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Methods for Quality Assessment of Window View

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Abstract: This paper summarises findings from two workshops evaluating a series of views in various settings by an interdisciplinary group of experts. In the first one (Trondheim, June 2022), ten experts visited and assessed views from nine rooms. In the second one (Lausanne, June 2023), eleven experts assessed window views from four spaces. The workshops' main objective was to develop and test multi-method assessments of window views. During both workshops, participants completed a survey that included close and open-ended questions about the perceived quality of the room and the view. Participants also measured lux level, took photographs, made hand drawings of the view, and answered a questionnaire about their mood and the environmental conditions in the room. After the workshop, point-in-time daylight simulations were performed for the visited rooms. The paper describes, compares, and recommends the use of the aforementioned methods depending on the type and complexity of the view, and the space, the evaluators' professional background, and the type of collected data. It also discusses the overlap of the methods and estimates the preparation time, time spent on site, and the amount of work after the visit. Finally, it recommends the use of the tested methods depending on the application.

Keywords: window view; view quality assessment; explorative approach; quantitative evaluation; qualitative evaluation; freehand drawing; photography; VAS

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1. Introduction

The modern urban society spends up to 90% of its time indoors [1]. Windows, therefore, play a crucial role in many respects. Alongside the provision of daylight and fresh air, they allow a connection to the outside and offer outdoor views. A view is a universally recognised asset for building occupants, architects, real estate specialists, and urban designers [2]. However, each professional group has a different perspective of what may constitute a good/beneficial view. The view assessment criteria outlined in the Daylight in Buildings standard [3] refer merely to the geometric configurations that assure access to the view, not to the content or the quality of the view. Although these criteria help to clarify the view framework during the design process, there are no established window view assessment methods in application [2]. Research on views is mainly linked with providing a good amount of daylight and fresh air; however, it can also have a positive, but still not fully measurable, impact on physical and psychological health [4–8]. Designing with daylight is about finding the right balance between excessive daylight, which may lead to glare and thermal discomfort, and insufficient daylight, which causes the use of electrical lighting during the daytime. Optimal window design translates into something other than heavily glass buildings with the air conditioning constantly on and blinds down to protect users from glare or thermal discomfort [9,10]. Optimal window layouts enhance users' psychological and physical health [11]. Another aspect that needs consideration is the rapidly changing urban landscape due to densification, which significantly reduces the amount of natural light entering interiors and compromises window views [12]. Studies indicate that buildings offering more resilient, user-oriented, and open outdoor places to work and live offer innovative pro-ecological solutions that serve smart urban areas [13–15].

The interest in window views as a research issue is rather new. Farley and Veitch [16] indicated that the most valued benefit of windows is attributed by the building occupants to the view. Good views are often associated with views towards nature [17–20] and balanced lighting provision [21]. Much research indicates a relationship between views, health recovery [22,23], restorative effects [24], learning outcomes [25,26], user performance [27], and psychological state [28,29] or well-being [30]. Good views also play a vital role in designing compact and sustainable cities [31,32]. This increased compactness in urban spaces and the reduction in window areas at a building level not only reduces the energy requirement for heating and air conditioning but also significantly reduces the supply of daylight and the access to view. These aspects should be studied together to account for the complexity of view assessment and to find optimal solutions [33]. The reduced daylight provision can be compensated for by additional LED lighting with a low absolute energy requirement compared to cooling or heating energy, and reduced costs of the lighting systems due to lower replacement and maintenance costs. For this reason, the use of daylight is not given high priority for purely energy-related reasons. Yet this has a direct influence on people's well-being and health and is therefore directly linked to healthy and appealing living conditions. One of the triggering factors has been trials to construct buildings for permanent stay of people without windows or with artificial windows. The Hershey Chocolate Corporation corporate headquarters building, also known as the windowless office building, served as a sign of modernity in its day, with the primary focus on increasing the efficiency of the cooling and heating systems. The most known recent case is the Munger Residence Hall, UC Santa Barbara, University of Michigan, intended as a dormitory for 4500 students [34–37]. After widespread negative attention, with criticism based on the lack of natural light and view out, the plans to build it were cancelled in August 2023. This case highlighted the importance of window view for occupants and triggered a question about how to assess the quality of the view, which is the subject of our research. The pending questions thereby are how we can account for good window views in the planning process and which methods are useful for the assessment of the window view quality by different stakeholders in various applications, such as planning, research, post-occupancy studies, or teaching.

The resulting research question for this work was—which methods to assess the view out from a window are suitable depending on:

- Character and complexity of the view and of the room/windows
- Knowledge and skills of evaluators
- Time available before, during and after the assessment on the location
- Application in:
    - research
    - teaching (students of architecture, urban design, building physics, etc.)
    - urban design (municipality, developers, etc.)
    - architectural design (architects, engineers, owners, etc.)
    - post occupancy validation (user perspective)

In this study, an explorative workshop format was used as a research method [38]. The objective of the workshop was first, to develop view assessment methods and test them in real settings. Second, to gain experience, improve, verify, and test them again. Some of the methods were modifications of methods used for other purposes, like surveys or photography, others we developed specifically for the view assessment, e.g., freehand drawing [39,40]. Finally, to formulate advice regarding the use of the tested methods for different applications.

2. Methodology

2.1. Explorative Research

Since there are no established methods for assessing the view from the window, an exploratory research methodology was used. According to R. Stebbins [41] "Social science exploration is a broad-ranging, purposive, systematic, prearranged undertaking designed to maximise the discovery of generalisations leading to description and understanding of an area of social or psychological life. Depending on the standpoint taken, such exploration is a distinctive way of conducting science—a scientific process—a special methodological approach". Additionally, Stebbins argues that the exploration method may be applied in all sciences.

He also explains the difference between serendipity, an informal and/or accidental discovery appearing from a spontaneous invention of an individual, and exploration as a broader-ranging, purposive, systematic, and prearranged undertaking made by a narrow group of people who "must routinely produce new ideas", like artists, scientists, or entertainers. Stebbins argues that to effectively explore a given phenomenon, they must approach it with two special orientations: flexibility and open-mindedness.

The exploratory method starts with a single exploration or attempt that develops to combined efforts, like a chain, leading step by step to new insight or knowledge. Initial methodological weaknesses can be corrected in the subsequent explorations.

The present study's exploratory method started from a digital workshop series during the COVID-19 pandemic between 2020 and 2021, followed by an in-person workshop in Trondheim in 2022 and the second in-person workshop in Lausanne in 2023 [39,40]. The exploratory method is used to develop and test window view assessment methods. Both qualitative and quantitative subjective assessment methods were used, as advocated by Stebbings. The quantitative method resulted in numerical records referring to view quality attributes, while the qualitative method resulted in word clouds and Positive Sentiment Word Frequency. In addition, visual evaluation was applied. Photos that participants were asked to take and hand drawings they were asked to make during workshops were analysed for the view content.

The methodology applied in the first workshop was thoroughly discussed by the workshop participants, and significant improvements were proposed and implemented in the second workshop. In particular, this concerned the structure and content of the questionnaire and the method of making the freehand drawings. In this article focusing on the methodology, we present the results of the room and view assessment only from the workshop in Lausanne (four locations) mainly to enable better understanding of the outcomes of the methods. The specific results of the view and room assessment from the workshop in Trondheim are to be presented in a forthcoming article [40].

The participants in both workshops (nine in the first and eleven in the second workshop) were drawn from the following professions: architecture, urban planning, engineering, lighting design, fine art, environmental psychology, and psychiatry; and were primarily affiliated with universities and research institutions. The interdisciplinary composition of the group allowed for the active use of knowledge and research methods developed in the respective professions.

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2.2. Locations

The locations were selected from easily accessible public spaces in the Lausanne region; see Table 1. During the selection, particular attention was paid to generating a variety of view features: long distance, short distance, panoramic, narrow, dominated or not by greenery, crowded or not, from large and small rooms.

Table 1. Short description of locations.

	Room Type and Size	View Type and Depth	Aerial View of the Locations Source: https://map.geo.admin.ch/ (accessed on 22 October 2024).
1	Hotel lobby middle-large room (46°31′0.22″ N, 6°33′59.7″ E)	Towards the square in front of the entrance and a conference building located vis à vis hotel Middle-long view distance	
2	Hotel room very small room (46°31′00.17″ N 6°34′01.54″ E)	Towards the space between two parallel buildings—wings of the hotel Rather a short view distance	
3	Motorway cafe very large and high space with fully glazed north facing wall 46°40′28.68″ N 6°34′06.41″ E	Towards a wide rural landscape Very long view distance, up to the horizon	
4	The restaurant at the lake shore is middle-large and has a partly outdoor room covered by a seasonal canopy. (46°31′01.0″N 6°34′36.8″E)	Towards a small harbour A lake and mountains in the distance.	

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2.3. Procedure

Participants stayed for 20–30 min in each room. During the visit, they were asked to identify their preferred place in the room to sit down and fill in the survey paper, where one of the first tasks was to take illuminance measurements and notice the overall impression of the room and the first impression of the view. The entire survey from the Lausanne workshop is presented in Supplementary Data. The qualitative questions were open-ended and probed for opinions, thoughts, associations, memories, and feelings generated

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During the Lausanne workshop a simple Visual Analog Scale (VAS) to assess personal state was applied [42]. VAS questions concerned how happy, sad, alert, anxious, dizzy, and nauseous participants were at the time they filled out the survey. Also, questions about the thermal, audial, visual, and fragrance comfort were added.

Finally, measurements of the rooms were taken by two participants with the aim of carrying out daylight simulation in the respective rooms afterwards.

2.4. Methods and Analysis

2.4.1. Daylight Measurements

The daylight measurements were taken with the help of a Hagner luxmeter, model EC1, both vertically ("illuminance on your eyes") and horizontally ("on the questionnaire paper that you are filling out") at the sitting positions the participants found favourable in each room.

2.4.2. Daylight Simulations

Daylight simulations for the studied rooms were performed point-in-time for the 21st of June (summer solstice) at 12:00, under a standard CIE overcast sky in Lausanne (46.3 N), using the Daylight Visualizer 3 software https://www.velux.com/what-we-do/digital-tools/daylight-visualizer (accessed on 23 January 2023) [43].

The reason for carrying out daylight simulations was to better understand and compare the distribution of daylight in the rooms. From the Trondheim workshop we have learned that the perceived quality of the view and the room may have mutual influence. The overall impression of the room may be increased/decreased by the high/low quality of the view. On the other hand, the design of the windows (framing of the view) and the quality of the room itself may influence the perceived quality of the view.

2.4.3. Quantitative Analysis

The quantitative analysis of the responses focused on four of the questions in this study. The four questions measured the evaluation of the view and the room using a 7-point scale. Q15 assessed the view quality based on 8 attributes: "excitement", "uniformity", "openness", "familiarity", "welcoming", "beauty", "naturalness", and "order". Q19 evaluates the rooms based on 9 attributes: "friendliness", "uniformity", "spaciousness", "openness", "familiarity", "playfulness", "beauty", "order", and "comfort". Q3 and Q13 measured the first impression of the view and the overall impression of the room, respectively. The four questions are as follows:

Q15: Evaluate the View quality attributes. (8 attributes)
Q19: Evaluate the Room quality attributes. (9 attributes)
Q3: Notice the overall impression of the Room.

Q13: Notice the very first impression of the View.

The subjective nature of the collected data refers to the fact that it is based on personal judgments or perceptions, but once these are converted into numerical form (e.g., a score for satisfaction or discomfort), they are treated quantitatively in the analysis [44,45]. Subjective data were collected through numerical ratings. In all cases, 7-point rating scales were used. In such cases when participants provide multiple responses, such as different views or scenes in our case, it is essential to account for individual differences between subjects. These differences can stem from various factors, including personality, experience, cognitive processes, and preferences, which inherently affect how each participant responds. Ignoring these subject-specific variations can lead to biassed or inaccurate results, as it assumes that each response is independent, which is not true when multiple responses come from the same individual.

In this study, Linear Mixed-Effect Modelling (LMM), expressed in Model Structure 1 and 2, is used as a method that allows the subject dependency to be overcome. This method is particularly effective in the case of our study due to the low sample size. Moreover, its reliance on larger processing power can be now mitigated; hence, it is more viable to use in the case of occupant behaviour and subjective assessment studies [46–49]. The primary advantage of using LMM is its ability to capture these subject-specific differences through "random effects". By allowing for unique baseline values (random intercepts or random slope or both) for each participant, LMM acknowledges that different subjects may have different starting points in their responses, even when exposed to the same conditions (e.g., views or scenes). This adjustment ensures that the model reflects individual tendencies without treating all responses as identical. For example, some participants may generally rate all views or scenes higher than others, not because the views are objectively better, but due to personal preferences or biases. Failing to account for these individual baselines could mask or distort the true effects of the experimental conditions. By incorporating random intercepts, we can model each participant's inherent response tendency, allowing for a more nuanced and accurate analysis of the overall effects of the predictors (e.g., views, scenes) while considering the diversity of participants.

LMM can handle multiple responses from the same subject while maintaining statistical rigour. If we were to treat multiple responses from the same subject as independent data points, it would violate a core assumption of traditional statistical models—independence of observations. This could lead to an overestimation of statistical significance because the responses are correlated due to being from the same individual.

By capturing subject-specific differences and using each subject's data independently, linear mixed modelling allows us to (i) accurately account for individual variability in responses, (ii) preserve the integrity of the data without violating the independence assumption and (iii) provide a more precise and generalizable understanding of the effects of the predictors.

This approach results in a more robust and flexible analysis, especially in studies with repeated measures or multiple responses from the same subjects. Adopting this approach for better understanding the relation between the attributes and the view/scenes while taking the subject-specific effects into account, we started with two main hypothesis and base models. The model structures shown below were selected incorporating random intercepts (1) and random slopes (2) to account for variation among individuals in their baseline levels of all responses to "First impression" as a view-out assessment.

$$\text{First impression} \sim \text{View Attribute 1 F} + \ldots + \text{View Attribute n F} + \text{Participant R} + \varepsilon \quad (1)$$

$$\text{First impression} \sim \text{View Attribute 1 F} + \ldots + \text{View Attribute n F} + \text{View Attribute 1 R} + \ldots + \text{View Attribute n R} + \text{Participant R} + \varepsilon \quad (2)$$

Moreover, the variation and relations between responses to different attributes are shown to demonstrate the nature of the subjective assessments.

2.4.4. Qualitative Analysis

The room evaluation questionnaire utilised to capture the workshop participants' impressions about the four rooms with the views visited during the workshop included 5 open-ended questions. They were as follows:

Q4: Comment: why have you chosen this place?

This question refers to the location in the room from which the participant conducted their room evaluation.

Q6: Write words or word-pairs that describe the ROOM best for you.
Q14: Write words or word-pairs that describe the VIEW.

These questions ask for a list of words that describe each participant's overall impression of the room and the view.

Q10: List the most liked (A) and disliked (B) colour (or colour compositions) in the view.

Expressions and words used by participants were not restricted.

The participants filled out paper-based questionnaires, which the eleven participants (completed manually on printed sheets of A4 paper. These completed questionnaires were subsequently transcribed digitally and anonymised, with numbers from 1 to 11 being assigned to each participant. The questionnaire qualitative data evaluation was initially analysed with a manual deductive pre-coding with Microsoft Word (Microsoft 365) and consolidated using ATLAS.ti 24.1.0 CAQDAS—Computer Assisted Qualitative Data Analysis Software. The analysis of individual rooms was summarised with 'word cloud' diagrams representing the word frequency—the larger the size of the text, the more often the word was used in the participants' room and view evaluations.

Additionally, sentiment analysis evaluation was conducted for all participants' answers to the five open-ended questions. This was carried out to determine which elements of the room and view were highlighted by participants as having positive connotations. Segments of text were analysed and coded to elicit 'positive' and 'negative' expressions as well as being 'neutral'. A tree-map diagram illustrates the summary of most frequently used words with positive connotations.

2.4.5. Hand Drawings

Participants were asked to make a simple sketch drawing of their view. They could make it on a separate white A4 paper, or on a tracing paper that they could lay over a background photo. Background photos were taken in each room from a few places close to the windows the day before and colour-printed in A4 format. Participants could choose one that was most similar to the view they had. They were given black pens to draw with. On the drawing, they had to mark and name the view elements that caught their attention, as well as the most liked and the most disliked view elements (e.g., its colour, texture, size, form, lack of maintenance, naturalness, historical value, etc.). Moreover, they had to give them a score on the 1–7 scale, where 1—dislike very much and 7—like very much. Additionally, they were asked to list the most liked and disliked colour (or colour compositions) in the view.

