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Article

The View from the Window—Assessment by the "View Owner" and the "View Observers"

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Abstract

Access to an unobstructed view of the outside through a window has been shown to play a critical role in supporting occupants' visual comfort, psychological well-being, and cognitive performance, as it provides environmental connection and reduces stress. The aim of this study was to investigate how window view assessment ratings differ between "view owners" (individuals with long-term experience of the view) and "view observers" (those who view photos of a view). Findings from 12 in-person workshops on window view assessment are presented. The participants were 207 students from six European universities. Each participant presented their window view as "view owner", while the remining students rated it on the 1–9 Likert scale as "view observers". The ratings given by the "view owners" (prior to workshops) were significantly higher than those given by the "view observers", showing the influence of familiarity and long-term experience. The additional contextual information about the interior and narrative descriptions provided orally by the "view owners" had a small positive effect. Night views were rated lower than day views by the "view observers". The findings highlight the impact of long-term experience on the assessment of the window view and encourage the inclusion of night-view in recommendations.

Keywords: view; window; view out of the window; window view assessment; night view; day view; images of window view; photos of window view

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1. Introduction

Windows are typically defined as daylight openings located on a vertical or near-vertical surface of a room's envelope [1]. Their primary functions include admitting daylight and providing occupants with a view to the outside. Among the various benefits and psychological functions of windows, the provision of a view is considered the most valued by building occupants [2,3]. The view out of the window, even short time, may

have high value, as it enables beneficial and often very much needed micro-breaks for the brain [4]. Moreover, a strong connection with views of nature and reaction in the brain has been shown in the literature: for instance, Magsamen et al. [5,6] developed a theoretical and translational framework that treats nature as an aesthetic stimulus capable of calming the brain-body system (reward circuit, amygdala downregulation, parasympathetic shifts). The brain calming effects due to a connection with natural settings were also proven by Bratman et al. [7], who provided experimental evidence that brief exposure to nature reduces self-stress, repetitive thoughts, blood pressure, and neural activity. Jo et al. [8] carried out a systematic review of the physiological benefits concerned with viewing nature, showing that viewing natural scenes (photos, VR, real plants) reliably produces more relaxed autonomic and cerebral responses vs. controls (reduced sympathetic activity, changes in EEG, and autonomic markers). In a study dated 2010, Veitch and Galasiu [9] stressed the importance of views of outdoors as a contributor to well-being, particularly if it is a nature or an attractive view, also highlighting that separation from the sky and the outside world is to be avoided, which was also confirmed by Zhang et al. [10]. Similarly, Sharam et al. [11] carried out an experimental study that showed the link between window views of greenery and mood restoration and mitigated adverse outcomes of urban confinement (cognitive and affective measures; implications for the built environment). A connection with the outside becomes particularly crucial in highly dense cities, where the view to greenery settings is limited: in this regard, Masoudinejad and Hartig [12] examined how sky visibility and other view contents influence the perceived restorative potential of urban window views. They showed that both greater sky exposure and the presence of greenery (e.g., window boxes) had direct positive effects on perceived restoration, being the most preferred. Ground-level scenes with people and street trees were rated comparably to some sky views, but to a lesser extent. In contrast, other studies showed that limited or fully façade-dominated views increase intolerance and perceptions of oppressiveness and annoyance, while reducing the perceived restorative quality of indoor environments [13–15].

