounds [83], or experience anything else in the environment that might affect their other senses [84].
- The presented nightscape scenery was devoid of other park users, so the study did not take into account the possible influence of other people on the tested feelings and various social situations that may occur in an actual park.
- In the studied scenery, the point and field of view were set to a specific frame of space, which could not be modified during the assessment, so the participants did not have a full view of the setting, nor could they explore it [41]; therefore, the view they saw could not change [85].

Therefore, our findings regarding the role of lighting should be considered conservatively. We wish to draw attention to the need for further research and experiments that may demonstrate that lighting manipulation can indeed lead to changes in perceptions and feelings regarding park landscapes at night.

7. Conclusions and Practical Recommendations

To sum up, the following conclusions can be drawn from the conducted research:

1. Lighting distribution:
   - In general, the respondents rated evenly lit spaces more highly than those with spot lighting—this was universally true (regardless of situational circumstances);
2. For lighting arrangement (location), the ratings varied, depending on the type of space:
   - In open spaces, scenes with illuminated surroundings were rated higher than those with just the path lit, but introducing additional path lighting only raised the ratings for evenly lit scenery;
   - In corridor spaces, mystery, contact with the environment, and safety were evaluated as greater in scenery with illuminated surroundings than with a lit path; in the case of legibility and preference, the opposite was true—path lighting was rated higher;
3. Differences between the assessments given by wheelchair-bound people and able-bodied people:
   - In unevenly lit spaces, the able-bodied people felt that illuminated surroundings were most important (additional path lighting did not change this assessment), while the disabled people rated the combination of path lighting and illuminated surroundings the highest;
   - In evenly lit spaces, when evaluating safety and preference, path lighting was less important for the disabled people than for the people without disabilities.

Taking the above conclusions into account, some considerations can be made:

A. By making a space transparent, even at low brightness levels, a park space may be used comfortably and confidently. Avoiding a linear approach in favour of area lighting with a balanced level of brightness may result in more frequent and willing visits to park spaces.

B. This research confirms that lighting should be adapted to the spatial context. The unification and standardisation of lighting throughout a park may discourage visits. Our analyses indicate that the type of vegetation cover in the park and the degree of landscape openness will influence the location and method for illuminating the area. The power of landscape openings—prospects—should be appreciated because they reduce the amount of light needed. On the other hand, attention should be paid to the impenetrability, compactness, and density of land cover and corridor systems, as they probably have the opposite effect and require more light, especially along transit routes.

C. The above conclusions offer some considerations in terms of how to light pedestrian thoroughfares in park landscapes. For both able-bodied and disabled people, safety is influenced more by illuminating the surroundings than by lighting the surfaces on which they walk. So, does the common practice of inwardly lit paths without any connection with the surroundings have a negative impact and, paradoxically, discourage people from visiting parks in the evening? It should be emphasised that contact with the environment and nature may be a basic need when it comes to spending time in green areas in the evening [37,39,86].

D. We believe that the above observations offer motivation to seek out new and future criteria for lighting park areas, taking into account both the consequences for the environment [87] and the benefits for people [13]. Walking is increasingly appreciated for its social and recreational value, and research in many disciplines shows that

walking and outdoor activity improve physical as well as mental health [5]. Therefore, we should ensure that parks are also accessible after dark and, in order to enhance their social role, eliminate obstacles caused by improperly planned and used lighting infrastructure.

Our study highlights that sustainable lighting in parks should be understood as a practice that focuses on the empowering and inclusive role of the assessment of lighting conditions by different social groups. With this approach, light can become a common good and express the needs of all citizens.

In our opinion, sustainable lighting in the social sense should be lighting that integrates different people. This is the result of a complex perception of the night landscape, in which the impact of lighting not only on visibility, but also on mood and behaviour, is examined.

We believe that the next step in defining sustainable lighting in parks is research that will show the extent to which we are able to decide to dim lighting in order to achieve a compromise between nature conservation and the visual and non-visual needs of users.

Supplementary Materials: The following supporting information can be downloaded at: https://www.mdpi.com/article/10.3390/insects15100795/s1. Supplementary S1. Sex and age—between-subject effects. Supplementary S2. Descriptives—age according to group division. Supplementary S3. Homogeneity of variances tests. Supplementary S4. Tests of sphericity. Supplementary S5. Post hoc comparisons.

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