On another white A4 paper, participants were asked to draw a quick sketch of the floor plan of the room (e.g., a simple rectangle) marking the window(s), the door(s), their sitting position and the view direction.

2.4.6. Photographs Taken by the Participants

The instruction given to participants regarding taking photos was as follows: "Take photos (do not use zoom) of the room and the view out (i) postcard from your sitting position, (ii) close-up of the window, (iii) interior—showing most of the interior and your sitting position, e.g., from the door, (vi) exterior showing the neighbourhood".

The analysis was conducted by the artist, a member of the group, and focused on the information these images generally convey about indoor and outdoor environments.

This includes characteristic features of the outdoor environment, relation between indoor and outdoor, the function of windows, and the description of single elements and colours. In addition, individual comments, evaluations, and observations about the interior and exterior aesthetics are included.

2.4.7. Psychological and Environmental Comfort

In Trondheim, to measure neurocognitive performance in each room, participants were administered a brief neurocognitive test battery comprising the Trail Making Test-A (TMT-A), the Trail Making Test-B (TMT-B), and the printed version of the Symbol Digits Modalities Test (SDMT), Alternate Form 1 and 2.

To investigate potential emotional biases in each condition, the Facial Expression Recognition Task (FERT), and two versions of the Emotional Categorization Task (ECAT), both from the Emotional Test Battery (ETB) (P1vital® Oxford Emotional Test Battery, 2017), were administered.

To investigate whether perceived mood and body states differed between the rooms, a brief Visual Analog Scale (VAS) was employed, requiring the participant to qualitatively evaluate on a continuum their current experience of six separate items: happiness, sadness, anxiety, nausea, alertness, and dizziness. See also Supplementary Data.

In the Lausanne workshop, a simpler approach was used. Visual analogue scales (VAS) were used to assess personal state (psychological comfort) and environmental comfort. Personal state questions (Q20) assessed feelings of happiness, sadness, alertness, anxiousness, dizziness, and nauseousness. Environmental comfort questions (Q21) assessed the degree (Low to High) of thermal, audial, visual, and olfactive comfort.

The responses were scanned and a graphic scale from 0 to 100 was overlaid onto the scale bars (see Supplementary Data)). Answers were transcribed with their numerical value onto score tables giving mean and standard deviations. Statistical analysis was performed using a paired t-test and most items were significant.

Figure 1 summarizes all data collection methods as per description within Sections 2.4.1–2.4.7 above.

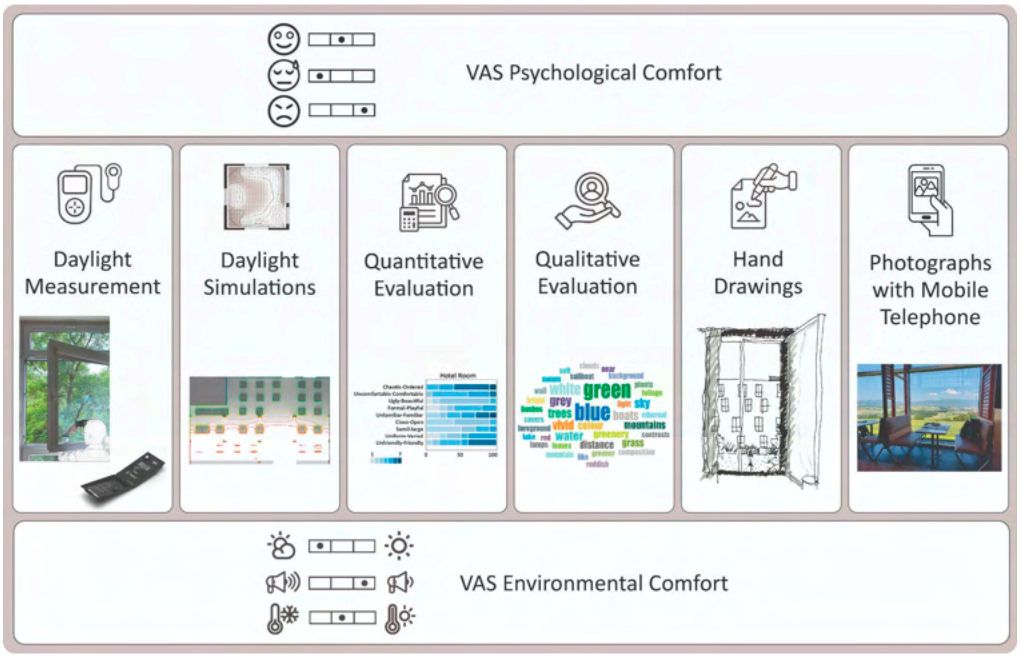

Figure 1. Summary of Methods. The data related to items 1. to 4. (Figure 1) was collected in situ during visits to each of the 4 locations, with data analysis performed after all visits were completed. The order for the completion of the tasks related to items 1. to 4. was not prescriptive; however, all tasks needed to be completed during the visit to each of the 4 locations. Items (2A.–2D.) were part of a questionnaire, whilst Item 5. was carried out after the site visits were completed.

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3. Results

The results presented in this chapter relate to the four locations/Rooms 1–4 visited during the Lausanne workshop: R1: Hotel Lobby, R2: Hotel Room, R3: Motorway Café, R4: Lake Restaurant. Figure 2 shows the plan drawings with the seats (blue dots) that participants chose during their visit, and arrows that show the preferred direction of view. The plan drawings are supplemented with photographs and hand drawings with num-

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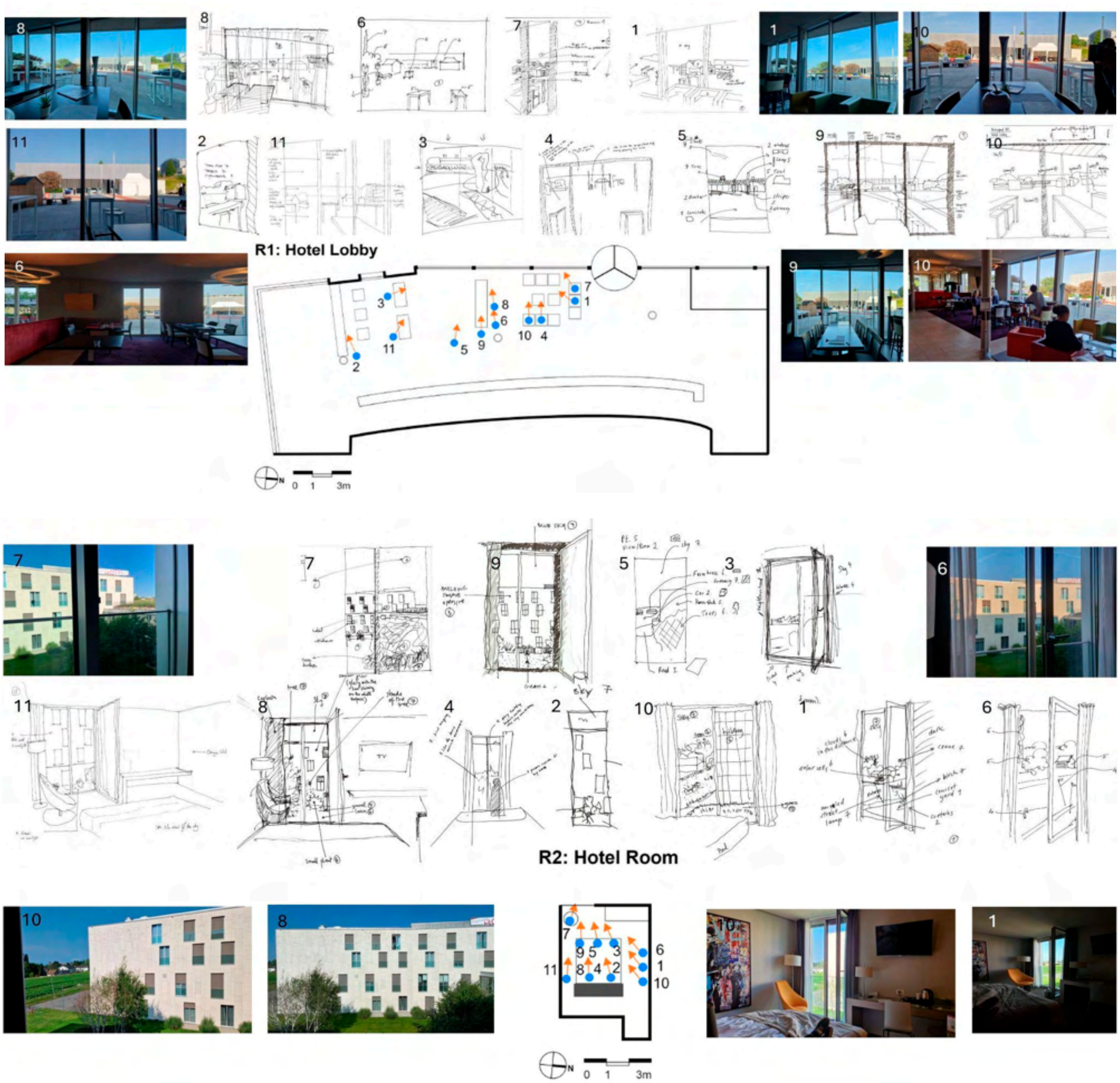

Figure 2. *Cont.*

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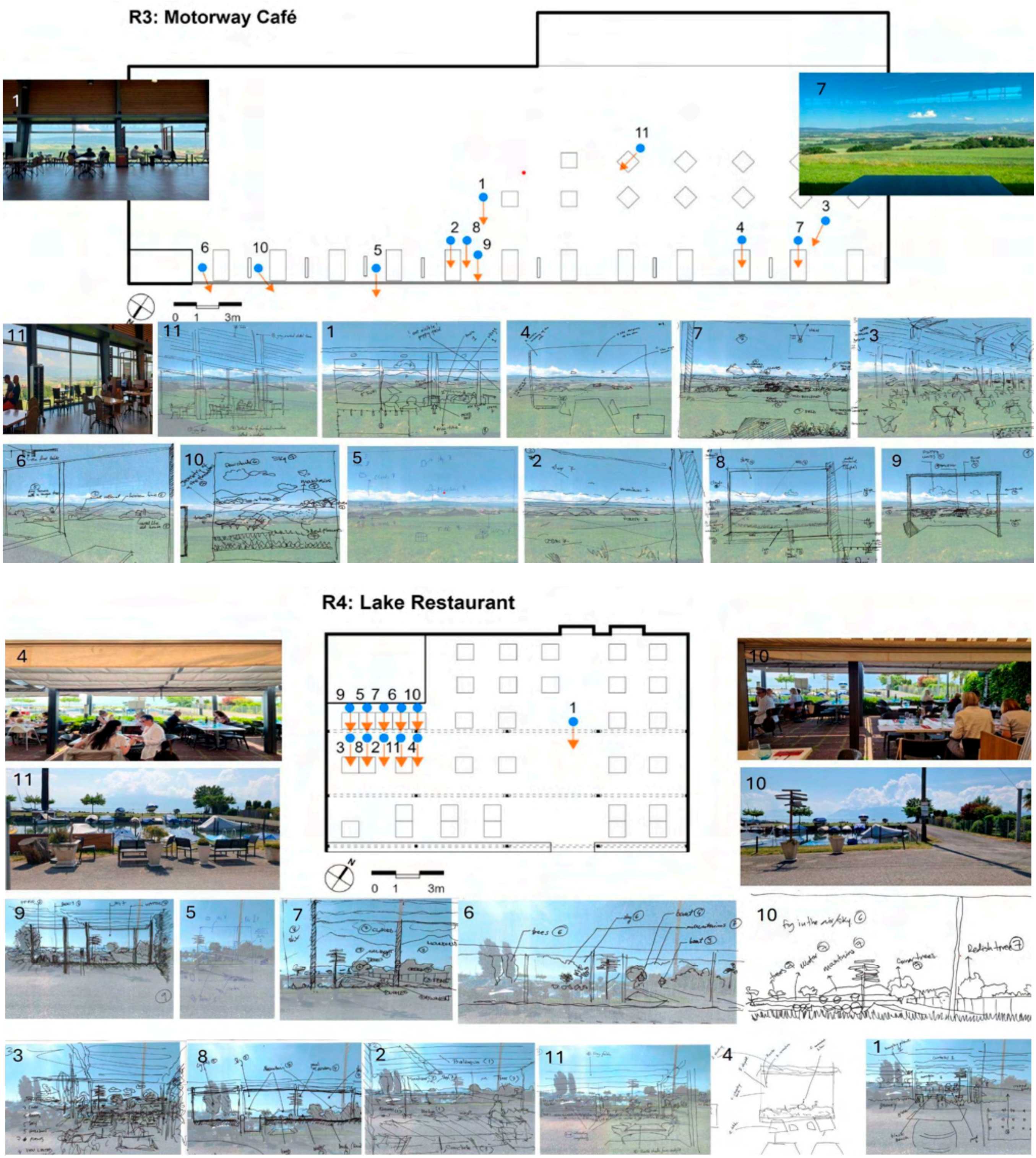

Figure 2. Plan drawings of the rooms (R1: Hotel Lobby, R2: Hotel Room, R3: Motorway Café, R4: Lake Restaurant) with participants' positions marked and their predominant views. Blue points indicate sitting positions, and red arrows refer to the preferred views captured by the drawing or the photograph. The formats of the photos (different phone cameras) and the sizes of the drawings on the A4 tracing paper vary. The numbers on the photos and drawings refer only to the sitting position of the participants. They indicate how views are changed due to the sitting position of the participant.

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3.1. Daylight Measurements and Simulations

The illuminance maps generated for the studied rooms are presented in Figure 3. Room 1, featuring a large unilateral window, exhibited a non-uniform daylight distribution yet achieved high illuminance levels in the area where the participants took the survey near the window wall. Room 2, the smallest space assessed, had a corner window that compromised the light distribution. In contrast, Rooms 3 and 4 had higher and more evenly distributed illuminance levels. This was attributed to their unique configurations: Room 4, a semi-outdoor space, had a lightweight white translucent canopy as a roof, while Room 3 was a double height space, with its windows oriented in three different directions. These architectural features significantly enhanced the daylight characteristics within these spaces.

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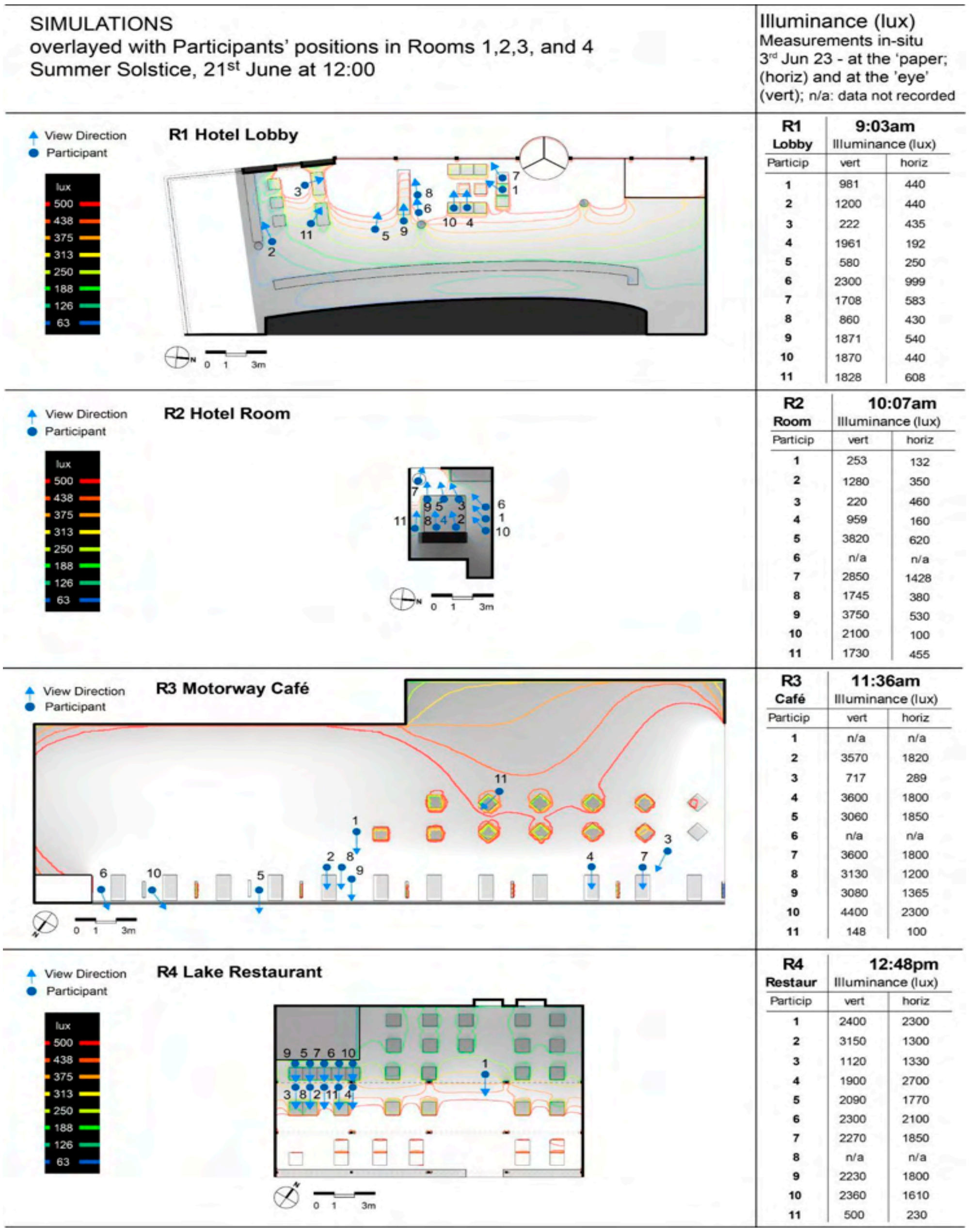
The vertical and horizontal illuminances measured during the workshop by the par ticipants are shown in the right column in Figure 3. Interestingly, the vertical illuminance are much higher than the horizontal ones for all subjects looking towards the window(in Rooms 1, 2 and 3, which confirms the daylight flux having a much higher lateral tha vertical component. The further from the window the greater the difference. In Room 4 the vertical and horizontal illuminances are more similar, which confirms high diffusenes of daylight passing through the translucent roof canopy.