On the one hand, even though the positive psychological-physiological effects of nature are known, the connection with the view outside through the window, especially towards the natural surroundings, is an aspect that is usually not addressed in architectural design (particularly in window design). The availability of unobstructed window views has been shown to be a key component of indoor environmental quality, as it supports visual comfort, promotes psychological recover, and enhances cognitive functioning; for instance, Ko et al. [16] demonstrated that occupants with access to outdoor views reported greater thermal comfort, more positive emotional states, and improved working memory, while Woo et al. [17] found that offices with better daylight and views were associated with reduced eyestrain, improved mood, and higher satisfaction, and a recent meta-analysis by Soga et al. [18] confirmed that even passive exposure to natural views through windows can reduce stress and contribute to overall well-being. Mirza and Byrd [19] sustained a nature-benefit hypothesis to support the inclusion of view access and view quality requirements in the New Zealand Building Code. Reviewing studies on view preferences, they found that distant views were generally favored over both nearby greenery and built views, while nearby greenery was preferred to urban scenes. Notably, even limited views of the sea increased acceptability across all view types.

In line with scientific evidence, the quality of window views has been incorporated as an independent criterion in major green building certification systems such as LEED [20] or WELL [21], as well as in the recent European Standard EN 17037:2018 “Daylight in Buildings” [22]. This certifies the importance attributed to views to the outside; nonetheless, current evaluation approaches are not standardized and do not reliably predict how occupants will perceive specific view motifs. To numerically characterize perceived view quality,

several methodologies have been introduced: these approaches vary in how they define and assess view motifs, for instance by categorizing different motif segments (landscape, sky, terrain, buildings, nature settings) or minimum view angles from a given position inside a room. This confirms the key role played by window views to the outside in architectural design and the lack of normative tools or building regulations in this regard. Which is particularly surprising if one considers the potential economic value of aspects such as panoramic views that add value in price listing in the real estate market of residential units or work environments [23–25] and are mentioned among the main drivers in buying a new home or appreciating the home where people live [26].

1.1. Window View in the Literature

In modern societies, people spend a substantial portion of their lives indoors (home, work, school), often exceeding 90% of their time within built environments [27]. This prolonged indoor occupancy highlights the critical need for daylight and quality window views to support mental and physical well-being [28]. Daylight exposure and visual connections to outdoor environments have been shown to enhance mood, productivity, and recovery from stress or surgery [29–32]. Such influences are particularly vital in urban contexts, where natural settings may be limited, and dynamic views can play a crucial role in compensating for the lack of direct access to nature [33–35].

Research on window views has primarily focused on the restorative and aesthetic benefits provided by access to natural and green spaces. Studies by Kaplan [30,36] and Ulrich [31,37] established the psychological and physiological advantages of exposure to nature through views, emphasizing stress reduction, improved focus, and faster recovery times, also in healthcare [38,39]. Subsequent studies have expanded on these findings, exploring visual access to nature as a critical factor in architectural design and urban planning [40,41]. Menga and Wang [42] carried out a systematic review of quantitative studies on window views and health, with attention to urban contexts and measurement approaches.

However, much of the existing literature treats window views as static visual elements, evaluated based on objective criteria such as greenery coverage, openness, and aesthetic appeal [43,44].

Recent studies have further emphasized the dynamic qualities of views and their impact. Vasquez et al. [45] highlighted the role of daylight variability and window features in enhancing visual comfort, productivity, and well-being, showing how lighting and view quality influence cognitive and emotional responses. Similarly, other studies highlighted how tolerance to glare is increased in the presence of natural sceneries [46], presence and distance to urban and man-made elements in the view [16], presence of sky in one's visual field [47]. Aries et al. [48] showed that the aesthetical quality of a view has an impact not only on the discomfort perceived, but also on the well-being after work. In another study, Aries et al. [49] also underscored the health benefits of daylight exposure, associated with reduced stress and improved mood, while noting the gaps in empirical evidence regarding long-term impacts. Rodriguez et al. [50,51] proposed systematic methods to capture and assess dynamic attributes in window views, demonstrating how variations in light and environmental changes influence occupants' psychological states and preferences. They explored dynamic attributes in views showing that daylight variations enhance recovery and preference responses through immersive virtual reality experiments, thus highlighting the importance of integrating dynamic visual factors in future assessments [32,49]. According to Domjan et al. [52], dynamic views, particularly the presence of sunlight, significantly enhance the perceived quality of window views. Sunny conditions improve psychological state, enhancing a positive physiological response, as shown by higher frontal alpha asymmetry (FAA). The study incorporated sunlight as a dynamic factor in its prediction