Illuminance (lux)
Measurements in-situ
3rd Jun 23 - at the 'paper; (horiz) and at the 'eye' (vert); n/a: data not recorded

R1 Lobby	9:03am Illuminance (lux)	
Particip	vert	horiz
1	981	440
2	1200	440
3	222	435
4	1961	192
5	580	250
6	2300	999
7	1708	583
8	860	430
9	1871	540
10	1870	440
11	1828	608

R2 Room	10:07am Illuminance (lux)	
Particip	vert	horiz
1	253	132
2	1280	350
3	220	460
4	959	160
5	3820	620
6	n/a	n/a
7	2850	1428
8	1745	380
9	3750	530
10	2100	100
11	1730	455

R3 Café	11:36am Illuminance (lux)	
Particip	vert	horiz
1	n/a	n/a
2	3570	1820
3	717	289
4	3600	1800
5	3060	1850
6	n/a	n/a
7	3600	1800
8	3130	1200
9	3080	1365
10	4400	2300
11	148	100

R4 Restaur	12:48pm Illuminance (lux)	
Particip	vert	horiz
1	2400	2300
2	3150	1300
3	1120	1330
4	1900	2700
5	2090	1770
6	2300	2100
7	2270	1850
8	n/a	n/a
9	2230	1800
10	2360	1610
11	500	230

Figure 3. Daylight simulations and in situ illuminance measurements (lux).

Figure 3. Daylight simulations and in situ illuminance measurements (lux).

The vertical and horizontal illuminances measured during the workshop by the participants are shown in the right column in Figure 3. Interestingly, the vertical illuminances are much higher than the horizontal ones for all subjects looking towards the window(s) in Rooms 1, 2 and 3, which confirms the daylight flux having much higher lateral than vertical component. The further from the window the greater the difference. In Room 4, the vertical and horizontal illuminances are more similar, which confirms high diffuseness of daylight passing through the translucent roof canopy.

3.2. Quantitative Analyses

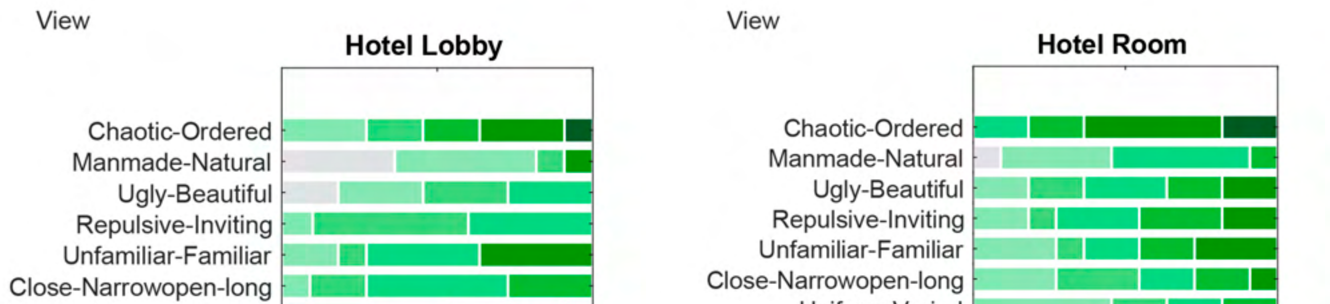
The analysis refers to the Lausanne workshop with eleven participants. Figure 4 provides an overview of participants' percentage of responses across four evaluated spaces: Hotel Lobby, Hotel Room, Motorway Café, and Lake Restaurant. Figure 4a–d shows view assessments based on eight different attributes of view, namely, Chaotic–Ordered, Man Made–Natural, Ugly–Beautiful, Repulsive–Inviting, Unfamiliar–Familiar, Close–Narrow/Open–Long, Uniform–Varied, and Boring–Exciting. In order to compare the results, the direction of the ratings is described on the two sides of the neutral score. Table 2 shows the sum of scores in each direction for view ratings. The Café's and the Restaurant's views are rated highly on the positive scores. The Café's view scored highly on attributes such as openness (100%), inviting, beautiful, and varied, while the restaurant's view rated highly on attributes including varied, openness, and inviting. In both cases, above 80% of the votes were on positive attributes, with less than 10% of the ratings being neutral. Hence, a stronger positive opinion on the view can be observed. The Café's view was overwhelmingly seen as open/long (100%), inviting (100%), beautiful and exciting (90%), and natural (80%). It rated highly as ordered (90%) and varied (72%). However, this view elicited lower scores on familiarity, with 60% participants rating it familiar and another 10% finding it unfamiliar. The Hotel Room's view received the most even distribution of votes with a general inclination towards the negative side of the attributes (40%). The Lobby's view in this context had the highest average rating on the negative side of the attributes. The Lobby's view was predominantly perceived as manmade (90%), ordered (54%), and uniform (54%). While there is a sense of structure, the view lacks natural elements and diversity, leading to a significant portion of respondents finding it repulsive and boring (both 72%). [illegible] (64%) [illegible] (45%) [illegible] (45%) [illegible] those who find the view inviting and those who consider it repulsive [illegible] feels narrow [illegible] respondents. Overall, while the [illegible] provides a sense of [illegible] and familiarity, it lacks variation and openness, making it a less dynamic or engaging space for many.

The evaluation of views across the four spaces—Hotel Lobby, Hotel Room, Motorway Café, and Lake Restaurant—shows a clear distinction between spaces. Comparison between the Room and View Assessments suggests an alignment between higher and lower ratings on different attributes. The rooms were on average rated lower, and the views were rated higher on the positive side of the attributes in case of the Café and the restaurant. While the Hotel Lobby is rated on average higher on the positive side of the attribute, its view is rated higher on the negative side.

Table 2. The sum of scores in each direction for view.

	⬅	Neutral	➡
Lobby	56	22	22
Room	41	26	34
Café	12	8	80
Restaurant	8	8	84

🟩 Tendency towards higher scale in room assessments
⬜ Tendency towards lower scale in room assessments



Restaurant	8	8	84

🟩 Tendency towards higher scale in room assessments
▪ Tendency towards lower scale in room assessments

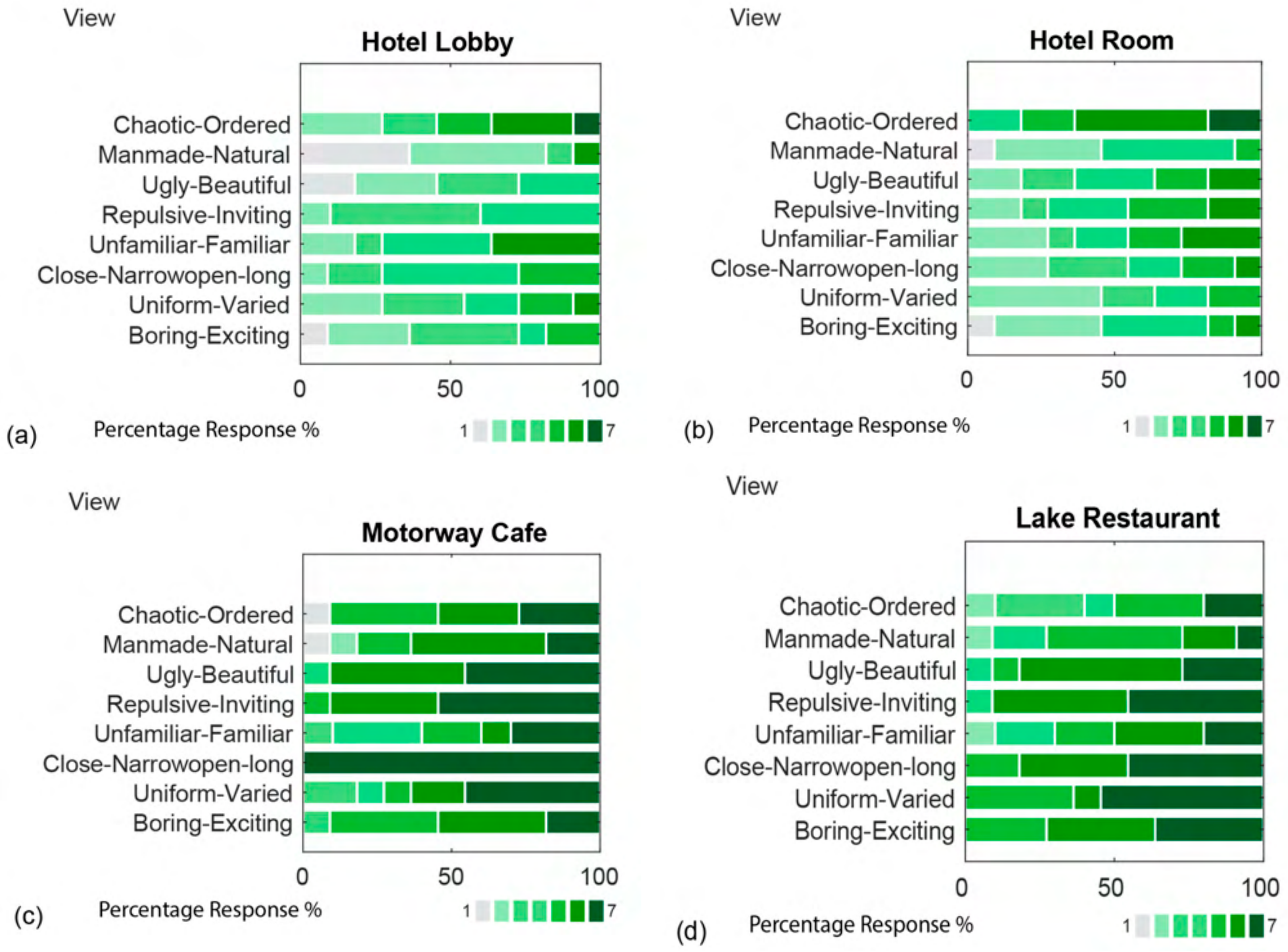


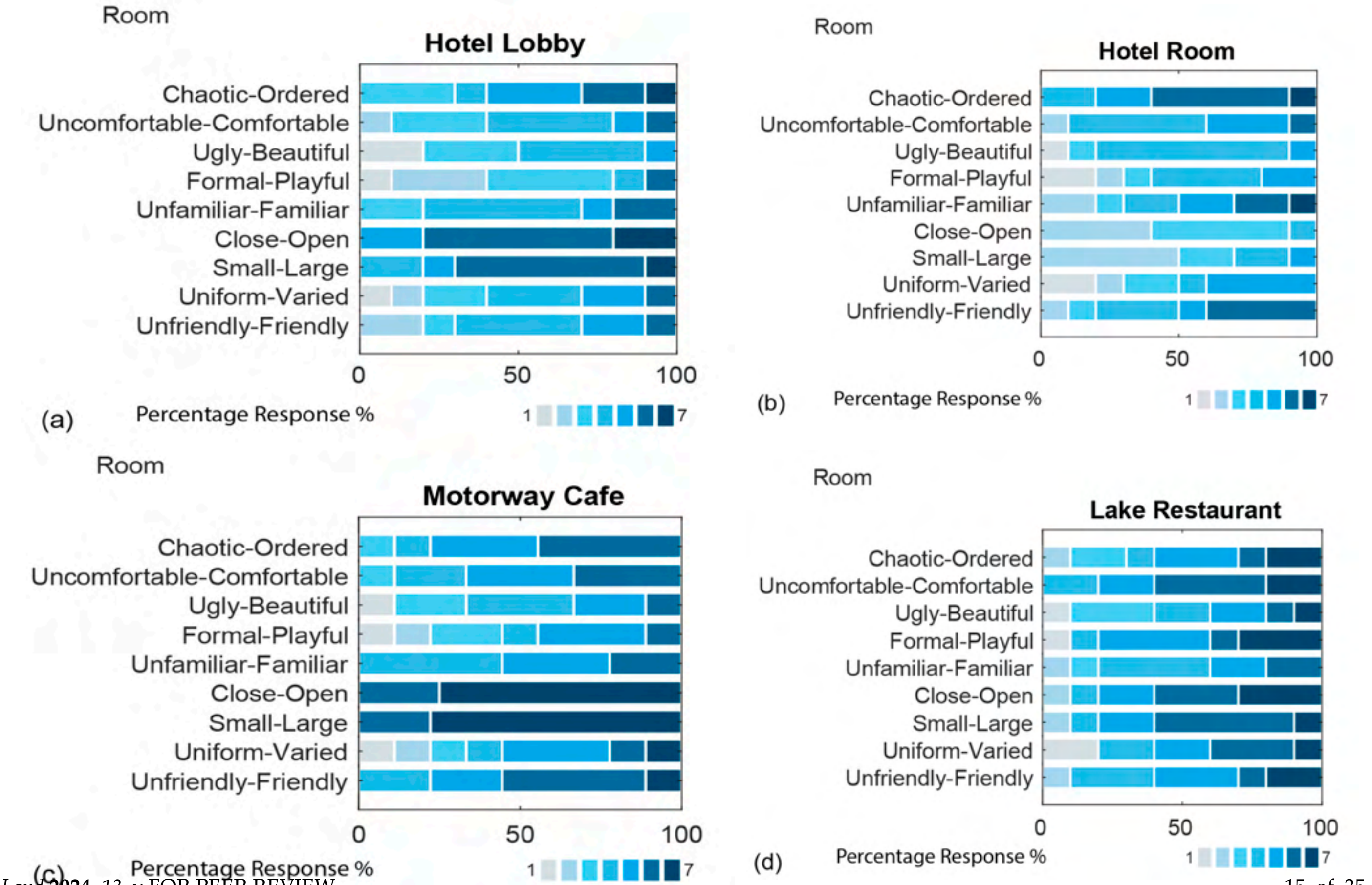
Figure 4. Overview of the scores for view impressions divided among the four evaluated spaces: (**a**) Hotel Lobby, (**b**) Hotel Room, (**c**) Motorway Café, and (**d**) Lake Restaurant.