model, demonstrating that sunny views are rated significantly higher than cloudy ones. This highlights the critical role of dynamic weather conditions in influencing window view quality. Some studies also demonstrated that views to the outside became significantly more valued during and after the lockdown, as a means of visual and social reconnection. The study by Batool et al. [33] addressed view preferences in urban settings, identifying as key drivers of preference both dynamic factors, such as human activity in motion (especially in the context of forced home confinements), and static aspects, such as visual complexity of a view and the architectural features it contains. Their findings also emphasized the need for holistic methodologies to evaluate the complexity and the dynamicity of views, particularly in dense urban contexts where natural elements are less prevalent.

Despite these insights, prior research has often failed to differentiate between individuals with long-term, personal connections to a view and those who assess it without prior familiarity. Most studies assume uniformity in perception, overlooking the role of experiential and emotional factors. This lack of differentiation between long-term view observers and other observers exposed shortly to view images has limited the understanding of how context, familiarity, and lived experiences shape evaluations of views.

1.2. Night Views Studies

The multifaceted experience of nighttime outdoor lighting and urban lighting exposure in cities, especially in the context of well-being, sleep quality, and safety, has been explored by many [53–55]. Research on nighttime window views is still sparse. However, some researchers have addressed the issue of nighttime window view quality and its impact on user satisfaction. Gerhardsson and Laike [56,57] conducted in-depth qualitative interviews in Swedish multi-dwelling buildings and found that long-term residents associate windows not only with daylight and views, but also with critical night-time functions such as maintaining sleep comfort, controlling obtrusive light from street lighting, and preserving visual privacy. Their findings emphasize that night-time window interactions—such as adjusting blinds or screening for privacy—are highly personalized and context-dependent, often balancing the need for external engagement (e.g., observing passersby or the ambient lighting) with the desire for enclosure. Meanwhile, Fan and Biljecki [58] introduced a novel paradigm for evaluating urban lighting from the street-level perspective using night-time street view imagery. Although not focused on window views per se, their study highlights how urban lighting patterns, visible from windows at night, can be systematically analyzed and predicted, revealing diverse luminance levels and spatial distributions that directly influence indoor perceptions of view quality and lighting comfort.

1.3. Coping with a View

People exposed to undesirable views may experience negative emotions and even distress. When such views persist over long periods, “view owners” often develop coping mechanisms to adapt. “Coping” has been defined as a category of adaptation elicited in individuals by taxing circumstances [59]. Lazarus and Folkman [60] developed a model of psychological stress response in which coping is defined as “constantly changing cognitive and behavioral efforts which are undertaken by an individual in order to deal with demands which are especially challenging”. Coping involves three main elements: the source of stress (stressor), cognitive appraisal (evaluation of the stressor), and coping mechanisms. Coping behaviors and strategies have traditionally been categorized into different approaches, such as problem-focused versus emotion-focused, functional versus dysfunctional, approach versus avoidance, and engagement versus disengagement. For the purpose of this research, the distinction between problem-focused and emotion-focused coping is particularly relevant, as Park et al. [61] suggested that problem-focused strate-

gies are appropriate when the stressor is controllable (e.g., a noise that can be switched off), whereas emotion-focused strategies are more suitable when the stressor appears uncontrollable (e.g., a window view).