Room assessments and responses are shown in Figure 5a–d, and Table 3 shows the sum of scores in each direction for room ratings. The rooms are rated on nine different attributes, listed as Chaotic–Ordered, Uncomfortable–Comfortable, Ugly–Beautiful, Formal–Playful, Unfamiliar–Familiar, Close–Open, Small–Large, Uniform–Varied, and Unfriendly–Friendly. The results show that the rooms exhibit varying degrees of perceived qualities across the nine attributes. The Café and the Lobby were perceived as the largest and the most open, while the Hotel Room was seen as the most closed. The Restaurant, while not ranked as open and large as the Café, has gained higher scores on most of the attributes (64% of the higher scores), (19% neutral and 17% lower scores). The Café is predominantly seen as ordered (78%) and friendly (78%), with a perception of spaciousness (both open and large 100%). Moreover, the Café scored as comfortable (67%), familiar (56%) and varied (56%). The Hotel Room was rated with the least diversity of score distribution on low, high, and neutral scales. Overall, the Restaurant and the Café received high ratings on most attributes, notably on comfort, playfulness, and friendliness, suggesting that participants found these larger, open spaces more "agreeable". These spaces were ranked similarly high on positive scales of view attributes. Like the view rating, the Hotel Lobby was seen as formal (80%), ordered (60%), and open (100%), but lacked comfort (20%), playfulness (10%), and friendliness (10%). The aesthetic appeal was mixed, with significant groups seeing the space as either ugly (50%) or being neutral (40%). There was also a consensus that the space is somewhat varied, but a portion still found it uniform and less inviting. The Hotel Room was primarily perceived as ordered (80%), formal (40%), and narrow/closed (90%).

Room	37	30	33
Café	15	17	68
Restaurant	17	19	64

🟦 Tendency towards higher scale in room assessments
⬜ Tendency towards lower scale in room assessments

A significant majority (90%) were neutral about the rooms being ugly or beautiful or its comfort levels (50%). The space was mostly seen as small (50%) but friendly (50%).



Land **2024**, *13*, x FOR PEER REVIEW 15 of 35

Land **2024**, *13*, x FOR PEER REVIEW 15 of 35

Figure 5. Overview of the scores for room impressions divided among the four evaluated spaces: (**a**) Hotel Lobby, (**b**) Hotel Room, (**c**) Motorway Café, and (**d**) Lake Restaurant.

Figure 5. Overview of the scores for room impressions divided among the four evaluated spaces: (**a**) Hotel Lobby, (**b**) Hotel Room, (**c**) Motorway Café, and (**d**) Lake Restaurant.

Table 3. The sum of scores in each direction for the rooms.

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Figure 6a,b displays percentage responses for different spaces (Hotel Room, Hotel Lobby, Lake Restaurant, Moto Café) in terms of the first impression of t ew (Q13) and overall impression of the (Q3). The Motorway Café and Lake Re ant have the widest spread of distribution. Both the

	←	Neutral	→
Lobby	32	27	41
Room	37	30	33
Café	15	17	68
Restaurant	17	19	64

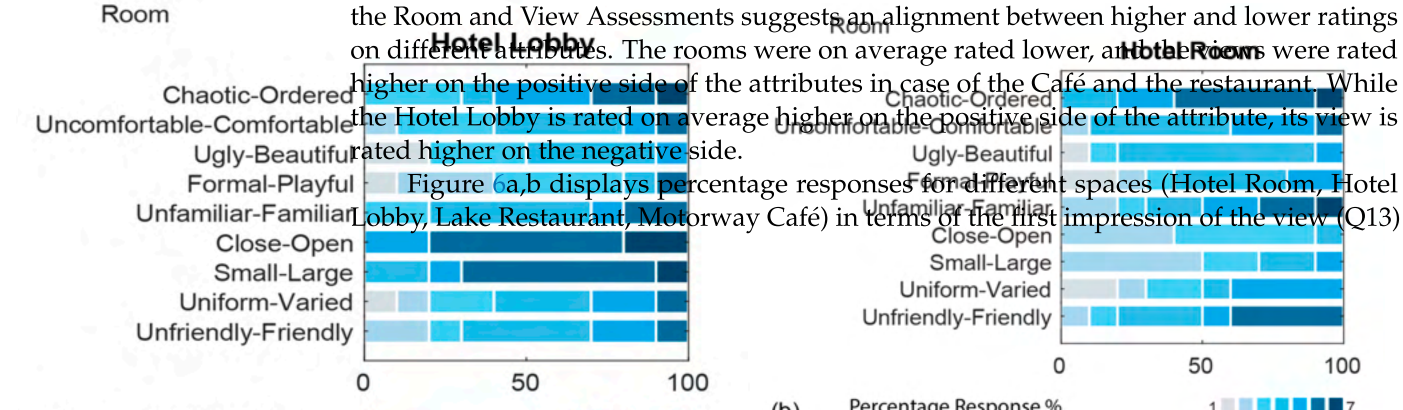
Restaurant	17	19	64

🟦 Tendency towards higher scale in room assessments
⬜ Tendency towards lower scale in room assessments

🟦 Tendency towards higher scale in room assessments
⬜ Tendency towards lower scale in room assessments

The evaluation of views across the four spaces—Hotel Lobby, Hotel Room, Motorway Café, and Lake Restaurant—shows a clear distinction between spaces. Comparison between the Room and View Assessments suggests an alignment between higher and lower ratings on different attributes. The rooms were on average rated lower, and the views were rated higher on the positive side of the attributes in case of the Café and the restaurant. While the Hotel Lobby is rated on average higher on the positive side of the attribute, its view is rated higher on the negative side.

Figure 6a,b displays percentage responses for different spaces (Hotel Room, Hotel Lobby, Lake Restaurant, Motorway Café) in terms of the first impression of the view (Q13)



and overall impression of the room (Q3). The Motorway Café and Lake Restaurant have the widest spread of positive impressions, while the Hotel Lobby has a more moderate distribution. Both the Lake Restaurant and Motorway Café show a strong first impression of the view. In both graphs, the Lake Restaurant consistently received strong positive responses, suggesting it stands out in both overall impression of the room and first impression of the view. The Lake Restaurant consistently received positive responses, while the Motorway Café had more varied perceptions comparing the room and view, while the Hotel Lobby and Hotel Room were perceived similarly, with a balance of negative, positive, and neutral impressions across both the room and view dimensions.

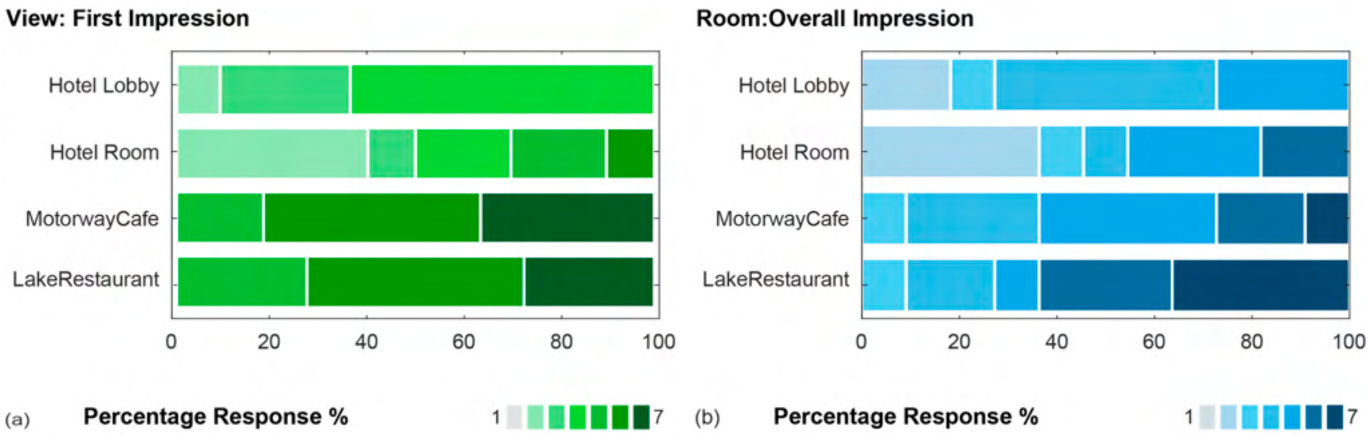


Figure 6. Percentage responses for different spaces in terms of: (**a**) first impression of the view and (**b**) overall impression and first impression of the view.

Table 4 summarises the results from a linear mixed-effects model that examines how various view descriptors of views (e.g., Boring-Exciting, Uniform Varied, etc.) affect the first impression of the view with random intercept.

Table 4. Fixed effect model with random intercept.

	AIC	BIC	Coefficient	SE	t(stats)	*p*-Value
Scene	139.376	146.421	0.997	0.151	6.617	0.0000001
Boring–Exciting	119.076	126.121	0.728	0.074	9.806	0.0000000
Uniform–Varied	133.715	140.760	0.646	0.086	7.483	0.0000000
Closed–Open	131.480	138.525	0.701	0.090	7.828	0.0000000
Unfamiliar–Familiar	153.214	160.068	0.426	0.140	3.039	0.0042221
Repulsive–Inviting	96.472	103.423	0.840	0.065	12.846	0.0000000
Ugly–Beautiful	166.318	173.363	0.754	0.063	12.009	0.0000000
Manmade–Natural	145.864	152.909	0.533	0.093	5.706	0.0000011
Chaotic–Ordered	166.250	173.201	0.015	0.147	0.105	0.9168278

The intercept in the Model Structure 3 is random, and each row corresponds to a fixed effect in the model. In the modelling, we considered the "First Impression" of the view as the response. The attributes (descriptor) are considered as fixed effects and the participants as random. Each room and view combined creates a different "scene" which is also considered as a variable. It can be seen that the "Repulsive–Inviting" dimension provides the best model fit (AIC = 96.47, BIC = 103.42) and has a significant positive effect (coefficient = 0.84, $p < 0.001$) (Model Structure 3). Its coefficient (0.84) indicates that as the view becomes more inviting, the overall impression increases by approximately 0.84 units. "Ugly–Beautiful" and "Boring–Exciting" have some of the highest coefficients (coefficient = 0.75, $p < 0.001$ and coefficient = 0.72, $p < 0.001$), indicating that the views perceived as more beautiful and exciting lead to a greater increase in overall impression (by >0.7 units) followed by perception of openness. These effects are also statistically significant ($p < 0.001$). The Chaotic–Ordered dimension does not significantly influence the overall impression ($p = 0.9168$). Other dimensions like Uniform–Varied, Unfamiliar–Familiar, Manmade–Natural, have statistically significant effects, with varying magnitudes of influence on the overall impression. The "Scenes" have the highest coefficient indicating a varying perception of each view and room.

$$\text{First impression}{\sim}\text{Repulsive/Inviting F} + \text{Participant R} \tag{3}$$

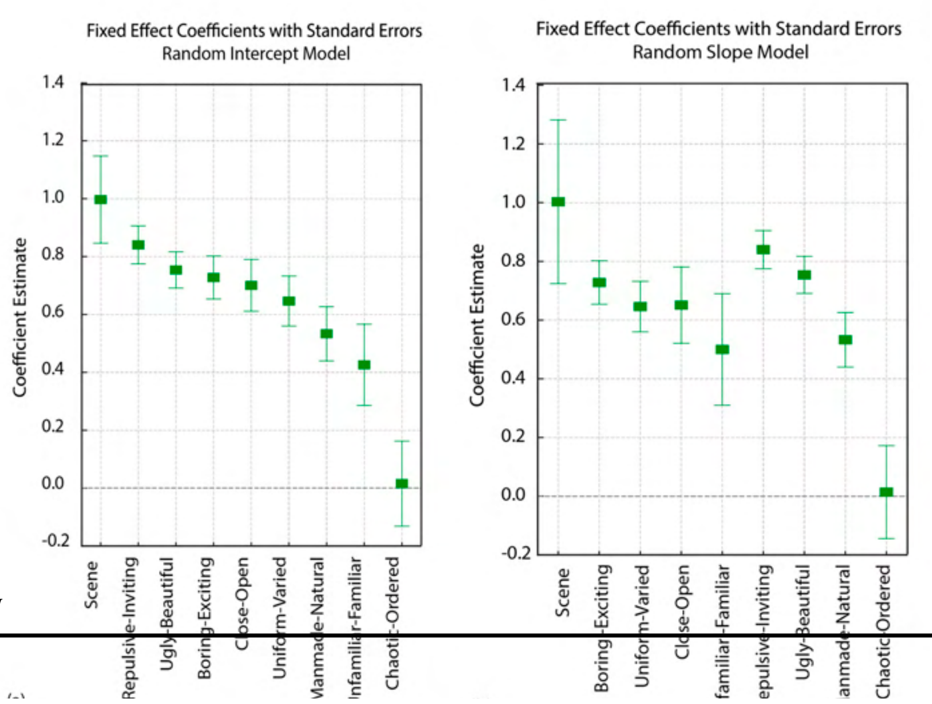
$$\text{First impression}{\sim}\text{Repulsive/Inviting F} + \text{Repulsive/Inviting R} + \text{Participant R} \tag{4}$$

Table 5 shows the results, where the model was updated to include a random slope, as shown in Structure 4, which accounts for varying effects of predictors across individuals or groups. The inclusion of random slopes allows for the slope (relationship between the predictor and outcome) to vary across clusters (e.g., participants, schools), providing a more flexible model that accounts for heterogeneity in responses. AIC and BIC values have slightly changed for each descriptor. For example, the AIC for "Scene" has been reduced from 139.376 to 135.564, indicating a potential improvement in model fit with the inclusion of random slopes. Some coefficients remain similar, such as "Boring Exciting" (now 0.728, previously 0.727), while others, like "Scene", have increased to 1.003 (previously 0.997). This suggests that the inclusion of random slopes slightly changes the estimated fixed effects for some descriptors. Notably, the "Scene" descriptor shows a stronger positive effect under the random slope model. Most of the descriptors remain highly significant ($p < 0.05$). For example, "Repulsive Inviting" and "Ugly Beautiful" retain their strong significance in both models. However, the "Unfamiliar Familiar" dimension's p-value has increased slightly to 0.012 (previously 0.004), which is still significant but reflects a minor change in the strength of evidence. Overall, the random intercept model appears to perform slightly better across the descriptors, as it has lower AIC and BIC values, Figure 7. While the random slope model may improve the fit for specific descriptors (e.g., "Scene"), it does not provide an overall improvement in model fit when considering the trade-off between model complexity and performance meaning that Model Structure 3 is still the best fit at this stage describing the effect of the "Repulsive–Inviting" descriptor on the first impression of the view.

Table 5. Fixed effect model with random slope.

	AIC	BIC	Coefficient	SE	t(stats)	*p*-Value
Scene	135.564	144.370	1.003	0.279	3.600	0.0008515
Boring–Exciting	121.076	129.882	0.728	0.074	9.806	0.0000000
Uniform–Varied	135.715	144.521	0.646	0.086	7.483	0.0000000
Close–Open	131.828	140.634	0.651	0.130	5.011	0.0000108
Unfamiliar–Familiar	152.039	160.607	0.500	0.190	2.632	0.0120897
Repulsive–Inviting	98.472	107.160	0.840	0.065	12.846	0.0000000
Ugly–Beautiful	108.318	117.124	0.754	0.063	12.009	0.0000000
Manmade–Natural	147.864	156.670	0.533	0.093	5.706	0.0000011
Chaotic–Ordered	168.035	176.723	0.014	0.158	0.091	0.9276696

7. While the random slope model may improve the fit for specific descriptors (e.g., "Scene"), it does not provide an overall improvement in model fit when considering the trade-off between model complexity and performance meaning that Model Structure 3 is still the best fit at this stage describing the effect of the "Repulsive–Inviting" descriptor on the first impression of the view.



Ugly–Beautiful	108.318	117.124	0.754	0.063	12.009	0.0000000
Manmade–Natural	147.864	156.670	0.533	0.093	5.706	0.0000011
Chaotic–Ordered	168.035	176.723	0.014	0.158	0.091	0.9276696

tercept

3.3. Qualitative Analyses

Table 4. Fixed effect model with random intercept.

	AIC	BIC	Coefficient	SE	t(stats)	p-Value
Scene	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]001
Boring–Exciting	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]000
Uniform–Varied	[illegible]	[illegible]	[illegible]	[illegible]	7.183	0.0000000
Closed–Open	131.480	138.323	0.701	0.090	7.828	0.0000000
Unfamiliar–Familiar	[illegible]	160.068	0.426	0.140	3.039	0.0042221
Repulsive–Inviting	96.472	103.423	0.840	0.065	12.846	0.0000000
Ugly–Beautiful	106.318	113.383	0.754	0.063	12.009	0.0000000
M	145.	[illegible]	[illegible]	[illegible]93	[illegible]	[illegible]0000011
C	166.	[illegible]	[illegible]	[illegible]47	[illegible]	[illegible]168278

The answers to question Q4, "Why have you chosen this place?", are similar and have been compiled into a single table. Interestingly, regardless of the room type, size, or furnishings, the primary reason for selecting a sitting place was the good access to the view, with the window being the secondary factor. This suggests that the participants' responses may have been influenced by the overall purpose of the workshop—view assessment—which could have introduced a bias in their choices, Table 6.