Carver [62] classified active coping, instrumental support, and planning as problem-focused strategies, whereas strategies such as acceptance, emotional social support, humor, positive reframing, and religion are categorized as emotion-focused. Furthermore, Nielsen and Knardahl [63] demonstrated that different coping mechanisms are associated with personality traits. From this perspective, the assessment of a window view after prolonged exposure, adaptation, and coping may differ from an initial assessment. For instance, a person who has used acceptance, humor, or positive reframing strategies may rate the view significantly higher than others and even higher than their own initial assessment before coping. The following coping strategies are commonly observed in response to psychological distress: (1) active coping, (2) self-distraction, (3) using instrumental support, (4) planning, (5) using emotional support, (6) positive reframing, (7) humor, (8) religion, (9) acceptance, (10) denial, (11) venting, (12) substance use, (13) self-blame, and (14) behavioral disengagement.

Young people who have recently started their studies and moved into a student dormitory constitute a significant part of the participants in this study. The literature review article by Mukhroni et al. [64] examined 29 journal articles addressing the issue of adjustment of students to life in a student dormitory. Most of the included articles describe successful transitions and adjustments starting from the time when students move to a dormitory in connection with starting a new study in a college. Almost all studies have found that first-year students are less mature emotionally and experience challenges while adjusting emotionally and socially to the demands of a new environment. They may have adjustment problems and experience unwanted stress and psychological problems during the first year on campus [65]. Many studies on the transition to college underscore the importance of the transition period, which is personally dependent. Still, even after the transition period, living in the dormitory seems to be somewhat challenging. In a study including 230 students from the university of Medical Sciences, Iran, the mean scores of physical health and mental health in non-dormitory students were higher than in dormitory students. There was a significant correlation between some domains of work–life balance and quality of life [66].

The literature review encourages the suggestion that view assessment is subjective and shaped by long-term exposure, adaptation, and personal coping mechanisms, which may lead to discrepancies between an owner's and an observer's evaluation. This provides the rationale for investigating these discrepancies systematically by comparing owners' and observers' assessments under different contextual conditions.

1.4. Problem Statement

In this study, a "view owner" is defined as an individual user with long-term, personal familiarity with a specific window view, developed through dynamic and continuous exposure and daily interactions. This perspective encompasses not only the visual and physical attributes of the view but also its emotional, sensory, and experiential dimensions, shaped over time by personal memories, routines, and contextual relationships. It must be underscored that the label "view owner" does not refer to legal property ownership, but to mental-emotional ownership.

In contrast, an external evaluator, defined in this study as "view observer", assesses the window view without prior familiarity or emotional attachment. These evaluations rely primarily on visual observations of static pictures and objective criteria, typically influenced by the content of the view (e.g., the percentage of visible sky, greenery, or noticeable

landmarks) and its immediate attributes, such as aesthetic appeal, clarity, composition, naturalness, order, complexity, and openness. Unlike "view owners", "view observers" do not incorporate lived experiences or personal associations tied to the view, which is a key difference in understanding the real potential of a view.

This research addresses a critical gap in existing studies, which often fails to differentiate between "view owners" and other observers who rely on assessment on first impression from viewing photos of the view. The goal of the research was to explore how ratings of a view can differ between "view owners" (occupants with a long experience of enjoying a view) and "view observers" (external observers who observe photos of the views, taken by the "view owners"). Comparing results from both groups is essential for informing future experimental designs that include views to the outside as a key design parameter. To address the challenges, this study seeks to answer the following research questions:

Q1. Is there a difference in the assessment of the window view between "view owner" and "view observer"?

Q2. Is the rating of the quality of the view through a window, as assessed by the "view observer", influenced by additional contextual visual/verbal information about the interior and exterior surroundings or by a complementary verbal-narrative description from the "view owner"?

Q3. Is there a difference in the assessment of the view through a window by the "view observer" between day view and night view?

By examining the influence of lived experience and the role of contextual information, this study contributes to understanding how perceptions of window views evolve over time and how they extend beyond what static photography or geometric metrics can capture.

2. Methods

The entire study consisted of the planning phase with two distant expert workshops and 12 in-person workshops involving students and carried out at universities. As described in Section 2.2, participation in in-person workshops implies completion of preparation tasks and delivery of a filled-out survey ahead of the workshop. The results from the preparation phase will be published in the forthcoming article. The survey from the preparation phase is included in Appendix A to give the reader a better understanding of the study.