Table 6. Reasons for choosing the sitting place in the respective rooms.

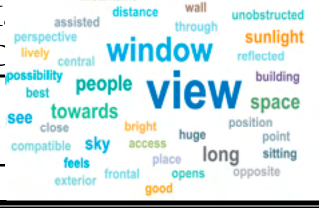
ROOM 1 Hotel Lobby	ROOM 2 Hotel Room	ROOM 3 Motorway Cafe	ROOM 4 Lake Restaurant
			

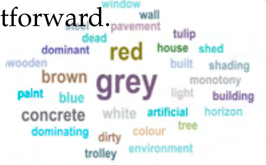
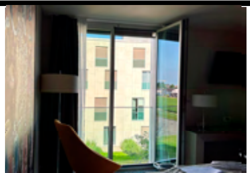
Table 5. Fixed effect model with random slope.

	AIC	BIC	Coefficient	SE	t(stats)	p-Value
Scene	135.564	144.370	1.003	0.279	3.600	0.0008515
Boring–Exciting	121.076	129.882	0.728	0.074	9.806	0.0000000
Uniform–Varied	135.715	144.521	0.646	0.086	7.483	0.0000000
Close–Open	131.828	140.634	0.651	0.130	5.011	0.0000108
Unfamiliar–Familiar	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]32	0.0120897
Repulsive–Inviting	98.472	107.160	0.840	0.065	12.846	0.0000000

To look closer at the answers for question Q10, "List the most liked (A) and disliked (B) colour (or colour compositions) in the view", the word clouds with words related to the most liked and disliked colours are combined in Table 7.

Interestingly green and blue colours are the most liked, and grey, brown, and black are the most disliked colours. Participants often used words representing view elements, e.g., mountains, sky, or buildings, instead of the names of colours, which suggests that finding an adequate name for the colour was not straightforward.

Table 7. The most liked and disliked colours in the views at respective locations.

Q10		A	B
ROOM 1			
ROOM 2			

[illegible] Table 7.

Table 7. [illegible] respective locations.

Interestingly [illegible] e.g., mountains [illegible] finding [illegible] The Positive Sentiment Word Frequency Treemap Summary, Figure 8, illustrates the most frequently used words from the positive quotes (appearing at least three times or more in the coded text). The larger the area the word occupies in the diagram, the higher the word frequency. The words "spacious" together with "sky", and "greenery" (expressed in many different forms) as well as "bright", "airy", and "welcoming" form a group of desirable qualities for rooms with a view.

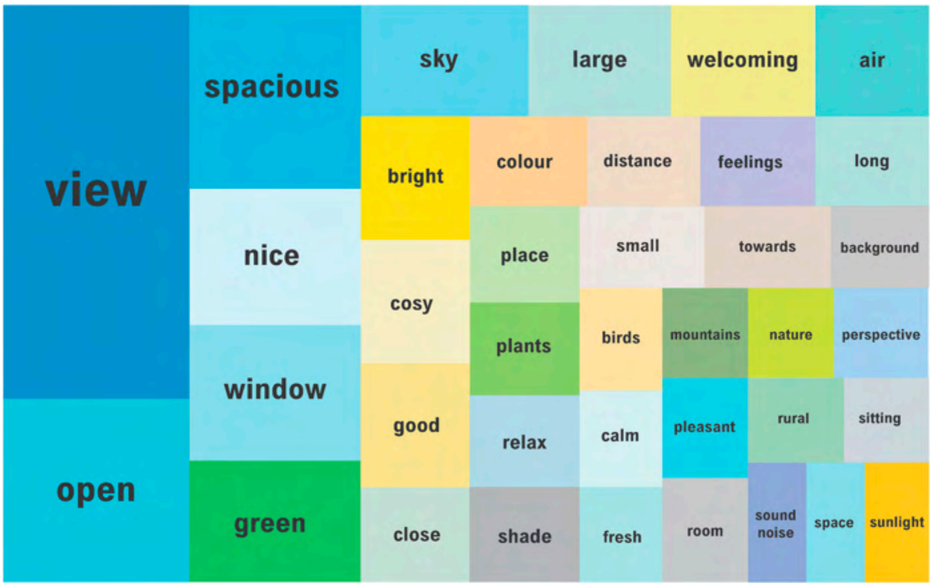


Figure 8. Positive Sentiment Word Frequency Treemap Summary.

Overall, Rooms 1 (Hotel Lobby) and Room 2 (Hotel Room) have a higher frequency of negative sentiments towards the view, with most used words "concrete", "limited", and "boring" (see question Q14. results shown in Table 8). The views from Room 3 (Motorway Café) and Room 4 (Lake Restaurant) include many positive reactions, with most frequently used words such as "beautiful", "relaxing", "calm", "open, and including reference to natural elements within the view content such as "landscape" and "mountains".

Figure 8. Positive Sentiment Word Frequency Comparison Summary.

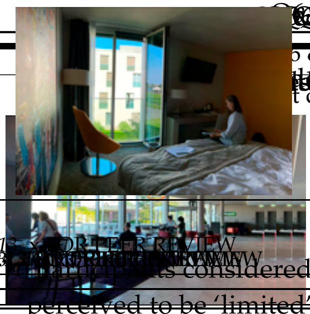
Overall, Rooms 1 (Hotel Lobby) and Room 2 (Hotel Room) have a high frequency of negative sentiments towards the view, with most used words "concrete", "limited", and "boring" (see question Q14 results shown in Table 8). The views from Room 3 (Motorway Café) and Room 4 (Lake Restaurant) elicited many positive reactions, with most frequently used words such as "beautiful", "relaxing", "calm", "open", and including references to natural elements within the view content such as "landscape" and "mountains".

Table 8. Rooms 1 to 4 Qualitative Assessment Summary, describes the combined findings from answers to open-ended questions Q6 "Words that describe the ROOM" and Q14 "Words that describe the VIEW" from the 11 participants whilst visiting each of the four rooms.

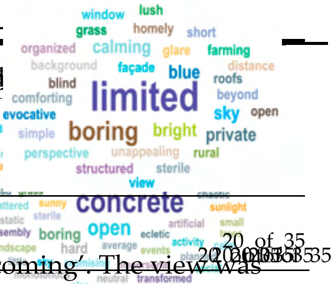
Q6 & Q14 QUALITATIVE ASSESSMENT SUMMARY

Q6 "Words that describe the ROOM" Q14 "Words that describe the VIEW"

ROOM 2
3 June 2023 at 10:07 am







ROOM 2: Hotel Room

Participants considered Room 2, a small standard hotel room, as 'cosy' and 'welcoming'. The view was perceived to be 'limited' and 'boring' but bright for that time in the morning—the sunlight was reflected from the light-coloured building façade ... glare in the room. Participants also noted

... low quality, 'boring', and 'too grey'—although the blue sky and some green vegetation are highlighted as the most

Q6 "Words that describe the ROOM" Q14 "Words that describe the VIEW"

ROOM 2
3 June 2023 at 10:07 am



ROOM 2: Hotel Room

Participants considered Room 2, a small standard hotel room, as 'cosy' and 'welcoming'. The view was perceived to be 'limited' and 'boring' but bright for that time in the morning—the sunlight was reflected from the light-coloured building façade

ROOM 3: Motorway Café

Most participants positively assessed Room 3, where the panoramic view of the landscape and the generous scale of the 'large' 'spacious' room ... most disliked elements relate to the brown tones of the room's interior and some buildings in part of the view's background.

Q6 "Words that describe the ROOM" Q14 "Words that describe the VIEW"

ROOM 3
3 June 2023 at 11:36 am



ROOM 3: Motorway Café

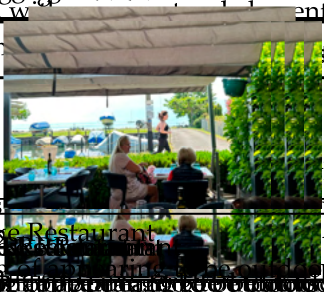
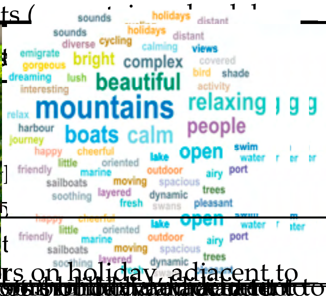
Most participants positively assessed Room 3, where the panoramic view of the landscape and the generous scale of the 'large' 'spacious' room ... most disliked elements relate to the brown tones of the room's interior and some buildings in part of the view's background.

In Room 4, participants were pleased with the feeling of ... Lake Leman and with a view of the French Alps in the background. The semi-outdoor space is noted as positive and 'welcoming', with the opportunity for fresh air, with views of boats, water, sky, greenery, and mountains ... or restaurant décor ... to the

... Overall, the view ... ly, w... ents (

Q6 "Words that describe the ROOM" Q14 "Words that describe the VIEW"

ROOM 4
3 June 2023 at 12:48 am

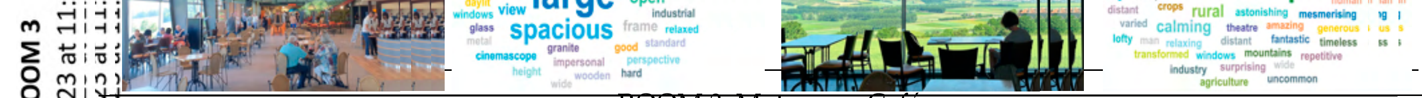




ROOM 4: Lake Restaurant

In Room 4, participants were pleased with the feeling of appearing to be outdoors on holiday, adjacent to Lake Leman and with a view of the French Alps in the background. The semi-outdoor space is noted as positive and 'welcoming', with the opportunity for fresh air, with views of boats, water, sky, greenery, and

Table 8. *Cont.*

Q6 & Q14: QUALITATIVE ASSESSMENT SUMMARY



ROOM 3: Motorway Café

Most participants positively assessed Room 3, where the panoramic view of the landscape and the generous scale of the "large", "spacious" room with generous floor-to-ceiling height were highlighted. The most disliked elements relate to the brown tones of the room's interior and some buildings as part of the view's background.

Q6 "Words that describe the ROOM"

Q14 "Words that describe the VIEW"

ROOM 4: Lake Restaurant

In Room 4, participants were pleased with the feeling of appearing to be outdoors on holiday, adjacent to Lake Leman and with a view of the French Alps in the background. The semi-outdoor space is noted as positive and welcoming, with the opportunity for fresh air with views of boats, water, sky, greenery, and mountains. Participants disliked the interior restaurant decor and black asphalt surfacing adjacent to the seating area. Overall, the view was rated positively, with many natural elements (mountains, sky, lake, greenery) offering a "calm" and "relaxing" feeling.

3.4. Analyses of Drawings

Drawing by hand is a reflective and informed decision. When you draw a whole landscape yourself instead of taking a photo, you choose which landscape elements to include in the drawing; you decide which elements to notice or ignore. The complexity of the visual information is reduced, and you choose the most important from the vast number of elements that most views contain and which are not relevant in the given context.

Understanding the role of windows in providing daylight, direct sunlight, ventilation and access to outside vistas towards landscapes and contributing to the quality of life of urban dwellers is growing [2,28,50,51]. However, no metrics can quantify the view's content in the standard recommendations like the EN 17037 Daylight in Buildings [5].

This view-out drawing appraisal objective was to test a novel method for assessing views of urban landscapes in a real context through a series of drawings with a numerical indication of the most liked (7) and the most disliked (1) elements (Q9), see Figure 9.

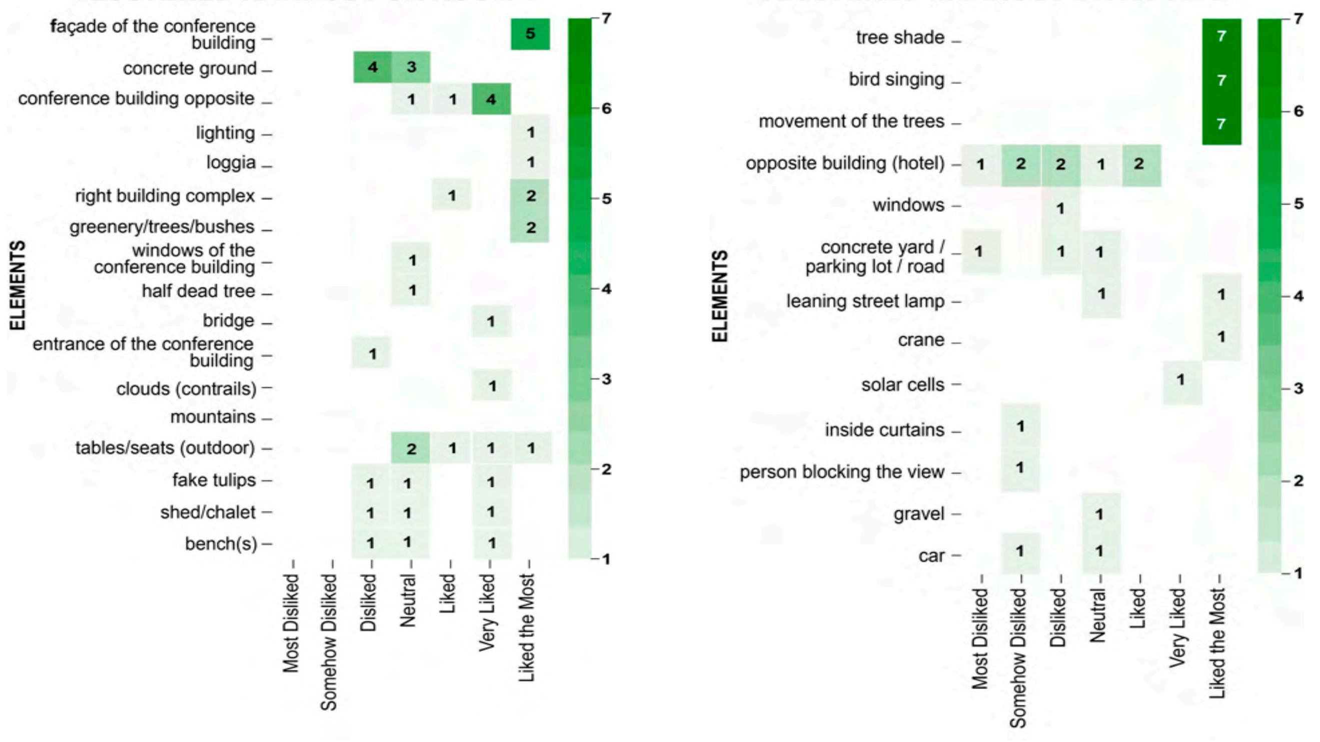


Figure 9. *Cont.*

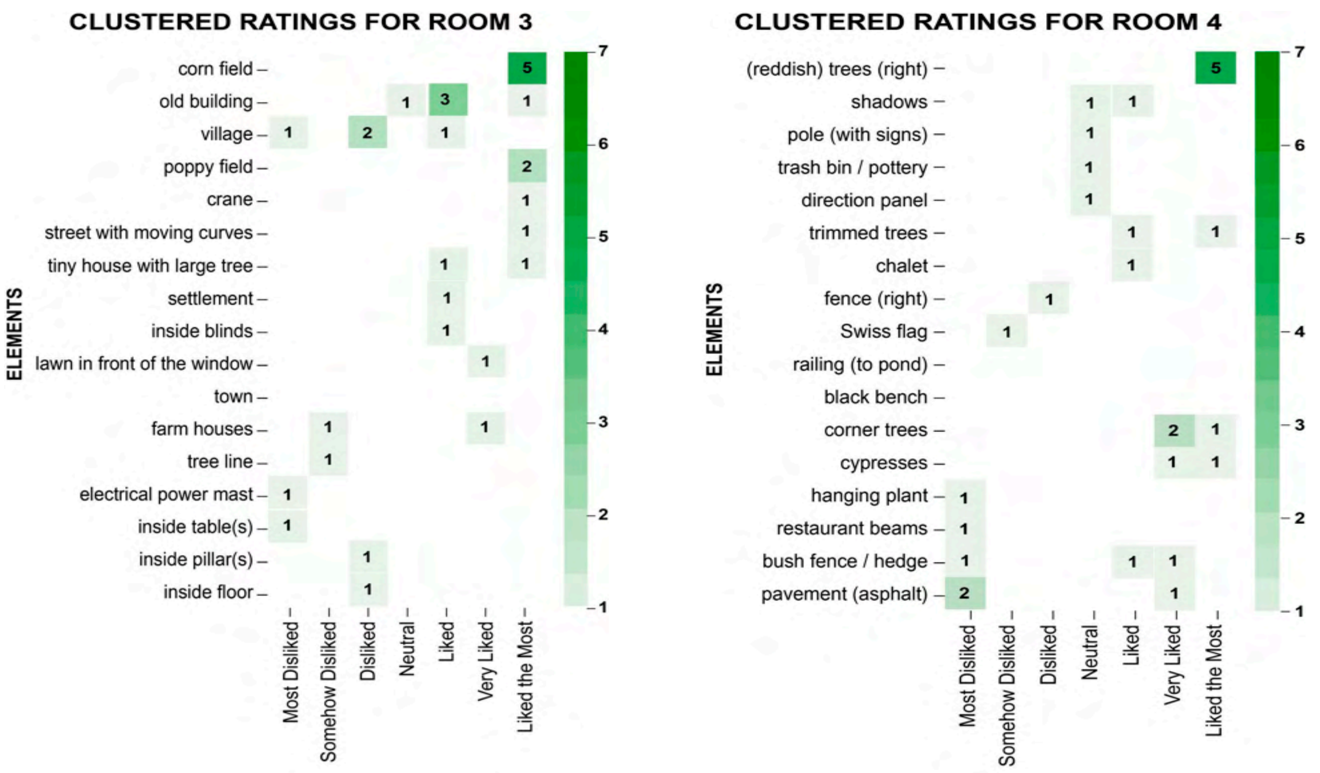


Figure 9. Heatmaps for each room (R1: Hotel Lobby, R2: Hotel Room, R3: Motorway Café, R4: Lake Restaurant) illustrate drawn and rated elements for each room. The intensity of the colours indicates how many participants assess a particular element.