The in-person workshops were mainly attended by students. One of the aims was thereby to raise awareness of the view from the window and indirectly influence architectural design practice. The protocol for the participatory research conducted through workshops is presented below.

2.1. Pre-Test: Two Distant Expert Workshops

As the project started during the COVID-19 lockdown (February–March 2022), the first meetings to develop the project idea took place digitally with groups of four to six researchers and members of the Daylight Academy (DLA) participating in the DLA "A room with the view" project. The researchers showed each other photos of their window views, commenting on each other's views and their own. During the discussion, it became clear that the participants' assessment of their own views was influenced by personal experiences and relationships with the view, which was not the case when assessing views presented by others. An interesting research question arose regarding the differences in window view assessment between "view owner" and "view observer".

The lead author then developed a proposal of research procedure for a large group of participants. The procedure was initially tested during two digital workshops as follows: each participant presented their window view as "owner of the view," using postcard

format photos, panoramic photos, and interior and exterior photographs, taken primarily from homes, but also from hospital offices and university lecture halls.

Some participants documented variations in diurnal (Figure 1a–c) daylight availability and its probable impact on the quality of the view. Each presentation lasted approximately 10 min and included a narrative explanation of the view (see Table 1). Following the narrative, the "view observers" responded to questions posed by other participants.



(**a**) (**b**) (**c**)

Figure 1. Diurnal variation in the view: (**a**) presents an interior photo showcasing the view with a daylight control treatment within a room, (**b**,**c**) provide examples of a close-up panoramic photo and a nighttime panoramic photo, respectively. Photos taken by Barbara Szybinska Matusiak.

Table 1. Overview of the parameters for photographic documentation and the oral narrative.

Evaluation Level/Photo Documentation	Context	Parameters
1 [Simple 2D Images] **Postcard photo** **+ Panorama** **Photo**	Immediate evaluation of the view out	▪ 'Postcard' type photo of the view taken at eye level (sitting or standing) ▪ Close-up, panorama photo (of the whole view) taken close to the window without window frame ▪ Horizontal format, full colour, taken with mobile phone or normal (50 mm) lens, at around 1 meg resolution without applying zoom ▪ Daytime and night-time photos for Panorama Photo
2 [Interior context] **Interior photos**	Evaluation in relation to the room function	▪ (2–4) Photos 2–3 m back from the window glass to show room context and furniture. ▪ Registration of objective spatial and functional parameters: - Inhabitants/users of the room (e.g., office mate, spouse) - Patterns of occupation (e.g., 1 h daily in afternoon) - Window management and daylight control (e.g., venetian blinds, curtains, automated electrochromic glass) - Other daylighting openings (e.g., skylights another window at 180 degrees) - Electric lighting conditions (e.g., fluorescent troffers overhead LED task lights Dimmers) - Type of glass and/or other window elements (e.g., tinted, low-e, triple glazed, insect screens) - Window operation - View category (e.g., office view, domestic view) - Aperture decoration elements, e.g., inside plans covering part of the view
3 [Exterior context] **Exterior photos**	Evaluation in relation to the outside context	▪ (2–4) Photos of the exterior environment, to better explain the window's context and 3D position from the outside. ▪ Registration of objective building parameters: - Description of geographic location (mark location in, e.g., google map image) - Solar orientation - Height from ground - Type of building - Climatic and seasonal variations - Mark time of day and time of year (in which photos were taken) - Ecological context (e.g., historic urban center, country farmhouse, university campus) - Information about key solar shading (e.g., nearby obstructions, deciduous trees, awnings)