Drawing by hand encourages more reflection and more informed decisions. When you draw a whole landscape yourself, instead of taking a photo, you choose which landscape elements to include in the drawing, you decide which elements to notice or ignore. The complexity of the visual information is reduced, and you choose the most important from the vast number of elements that most views contain and which are not relevant in the given context. This helps you choose your most liked and disliked elements and give them points.

The main research questions for this evaluation were:

- What elements within the observed landscape views were the most liked ones?
- What elements within the observed urban landscapes were the most disliked ones?

Concerning Room 1, the elements “disliked the most” are the windows of the conference building, a half-dead tree, a bridge, the entrance to the conference building, and clouds (contrails). Elements rated as “disliked the most” were primarily associated with architectural, and less natural, features, suggesting a preference for more scenic or organically integrated views. The “liked very much” elements include the façade of the conference building, the concrete ground, the greenery/trees/bushes, and the right building complex. Elements that were liked predominantly included greenery and aesthetically pleasing landscape features, indicating an appreciation for clean and natural settings— also see Supplemented Data.

The most disliked elements for the view from Room 2 were the solar cells, the inside curtains, people blocking the view, gravel, and cars. Disliked elements often obstructed views or represented utilitarian aspects of the environment, highlighting a preference for unobstructed and visually appealing landscapes. Elements apprised as “liked very much” were the shade of the tree, birds singing, the movement of trees, and the opposite part of the building. Natural elements, such as dynamic scenes involving trees and the presence of nature sounds, were highly rated, reflecting a preference for tranquil and natural settings.

Regarding the view from Room 3, the “disliked the most” elements were the inside blinds, the settlement, the town, farmhouses, and the electrical power mast. The commonality among disliked elements is their association with indoor or obstructive features, suggesting that participants favour open, natural, and aesthetically pleasing outdoor views. The most liked elements included a cornfield, poppy field, a crane, and a village. Rural and nature-oriented elements were consistently rated highly, demonstrating a clear preference for scenic countryside environments over urban settings.

The most disliked elements from Room 4 included the chalet, a fence, the Swiss flag, a railing for the pond, and a black bench. The disliked elements tended to include man-made structures, indicating a preference against overly structured or artificial components

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The most disliked elements from Room 4 included the chalet, a fence, a Swiss flag, a railing for the pond, and a black bench. The disliked elements tended to include man-made structures, indicating a preference against overly structured or artificial components within natural settings. The elements that were liked very much are reddish trees, corner trees, cypresses, and shadows. Tree-related and natural elements were highly favoured, reinforcing the trend across rooms for scenic, green, and naturally integrated environments.

Overall Insights:

Analysis of the 36 drawings revealed that the most liked elements within the observed landscapes were the sky (blue, clear, and without glare) and vegetation, including bushes, grass lawns, forests, trees, greenery, mountains on the horizon, and water/lake views. Conversely, the most disliked elements included plastic tulips, a lack of greenery, grey concrete, buildings or other man-made elements obstructing the view, shading structures, and excessive brightness caused by reflections on buildings or other structures.

The analysis reveals a consistent pattern of preferences across all rooms, with natural, scenic, and open environments rated as the most liked. In contrast, urban, obstructive, and artificial elements were commonly disliked. These findings underscore the importance of integrating greenery and open views into environmental designs. This empowers urban planners, architects, and landscape designers to enhance user satisfaction by creating aesthetically pleasing and tranquil natural settings.

This method provides a valuable approach for objectively assessing the visual quality of urban landscapes, highlighting elements that enhance or detract from the aesthetic and psychological benefits of urban views, see Table 9.

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This method provides a valuable approach for objectively assessing the visual quality of urban landscapes, highlighting elements that enhance or detract from the aesthetic and psychological benefits of urban views, see Table 9.

Table 9. Word clouds summarise the most liked, neutral, and disliked elements across the locations obtained throughout the drawing analysis.

Most Liked Elements	Neutral Elements	Most Disliked Elements
		

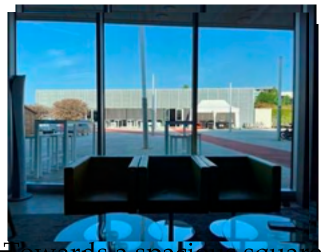
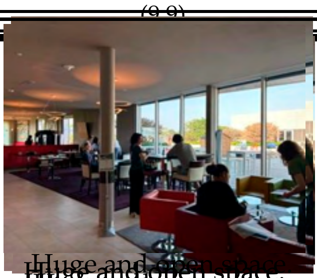
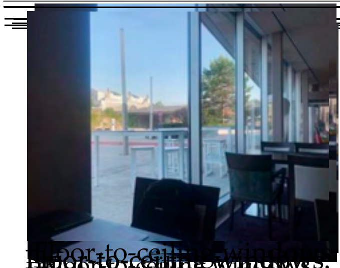
3.5. Analyses of Photos Taken by the Participants

At each room/location, participants took four–nine photos showing the outside environment interior and photos of the view out, Table 10. Due to the short distance between the participants' sitting places (except for location 3), many of the photos were very similar. The analysis was conducted considering all the photos; still, only a few are included from each location. For brevity, the analyses of the images from locations 2, 3 and 4 are to be found in Supplementary Data.

Table 10. Table presenting photos taken by participants at location/Room 1. The numbers in brackets refer to the specific participant who took a photo.

ROOM 1—Starling Hotel Lobby			
VIEW FROM INSIDE TO OUTSIDE (4,3)	DIRECT VIEW (4,3)	INTERIOR SPACE, SITUATION (9,9)	ENVIRONMENT (6,2)

Table 10. Table presenting photos taken by participants at location/Room 1. The numbers in brackets refer to the specific participant who took a photo.

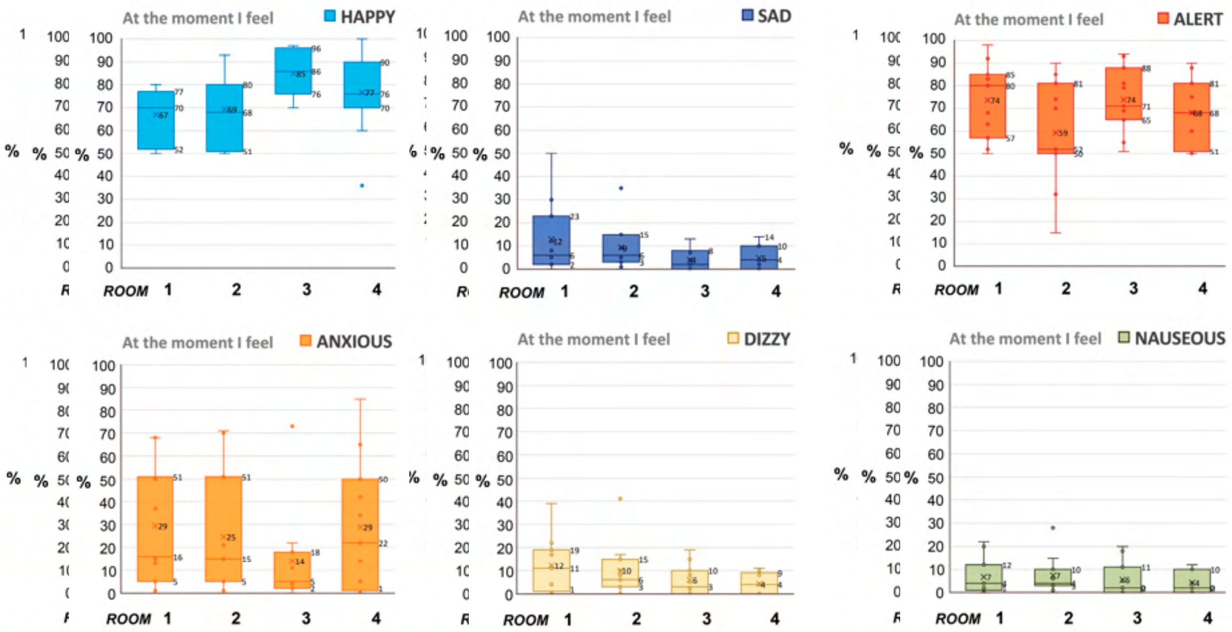
ROOM 1—Starling Hotel Lobby			
VIEW FROM INSIDE TO OUTSIDE (4,3)	DIRECT VIEW (4,3)	INTERIOR SPACE, SITUATION (9,9)	ENVIRONMENT (6,2)
 Towards a spacious square, opposite a low, elongated building.	 The elongated building opposite, as well as trees and various materials, limit the view into the distance.	 Huge and open space. Rows of tables along the window front. You sit relatively close to the window front with a direct outside view.	 An outdoor space in which one moves around, passing through, and for special occasions. It is also used as a place to stay.
 Floor-to-ceiling windows. The frame construction of the windows creates a boundary between the inside and outside.	 Furniture outside the window front (bar tables) forms a barrier to the direct view.	 The connection to the outside is possible from anywhere in the room.	 An open, spacious square which appears as an enclosed space due to the various boundaries. The view is only lost in the sky.
	Exterior aesthetics: mixed, not very well organised, moderate design.	Interior aesthetics: moderate design, furniture and materials do not harmonise.	
Main colours: blue, green, grey Other colours: medium brown, red	Main colours: blue, grey Other colours: brown, green, red	Main colours: beige, grey Other colours: white, red	Main colours: blue, grey, green Other colours: white, red

3.6. Psychological and Environmental Comfort

The responses per item of the psychological (Q20.) and the environmental comfort questions (Q21.) for each of the four evaluated rooms are shown in box and whisker plots with scores tables at the bottom of each plot within Table 11—Q20 items and Table 11—Q21 items.

Results for the Psychological Comfort item “HAPPY” showed quite high scores across rooms but with a significant difference between rooms with the lowest score for the Hotel Lobby of 67.0 (11.3) and the highest score for the Café with 84.9 (9.9) (t = 5.1, p = 0.004). For the item “SAD”, the Café had the lowest score with 3.8 (4.5) and the Hotel Lobby a significantly higher score of 12.8 (15.3) (t = 2.3, p = 0.04). For the item “ALERT,” scores were generally higher with the lowest score from the Hotel Room with 59.3 (24.2) and a significantly higher score from the Café with 73.8 (14.3) (t = 2.2, p = 0.03). For the item “ANXIOUS”, scores were low-to-moderate with the lowest score from the Café with 14.0 (20.8) and a significantly higher score from the Hotel Lobby with 29.5 (26.2) (t = 2.4, p = 0.04). The scores on the items “DIZZY” and “NAUSEOUS” were low and without much difference between rooms. See Table 12.

Table 11. O20—Items Happy, Sad, Alert, Anxious, Dizzy, Nauseous (N = 11). Rooms 1, 2, 3, and 4.

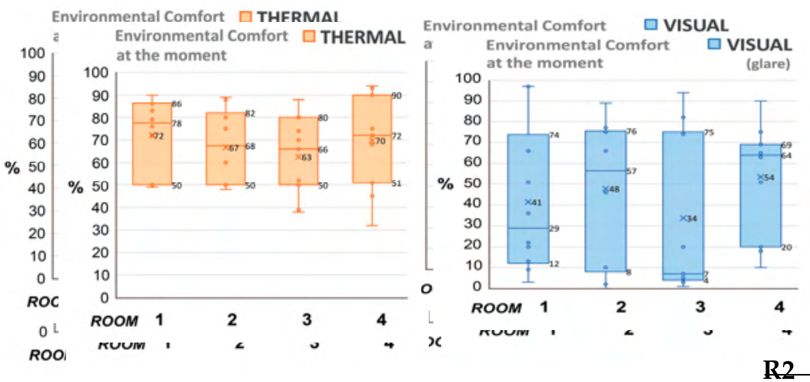


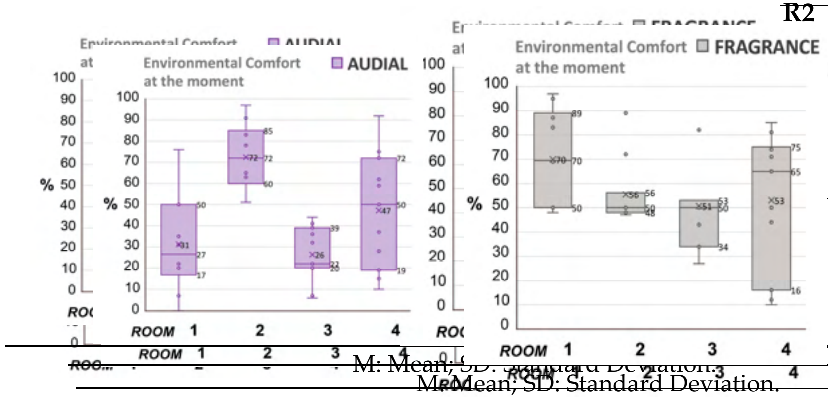
Psychological Comfort	R1		R2		R3		R4	
	M	SD	M	SD	M	SD	M	SD
Happy	67.0	11.3	69.4	15.7	84.9	9.9	76.6	17.7
Sad	12.8	15.5	9.4	9.9	3.8	4.5	4.7	4.7
Alert	73.5	16.4	59.3	23.2	73.8	14.5	68.1	14.8
Anxious	29.5	26.2	24.6	26.6	14.0	20.8	28.9	29.0
Dizzy	12.3	12.0	9.8	11.7	5.9	6.4	4.3	4.5
Nauseous	6.7	7.8	7.4	8.1	5.5	7.4	4.3	4.6

M: Mean, SD: Standard Deviation.

The environmental comfort item “THERMAL” was rated quite high across all rooms with a range from 62.5 to 72.2, and thus without much difference between rooms. Rooms 1, 2, and 3 were indoor rooms with temperature control, and although Room 4 was a semi-external space, it was covered and open on two of the external enclosures, with some natural ventilation mainly coming from the openings facing Lake Leman. The ratings on the item “AUDIAL” was much lower, in general, but differed significantly between rooms with the lowest being 26.4 (13.1) for the Café (the largest of the four rooms) and the highest a score of 72.4 (15.8) for the Hotel Room (the smallest of the four rooms), (t = 8.2, $p < 0.0001$). The item “VISUAL (glare)” was rated low-to-moderate and with little difference between rooms with a range from 33.7 to 53.5. Lastly, the item “FRAGRANCE” had moderate scores showing some differences between rooms with the lowest score in the Café of 50.6 (17.9) and the highest in the Hotel Lobby with 69.9 (19.7). See Table 12.

Table 12. Q21—Thermal Comfort, Audial Comfort, Visual (Glare), and Fragrance Comfort (N = 11). Rooms 1, 2, 3, and 4.



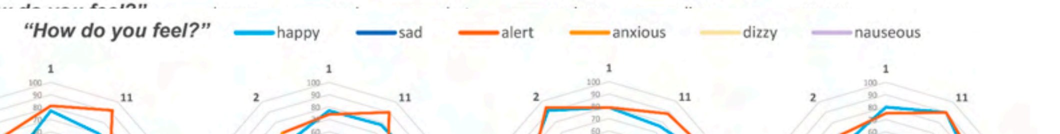


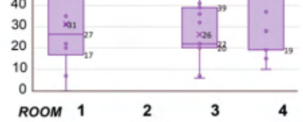
		Environmental Comfort			
		THERMAL	AUDIAL	VISUAL	FRAGRANCEW
R1	M	72.2	31.2	41.4	69.9
	SD	16.4	22.6	35.1	19.7
R2	M	66.7	72.4	47.8	55.5
	SD	16.6	15.8	32.9	13.8
R3	M	62.5	26.4	33.7	50.6
	SD	17.4	13.1	38.3	17.9
R4	M	69.8	47.2	53.5	53.0
	SD	20.0	27.3	26.0	28.6

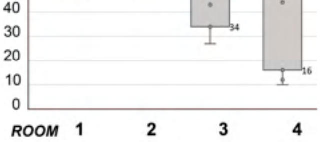
M: Mean; SD: Standard Deviation.

In general, there are moderate-to-large inter-individual differences for all items, as seen from the interquartile ranges and min–max range in the box and whisker plots. Especially large inter-individual differences are seen in the items “Anxious”, “Audial” and even larger in the “Visual” and “Fragrance” items.

The results from the psychological comfort and environmental comfort questions are also presented in spider plots for each of the evaluated rooms depicting individual scores from the participants—Figure 10. They show inter-individual differences, which are not captured with the box plot pr. room.







R4	M	69.8	47.2	53.5	53.0
	SD	20.0	27.3	26.0	28.6

M: Mean; SD: Standard Deviation.

In general, there are moderate-to-large inter-individual differences for all items, as seen from the interquartile ranges and min–max range in the box and whisker plots. Especially large inter-individual differences are seen in the items "Anxious", "Audial" and even larger in the "Visual" and "Fragrance" items.

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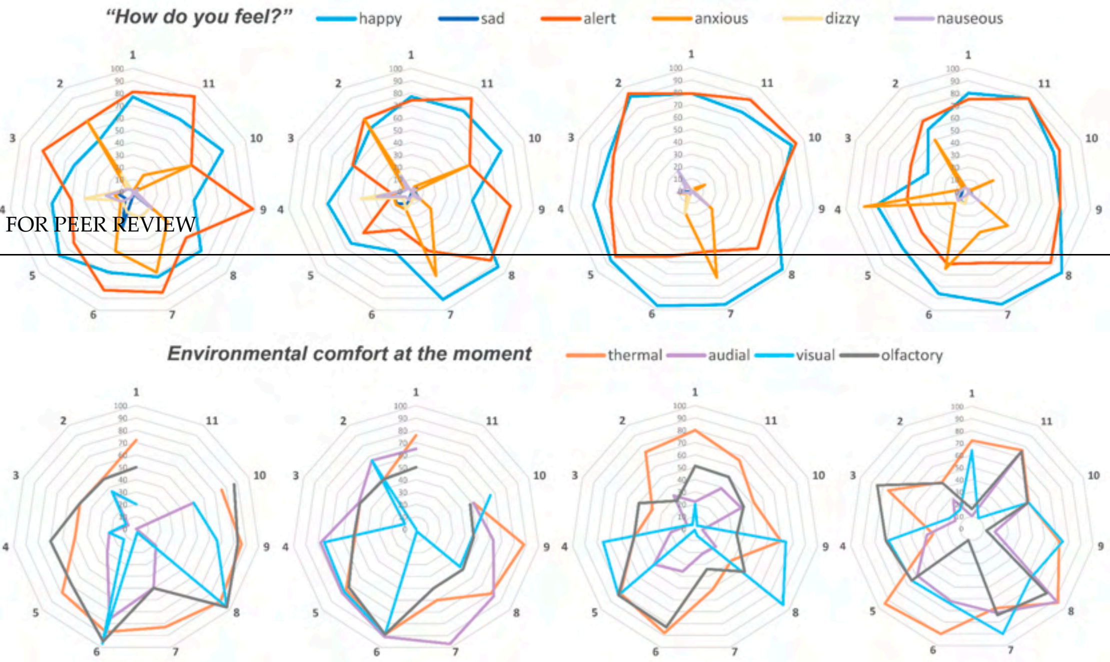

Figure 10. Q20. Psychological Comfort—Participants' Individual Scores and Q21. Environmental Comfort—Participants' Individual Scores for Rooms 1, 2, 3, and 4. The data from Participant 11 is missing for two of environmental comfort questions, therefore the 'spider' plots have open lines.

In summary, large differences were found between rooms for the psychological items and less marked differences for the environmental comfort items and with large inter-individual differences for most items.

4. Discussion

The results of the window view assessment conducted using different methods are similar. Still, they differ in the type of collected information complementing each other. The quantitative method gives precise numerical answers. The Motorway Café was appreciated the most, followed closely by the view from the Lake Restaurant. The views from the Hotel Lobby and the Hotel Room were both on the middle of a scale. The Lobby scored lowest. The quantitative method also shows which attributes of the respective views were appreciated to which degree. Still, to better understand why participants liked or disliked the views, the qualitative evaluation is recommended. It gives participants the possibility to express their thoughts and feelings using many more words and words not included in the quantitative part. The photos enable the easy and detailed visual registration of the visual environment (indoor–outdoor) and the view. The freehand drawings, especially with numerical scores, enable the assessment of the view elements with exceptional precision. Daylight measurements and simulations, on the other side, help to understand the light distribution and Daylight Factor in the room, which is closely linked to the appearance of the room. Interestingly, there is a connection between the perceived quality of the view and the room, as was also observed in the study of views and rooms in the Trondheim workshop, which deserves more research. Finally, the VAS part of the study gave answers about psychological and environmental comfort of the participants. Both comfort types are essential to obtaining reliable responses from evaluators.

In this chapter the methods tested both in Trondheim and Lausanne are considered. The methods from Trondheim not applied in Lausanne are exemplified in the Supplemenwhich deserves more research. Finally, the VAS part of the study gave answers about psychological and environmental comfort of the participants. Both comfort types are essential to obtaining reliable responses from evaluators.

In this chapter the methods tested both in Trondheim and Lausanne are considered. The methods from Trondheim not applied in Lausanne are exemplified in the Supplementary Data.

4.1. Time

The time spent at the location during the assessment is valuable due to participants' vulnerability to fatigue and unpredictable weather conditions; access to the space is often time limited. In Table 13, we show the time spent on-site for each method and the need for preparation and the work needed after the visit.

Table 13. Tasks and time spent before, during and after the visit, and needed equipment.

Method	Preparation	Time During the Visit/Participant	After Visit	Equipment
Light measurements vertical and horizontal illuminance	Calibration of luxmeters	2–3 min. for measurements and noticing the results	Collecting the data is easy and time-effective	luxmeters
Daylight simulation of the room	Collect drawings of the room, otherwise prepare sketch drawings of the room, especially plan, vertical section, and window wall drawings	Taking measurements and noticing dimensions on the sketch drawing may take 10–30 min depending on the complexity of the room.	Creation of a digital model of the room and performing the simulations	Laser meter Paper and pen NCS colour picker for reflectance measurement Simulation programme, e.g., Velux Visualizer
Quantitative evaluation in	Prepare paper copy of the survey for each participant	2–3 min	Statistical analysis and visualisation of results may be time consuming depending on the skills of the researcher and digital tools	Pen and survey paper
Qualitative evaluation—words	Prepare paper copy of the survey for each participant	3–5 min	Statistical analysis and visualisation of results may be time consuming, depending on the skills of the researcher and digital tools	Pen and survey paper
Hand drawing of the room plan showing sitting place and the main view direction	Very short, assure blank paper and drawing tools	2–3 min.	Short time for collection the information about sitting places and view directions	Pen and blank paper
Simple hand sketches as in the Trondheim workshop, one in black and one in colours	Very short, assure blank paper, drawing pen and crayons in most colours, for all participants	10–15 min	Analysis of the drawings takes much time(hours) and leaves uncertainties	Paper, pen, or pencil and crayons

Table 13. *Cont.*

Method	Preparation	Time During the Visit/Participant	After Visit	Equipment
Hand drawings on tracing paper laid over photos taken in advance, as in workshop 2 + numerical assessment (Likert 1–7) of the most liked/disliked elements	Long preparation time, as one person has to visit the room in advance to take close to the window photos and print them in A4 format on the paper	5–10 min	Short time, easy to understand and analyse the answers. Results may be presented in heat maps	Stiff “table”, printed photos, tracing paper and a black pen
Taking photos with the cell phone	Very short, assure all have cell phones	2–5 min.	Easy to gather visual information about the content of the view.	Cell phone, charged
VAS for emotional tone	As above	1 min	Processing and visualisation of data takes time	Pen and survey paper
VAS for comfort	As above	1 min	Processing and visualisation of data takes time	As above

4.2. Overlap of the Methods

Few of the methods deliver similar information, e.g., view elements (e.g., a tall tree) may appear in hand drawings, on photos and in the form of words answering qualitative questions. Still, the word “tree” may not convey the characteristics of the tree, e.g., form, size, richness of foliage, or its size and location in relation to other view elements. If such information is valuable, a visual registration with photos or drawings is necessary.

The words used as attributes in quantitative evaluation, e.g., open, ordered, playful, etc. may also appear in the qualitative evaluation.

Colours in the view appear on photos, may be shown with crayons on the coloured drawings or described with words answering Q10 “List the most liked/disliked colours in the view”. Photos may show the close to perceived colours in the present illumination, the drawings show nominal colours that the participants believe may represent the colour pigments imbued in materials and paintings, while when answering the Q10 with words, participants can express their attitude to the colour. The words describing the colours cannot be translated directly to colour systems, as hundreds of nuances exist for a single word, e.g., green.

The information about the lightness of the room may be included in daylight simulation, quantitative, and qualitative evaluations. The light distribution (even or not) also overlaps with the “uniform—varied” attribute. Similarly, daylight measurements may give information about lightness, light distribution, and even the risk of glare, which may appear in word form in response to open-ended questions in the qualitative evaluation.

A certain degree of overlap can confirm the consistency of answers given by a person. On the other hand, too much overlap may be perceived as unnecessary use of time. Figure 11 shows the potential overlaps and Table 14 specifies recommendations for using each method. It has to be underscored that both VAS used in the study have no direct overlap regarding the assessment of the view or the room but are useful for registration of the condition and enhancement of the positive attitude and responsiveness of participants.

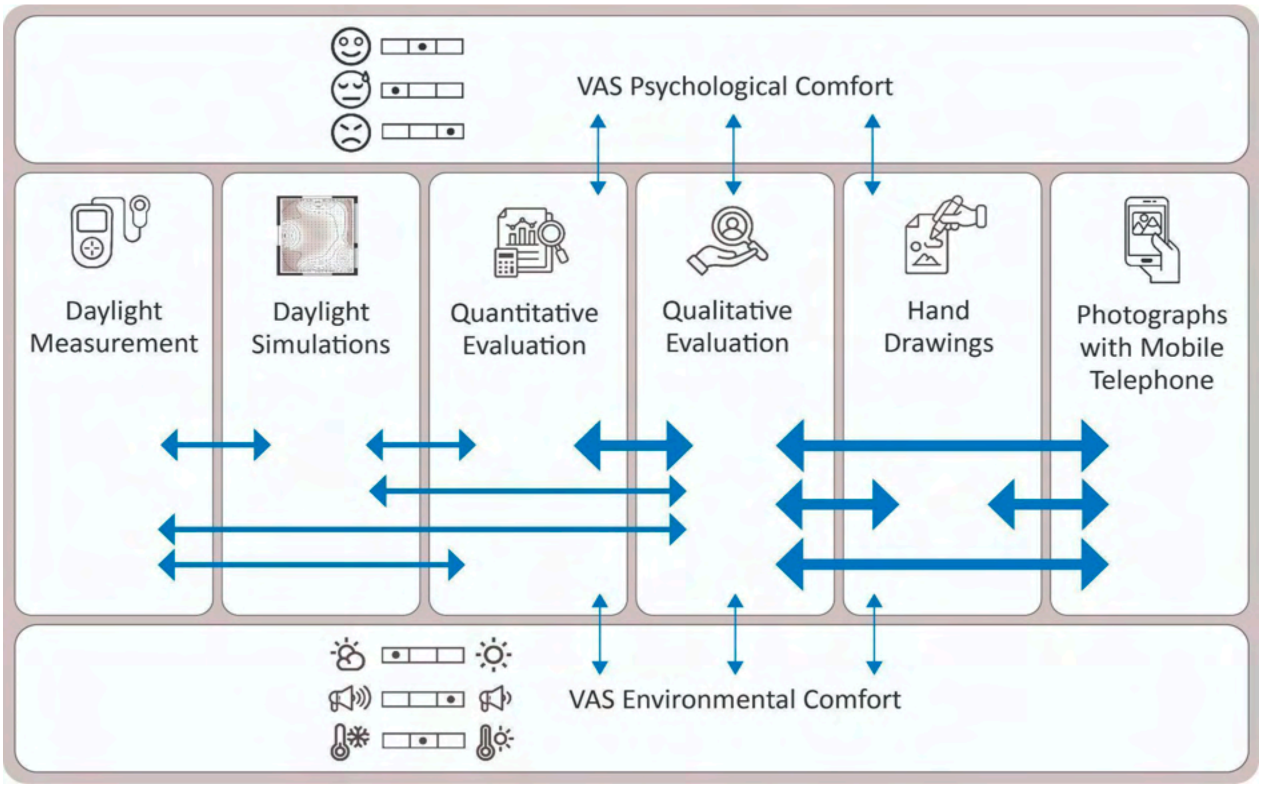

Figure 11. Overlap between Methods.

Figure 11. Overlap between Methods.

Table 14. Recommendation for use of the methods.

	Type of Collected Information	Character and Complexity of the Room and Windows	Type and Complexity of the View	Workshop Participants—Evaluators
Light measurements	Vertical/Horizontal Illuminance at few points chosen with a purpose	Especially in rooms with uneven light distribution, e.g., windows in different walls and/or roof	N/A	Professionals (lighting)
Daylighting simulations	Light level and light distribution in the room, may be performed for one time point or for a year	In rooms with daylight obstructions (balconies, protruding roof), multiple windows or advanced glazings	N/A	Professionals (lighting)
Quantitative assessment	Numerical grading of view attributes chosen in advance by the workshop leaders supported by descriptive statistics or LME method	In all rooms. In simple/standard rooms where the attributes are highly adequate, the quantitative assessment may be the only method used	For all views, but in the case of uniform views with few view elements, like a rural open landscape, the quantitative assessment may be the only one used	Mainly all, but the meaning of attributes/words should be well explained in advance, orally or in the written form

4.3. Recommendations for Use

Some recommendations for the application of the assessment methods tested in both Trondheim and Lausanne are presented in Tables 14 and 15. It should be mentioned that the methods refer to assessment of the window view from existing buildings. Onsite assessments are valuable for many reasons. They provide the best conditions for research on the quality of the view from the window, in general. Many interesting parameters, such as the time during the year (e.g., presence of snow, leaves, etc.) and the day (illumination by sunlight) or idiosyncratic characteristics of observers, can be studied by revisiting the room. Such studies are needed to extend the knowledge about importance of view assessment parameters and to extend view recommendations in current standards and codes.

In teaching, we should not underestimate the individual experience that each student can gain during an in-situ assessment. It can become an impulse for discussion between students and teachers about the visibility of various view elements, such as the horizon, landmarks, green areas, people etc. depending on the position in the room, and/or the use of sun shading devices. It will be possible to check the importance of immediate visibility of certain view elements.

In urban planning and architectural design, the assessment of the window views should be carried out from existing buildings before decisions are made about future urban development.

Finally, in new buildings the post-occupancy evaluation would reveal whether the previous promises or expectations have been met.

Table 14. Recommendation for use of the methods.