Table 1. *Cont.*

Evaluation Level/Photo Documentation	Context	Parameters
4 [Lived experience] **Narrative of the owner of the view**	In-depth/subjective evaluation of the view out	▪ Narrative about the relationship with the window/view out. Including: - When do you go there and why? - How it makes you feel? - What do you love about it, what annoys you? - What makes you think about it? - How you manage your relationship with the window (e.g., operating blinds, changing viewing direction) - Events of importance (e.g., greeting visitors, watching birds, opening the window for air, viewing a parade) - Are you satisfied with the content of the view? (elements like greenery, amount of sky or ground visible, parked cars, moving people, trash containers, etc.) - Sensory experiences (e.g., sounds, thermal comfort, visual comfort (glare?), sleep, smells) - How does your relationship, or 'use' of the window change over time (e.g., daily, seasonally, or with more experience/memories) - What else about the window is important to you, or do you wish you could change? - Has your relationship with the window changed after the COVID-19 pandemic? (e.g., not used before but now is part of your home office?) If so, are you satisfied with the view for working purposes? - Are you satisfied with the level of privacy that the window provides you?

The insights gained from expert workshops, partially included in Table 1, were used to develop the final design of the subsequent in-person workshops conducted at universities, discussed in this article.

2.2. Participants

The main part of the project was structured in a series of in-person workshops carried out from September 2023 to April 2024 at six universities in five European countries (Norway, Poland, Italy, Germany, and UK). The participants were mainly students of architecture or related fields (age: 20–35 years old). A total of 207 participants took part in 12 workshops; the number of participants in the respective workshops varied, from eight participants in one of them to 15–28 in the rest. The gender was well balanced with a slight predominance of women (about 59%). The common feature of the participants was the lack of expertise in daylighting, as students participating in this study did not undergo theoretical daylight courses and were not taught methods or procedures of the window view evaluation. As such, they represent rather lay people than professionals.

The population of 207 participants represents two main types of university-going students: students living in an apartment (their own, their family's, or shared apartment with other students) (approximately two-thirds of the participants) or students living in a dormitory (approximately one-third of the participants). Furthermore, one of the requirements for participation in the study was sustained experience of the chosen view, acquired over a period of at least six months. This period is sufficient to ensure that students are accustomed to the view, regardless of the type of space they live in, a student residence or an apartment.

2.3. Preparation Phase Procedure

Prior to the workshop, each participant had to describe and evaluate their own view as "view owner", including attributes of the view, presence of people, landmarks, moving elements, and visibility of sky, greenery, or ground. Then, they had to prepare a presentation of the view, in photographic and verbal form, several days before the in-person workshop. Each participant chose a view from the window that was familiar to them. Since the

workshops were held in several locations, the preparatory documents and procedures were unified. Such preparation was divided into four levels.

The first level involved capturing the view in a postcard-form photograph from a typical vantage point to show a characteristic view (P1), then a close-up to the window (0.5–1.0 m from the glass), later called the panorama photo, by day (P2) and by night (P3). These photographs, and all subsequent ones, were then inserted into slides for presentation in the workshop. The template is included in Appendix C.

The second level involved photographing the interior of the room in daylight to determine the size and position of the window in relation to the room and its function (P4). To do this, both the window and the seating area had to be visible in the photographs (P5). In addition, a short survey about satisfaction with the room features (window size, amount of view, daylight in the room, and the view in relation to the window design and the room function) had to be answered. The survey provided them with topics they needed to think about ahead of the presentation of (P4) and (P5), which contained a short oral part.

On the third level, two external photos of the building's façade were taken during daytime, and the corresponding window (P6 and P7) was highlighted. Each "view owner" answered another short survey about her satisfaction with the external environment and the building. These included, for example, window orientation and external solar protection. The survey provided them with topics that they later discussed during the presentation of photos (P6) and (P7).