	Type of Collected Information	Character and Complexity of the Room and Windows	Type and Complexity of the View	Workshop Participants—Evaluators
t measurements	Vertical/Horizontal Illuminance at few points chosen with a	Especially in rooms with uneven light distribution, e.g.,	N/A	Professionals (lighting)

Table 14. *Cont.*

	Type of Collected Information	Character and Complexity of the Room and Windows	Type and Complexity of the View	Workshop Participants—Evaluators
Qualitative assessment	Words used spontaneously at the location which may be arranged in clouds and/or Positive Sentiment Word Frequency	Especially in complex rooms with unusual use of forms, decorations and colours, where the use of attributes may not give enough information about the character of the room	For complex views with many different elements, like the distant urban view, the qualitative assessment is very much recommended	Mainly all, It is advocated to use simple words, avoid sentences or phrases, which will simplify the analysis of the collected data
Hand drawing of the room plan showing sitting place and the main view direction	Preference for the sitting place in the room and for preferred view direction	Recommended for all rooms and studies where information about preferences for sitting places are important	N/A	All. For participants with a limited drawing training a plan-background is recommended
Hand drawing (black) of the view with numerical assessment of view elements	View content and precise information about eye-catching view elements and its value for a single participant	N/A	Recommended for all view types	All who wish a deep understanding of the view. For participants with a limited drawing training a photo-background is recommended
Hand drawings of the view with colours	Dominating colours in the view	N/A	Preferable for views with many colours or surprising colour choices and colour compositions	Mainly professionals, wide spectrum of crayon colours should be accessible
Taking photos with mobile phones	The character of the room, view content and view clarity, colours.	Especially in rooms with narrow or small windows that restrict the access to the view	Complex view content, suspicion of reduced view clarity	For all, to avoid distortions, it is advocated to use fully automatic settings on phone cameras—no HDR or zoom
VAS for emotional tone	Emotional data	Where some participants may be tired/sick or not motivated for participation		All
VAS for comfort	Comfort data	When there is a risk that some comfort types may not be achieved		All

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Table 15. Recommendation for use of the tested window view assessment methods depending on the application. Strongly recommended "++", recommended "+", optional "o", not recommended "-".

	Research	Teaching	Urban design	Architectural Design	Post-occupancy
Light measurements	++	+	-	+	o
Daylighting simulations	++	+	o	+	o
Quantitative assessment	++	+	++	++	+
Qualitative assessment	++	++	++	++	+
Hand drawing (room plan, sitting positions)	+	+	o	+	o
Hand drawing (numerical assessment)	+	++	+	+	o
Hand drawing (view with colours)	o	++	o	+	o
Taking photos	+	+	+	+	+
VAS for emotional tone	o	o	o	o	+
VAS for comfort	o	o	o	o	+

In teaching, we should not underestimate the individual experience that each student can gain during an in-situ assessment. It can become an impulse for discussion between students and teachers about the visibility of various view elements, such as the horizon, landmarks, green areas, people etc. depending on the position in the room, and/or the use of sun shading devices. It will be possible to check the importance of immediate visibility of certain view elements.

In urban planning and architectural design, the assessment of the window views should be carried out from existing buildings before decisions are made about future urban development.

Finally, in new buildings the post-occupancy evaluation would reveal whether the previous promises or expectations have been met.

5. Conclusions

The aim of the study was to develop and test assessment methods of window views. Among the tested methods were lux measurements, photography, hand drawings and a questionnaire that included close and open-ended questions for qualitative and quantitative assessment, as well as VAS questionnaire for comfort and for emotional tone. This wide spectre of methods was tested and evaluated by an interdisciplinary group of professionals, members of the Daylight Academy, in various locations.

The paper describes, compares, and recommends the use of the mentioned methods depending on the type and complexity of the view, the character and complexity of the room, the professional background of the evaluators, and the type of collected data. It also discusses the overlap of the results obtained with the different methods and estimates the preparation time, time spent at the location, and amount of work after the visit. Finally, advice regarding use of the methods depending on application (research, teaching, urban design, architectural design, post occupancy validation) is given.

The multi-method assessment was conducted by groups of experts, mainly scientists, who were familiar with the different assessment methods used in research, who contributed to the development of the final version of the survey and were familiar with the vocabulary. This allowed the workshops to be conducted trouble-free, within a limited time and with reliable results. As suggested in Table 15, the methods may be used by different groups of people with different degrees of experience, skills, and knowledge. In that case, special attention should be paid to thoroughly explaining all the conditions, details, and notions. Whether the results would be significantly different after including non-experts is a question for a subsequent study.

Supplementary Materials: The following supporting information can be downloaded at: https://www.mdpi.com/article/10.3390/land13122090/s1.

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References

1. Conrad, A.; Seiwert, M.; Hünken, A.; Quarcoo, D.; Schlaud, M.; Groneberg, D. The German Environmental Survey for Children (GerES IV): Reference Values and Distributions for Time-Location Patterns of German Children. *Int. J. Hyg. Environ. Health* **2013**, *216*, 25–34. [CrossRef] [PubMed]
2. Ko, W.H.; Schiavon, S.; Altomonte, S.; Andersen, M.; Batool, A.; Browning, W.; Burrell, G.; Chamilothori, K.; Chan, Y.-C.; Chinazzo, G.; et al. Window View Quality: Why It Matters and What We Should Do. *LEUKOS* **2022**, *18*, 259–267. [CrossRef]
3. *EN 17037:2018+A1:2021*; Daylight in Buildings. European Committee for Standardization: Hørsholm, Denmark, 2021.
4. Kaplan, R. The Nature of the View from Home: Psychological Benefits. *Environ. Behav.* **2001**, *33*, 507–542. [CrossRef]
5. Kim, J.-J.; Wineman, J. *Are Windows and Views Really Better? A Quantitative Analysis of the Economic and Psychological Value of Views*; The University of Michigan: Ann Arbor, MI, USA, 2005.
6. Koprivec, L.; Zbašnik-Senegačnik, M.; Kristl, Ž. A Study of Restorative Potential in Window Views Adopting Kaplan’s Attention Restoration Theory and Urban Visual Preferences Defined by Lynch. *J. Archit. Urban.* **2022**, *46*, 148–159. [CrossRef]
7. Li, W.; Samuelson, H. A New Method for Visualizing and Evaluating Views in Architectural Design. *Dev. Built Environ.* **2020**, *1*, 100005. [CrossRef]
8. Masoudinejad, S.; Hartig, T. Window View to the Sky as a Restorative Resource for Residents in Densely Populated Cities. *Environ. Behav.* **2020**, *52*, 401–436. [CrossRef]
9. Tuaycharoen, N.; Tregenza, P.R. View and Discomfort Glare from Windows. *Light. Res. Technol.* **2007**, *39*, 185–200. [CrossRef]
10. Markus, T.A. The Function of Windows—A Reappraisal. *Build. Sci.* **1967**, *2*, 97–121. [CrossRef]
11. Beute, F.; De Kort, Y.A.W. Salutogenic Effects of the Environment: Review of Health Protective Effects of Nature and Daylight. *Appl. Psychol. Health Well-Being* **2014**, *6*, 67–95. [CrossRef]
12. Li, M.; Xue, F.; Yeh, A.G.O.; Lu, W. Classification of Photo-Realistic 3D Window Views in a High-Density City: The Case of Hong Kong. In Proceedings of the 25th International Symposium on Advancement of Construction Management and Real Estate, Wuhan, China, 28–30 November 2020; Lu, X., Zhang, Z., Lu, W., Peng, Y., Eds.; Springer: Singapore, 2021; pp. 1339–1350, ISBN 9789811635861.
13. Batool, A.; Rutherford, P.; McGraw, P.; Ledgeway, T.; Altomonte, S. View Preference in Urban Environments. *Light. Res. Technol.* **2021**, *53*, 613–636. [CrossRef]
14. Kent, M.; Schiavon, S. Evaluation of the Effect of Landscape Distance Seen in Window Views on Visual Satisfaction. *Build. Environ.* **2020**, *183*, 107160. [CrossRef]
15. Hellinga, H. Daylight and View: The Influence of Windows on the Visual Quality of Indoor Spaces. Ph.D. Thesis, Delft University of Technology, Delft, The Netherlands, 2013.

16. Farley, K.M.J.; Veitch, J.A. *A Room with a View: A Review of the Effects of Windows on Work and Well-Being*; National Research Council of Canada: Ottawa, ON, Canada, 2001.
17. Ulrich, R.S. Natural Versus Urban Scenes: Some Psychophysiological Effects. *Environ. Behav.* **1981**, *13*, 523–556. [CrossRef]
18. Grinde, B.; Patil, G.G. Biophilia: Does Visual Contact with Nature Impact on Health and Well-Being? *Int. J. Environ. Res. Public Health* **2009**, *6*, 2332–2343. [CrossRef] [PubMed]
19. Matusiak, B.S. No-Greenery Line and Greenery-View Factor, New Architectural Design Tools. *J. Daylighting* **2020**, *7*, 282–286. [CrossRef]
20. Kaplan, R. The Role of Nature in the Context of the Workplace. *Landsc. Urban Plan.* **1993**, *26*, 193–201. [CrossRef]
21. Boyce, P.R.; Hunter, C.M.; Howlett, O. *The Benefits of Daylight Through Windows*; Rensselaer Polytechnic Institute: Troy, NY, USA, 2003.
22. Ulrich, R.S. View Through a Window May Influence Recovery from Surgery. *Science* **1984**, *224*, 420–421. [CrossRef]
23. Nezamdoost, A.; Modarres Nezhad, M. Vitamin V. Evaluating the Benefits of View Quality in Hospital Patient Rooms Using a Large-Scale Human Factors Study. *Build. Serv. Eng. Res. Technol.* **2020**, *41*, 153–166. [CrossRef]
24. Veitch, J.A.; Galasiu, A.D. *The Physiological and Psychological Effects of Windows, Daylight, and View at Home: Review and Research Agenda*; National Research Council of Canada: Ottawa, ON, Canada, 2012.
25. Heschong, L.; Wright, R.L.; Okura, S. Daylighting Impacts on Human Performance in School. *J. Illum. Eng. Soc.* **2002**, *31*, 101–114. [CrossRef]
26. Heschong, L. *Daylighting in Schools an Investigation into the Relationship Between Daylighting and Human Performance Condensed Report*; Pacific Gas and Electric Company: Oakland, CA, USA, 1999. [CrossRef]
27. Jamrozik, A.; Clements, N.; Hasan, S.S.; Zhao, J.; Zhang, R.; Campanella, C.; Loftness, V.; Porter, P.; Ly, S.; Wang, S.; et al. Access to Daylight and View in an Office Improves Cognitive Performance and Satisfaction and Reduces Eyestrain: A Controlled Crossover Study. *Build. Environ.* **2019**, *165*, 106379. [CrossRef]
28. Boubekri, M.; Lee, J.; MacNaughton, P.; Woo, M.; Schuyler, L.; Tinianov, B.; Satish, U. The Impact of Optimized Daylight and Views on the Sleep Duration and Cognitive Performance of Office Workers. *Int. J. Environ. Res. Public Health* **2020**, *17*, 3219. [CrossRef]
29. Ko, W.H.; Schiavon, S.; Zhang, H.; Graham, L.T.; Brager, G.; Mauss, I.; Lin, Y.-W. The Impact of a View from a Window on Thermal Comfort, Emotion, and Cognitive Performance. *Build. Environ.* **2020**, *175*, 106779. [CrossRef]
30. van Esch, E.; Minjock, R.; Colarelli, S.M.; Hirsch, S. Office Window Views: View Features Trump Nature in Predicting Employee Well-Being. *J. Environ. Psychol.* **2019**, *64*, 56–64. [CrossRef]
31. Volf, C.; Bueno, B.; Edwards, P.; Hobday, R.; Mäder, S.; Matusiak, B.S.; Wulff, K.; Osterhaus, W.; Manoli, G.; Della Giustina, C.; et al. Why Daylight Should Be a Priority for Urban Planning. *J. Urban Manag.* **2024**, *13*, 175–182. [CrossRef]
32. Littlefair, P. Daylight, Sunlight and Solar Gain in the Urban Environment. *Sol. Energy* **2001**, *70*, 177–185. [CrossRef]
33. Waczynska, M.; Sokol, N.; Martyniuk-Peczek, J. Computational and Experimental Evaluation of View out According to European Standard EN17037. *Build. Environ.* **2021**, *188*, 107414. [CrossRef]
34. Cramer, M. After a Billionaire Designed a Dorm, an Architect Resigned in Protest. *The New York Times*, 30 October 2021.
35. Conroy, J.O. A Torture Experiment': Plan for Almost Windowless Student Megadorm Raises Alarm. *The Guardian*, 4 November 2021.
36. Maruf, R. Here's What It's like to Live in One of Charlie Munger's Windowless Dorms. *CNN Business*, 3 November 2021.
37. Hayden, T. Architect Resigns in Protest over UCSB Mega-Dorm. *The Santa Barbara Independent*, 28 October 2021.
38. Swedberg, R. Exploratory Research. In *The Production of Knowledge: Enhancing Progress in Social Science*; Elman, C., Mahoney, J., Gerring, J., Eds.; Strategies for Social Inquiry; Cambridge University Press: Cambridge, UK, 2020; pp. 17–41. ISBN 978-1-108-48677-4.
39. Matusiak, B.; Sarey Khanie, M.; Moscoso, C.; Pálsdóttir, A.M.; Appelt, S.; Hemauer, C.; Martiny, K.; Woznicka Miskowiak, K.; Lindegaard, I.A.; Ysbæk-Nielsen, A.T.; et al. View Quality Assessments: A Pilot Study of Field Methods. *Leukos*, 2023; *under revision, submitted for publication in December 2023 for Leukos*.
40. Matusiak, B.; Sarey Khanie, M.; Moscoso, C.; Pálsdóttir, A.M.; Appelt, S.; Volf, C. View Quality Assessments: A Pilot Study of Field Methods. 2024 ISBN 978-82-7551-254-1. Available online: https://daylight.academy/wp-content/uploads/2024/06/135023_Innmat_00_0_Roomwithaviewfinalcopy.pdf (accessed on 1 June 2024).
41. Stebbins, R. *Exploratory Research in the Social Sciences*; SAGE Publications, Inc.: Thousand Oaks, CA, USA, 2001; ISBN 978-0-7619-2399-2.
42. Gries, K.; Berry, P.; Harrington, M.; Crescioni, M.; Patel, M.; Rudell, K.; Safikhani, S.; Pease, S.; Vernon, M. Literature Review to Assemble the Evidence for Response Scales Used in Patient-Reported Outcome Measures. *J. Patient-Rep. Outcomes* **2018**, *2*, 41. [CrossRef]
43. Labayrade, R.; Jensen, H.W.; Jensen, C. Validation of Velux Daylight Visualizer 2 against CIE 171: 2006 Test Cases. In Proceedings of the Building Simulation 2009: 11th Conference of IBPSA, Glasgow, UK, 27–30 July 2009; IBPSA: Rapid City, SD, USA, 2009; Volume 11.
44. Møller, J.K.; Schweiker, M.; Andersen, R.K.; Gunay, B.; Yilmaz, S.; Barthelmes, V.M.; Madsen, H.; Raton, B. *Statistical Modeling of Occupant Behavior*; CRC Press: Boca Raton, FL, USA; Taylor & Francis Group: Abingdon, UK; Chapman and Hall: Boca Raton, FL, USA, 2024; ISBN 978-1-032-33460-8.

45. Sarey Khanie, M.; Andersen, R.K. Characterisation of View Relative to Solar-Control Systems. *Build. Environ.* **2024**, *265*, 112004. [CrossRef]
46. Haldi, F.; Calì, D.; Andersen, R.K.; Wesseling, M.; Müller, D. Modelling Diversity in Building Occupant Behaviour: A Novel Statistical Approach. *J. Build. Perform. Simul.* **2017**, *10*, 527–544. [CrossRef]
47. Baayen, R.H.; Davidson, D.J.; Bates, D.M. Mixed-Effects Modeling with Crossed Random Effects for Subjects and Items. *J. Mem. Lang.* **2008**, *59*, 390–412. [CrossRef]
48. Barr, D.J.; Levy, R.; Scheepers, C.; Tily, H.J. Random Effects Structure for Confirmatory Hypothesis Testing: Keep It Maximal. *J. Mem. Lang.* **2013**, *68*, 255–278. [CrossRef] [PubMed]
49. Bates, D.; Mächler, M.; Bolker, B.; Walker, S. Fitting Linear Mixed-Effects Models Using Lme4. *J. Stat. Softw.* **2015**, *67*, 1–48. [CrossRef]
50. Mirza, L. Windowscapes: A Study of Landscape Preferences in an Urban Situation. Doctoral Thesis, University of Auckland, Auckland, New Zealand, 2015.
51. Mirza, L.; Byrd, H. Towards Appreciating the Importance of Windowscapes: Evaluation and Suggestion for Improvement of New Zealand Building Code. *J. Contemp. Urban Aff.* **2018**, *2*, 55–65. [CrossRef]