The last part (level 4) of the preparations involved writing a narrative to describe the personal relationship and long-term experience with the window view, following the guiding questions given in the survey. The narratives contained thoughts, feelings, memories, and long-term experience with the window view. For example, what is perceived as positive about the view, what is considered disturbing, and when or why the window is approached. Then, using a 9-point Likert scale, a final assessment was made of the overall level of satisfaction with the view. The procedure applied in the preparation phase is shown in Figure 2. The complete questionnaire can be found in Appendix A. Delivery of the fully completed questionnaire was a condition for participation in the in-person workshop.

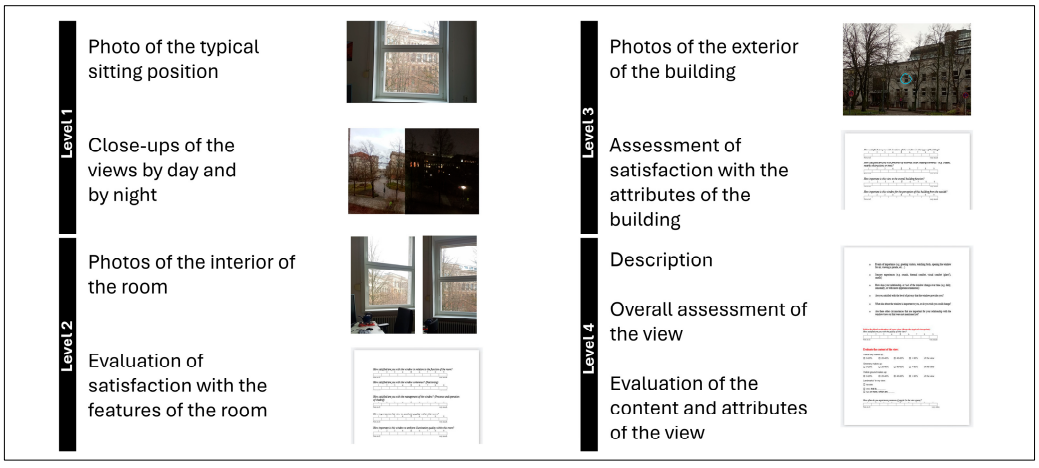


Figure 2. Study procedure applied in the preparation phase. The blue circle in the level 3 photos indicates the window from which the view was assessed.

The results of the individual view assessments by the "view owners" will be presented in a dedicated, forthcoming paper.

2.4. Procedure for In-Person Workshops

The workshops were held at different universities at different times of the year. During the workshops, each participant (student) presented their view as a "view owner," which took five to ten minutes per person. Images of window views were projected onto a large white screen. Each "view owner" presented their view at four levels (see the preparation procedure), while all other students (acting as "view observers") viewed the images from their seats in the auditorium and rated the view (at each level) on a Likert scale from 1 to 9. All scores were given individually, without communication with other students, using a previously prepared evaluation form, see Appendix B. After finishing, the next student presented her/his view while the previous student has taken a place in the auditorium and continued as one of the "view observers". The presentations of the photos were prepared in the same way across universities using an earlier prepared template, see Appendix C. The evaluation forms with scores given by students were collected by the researcher immediately after the last scores were noted down. The students were informed from the beginning that their answers would be handled anonymously in the following step of the research study.

At the first level, the student showed a postcard photo (P1), and a close-up photo of the view by day (P2) and by night (P3). No comments were allowed by the "view owner" at the first level. At the second level, the "view owner" showed two interior photos (P4, P5), commenting about the window design and the impact the view and daylight had on the quality of the interior space (topics from the short survey about interior, described in Section 2.3). At the third level, the "view owner" showed two photos from the external environment (P5, P6) and commented on the window design in relation to the building and the external context (topics from the short survey about exterior, described in Section 2.3). Lastly, the first photo (P1) was shown again while the "view owner" read the narrative about their long-time experience with the view, which could include sensory experiences (like noise and smell), memories of past events, thoughts, and feelings connected to the view. The "view observers" assessed the view on the 1–9 Likert scale after each slide shown by the view owner. The sequence of presentation and evaluation of the photos is illustrated in Figure 3. The evaluation form can be found in Appendix B.

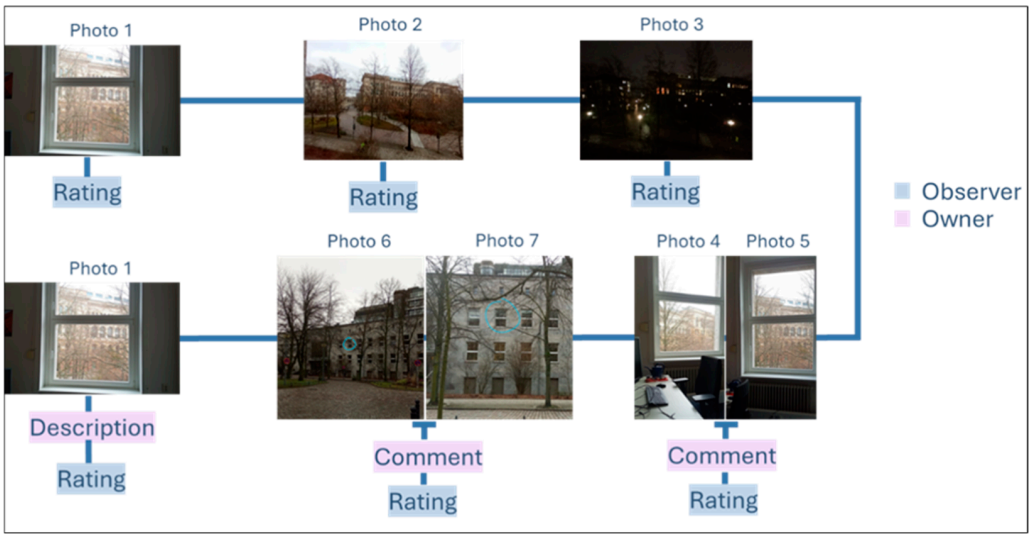


Figure 3. Study procedure applied during the in-person workshops with examples of photos taken. Images are illustrative and cropped for layout; original data were unaltered landscape photos. The blue circle in the level 3 photos indicates the window from which the view was assessed.

2.5. Analysis Method

To make a comprehensive investigation of the "view owner" and "view observers" judgments, the rating provided by each "view owner" was compared to the aggregated ratings expressed by the "view observers" on images 1 to 7 presented by the "view owner". The analysis was performed first by visualizing the spread, probability density, and skewness of the votes. The observed trend following normality tests was statistically tested.

To robustly assess the normality of the data, three complementary tests were used: the Shapiro–Wilk test (optimal for platykurtic distributions), the Shapiro–Francia test [67] (more sensitive to leptokurtic distributions (kurtosis > 3) [68]), and the Kolmogorov–Smirnov test (a non-parametric goodness-of-fit test comparing empirical and theoretical distributions). This multi-method approach ensures a comprehensive evaluation of normality across different distributional characteristics.

As a first step, "postcard" images (photo 1—taken from the sitting position) and the "panorama" images (photo 2) were compared. To test the agreement and reliability of the votes, the "agreement index" and a "reliability test" were applied. The agreement index measures the level of consensus among raters or respondents on a given scale. For this purpose, James, Demaree & Wolf's [69] agreement index was used (measures within-group agreement for single-item or multi-item measures):

$$r_{\omega g} = 1 - S_x^2 / \sigma_E^2 \quad (1)$$

where

S_x^2 is the observed variance of responses;

σ_E^2 is the expected variance under a null distribution (typically uniform).

- Values closer to 1 indicate strong agreement, while values near 0 suggest no agreement;
- A common cut-off for acceptable agreement is ($r_{\omega g}$) > 0.7.

Together with the agreement index, Brown & Hauenstein's [70] is reported, which directly captures the average deviation (AD) from a central measure (mean or median) [71]. Lindell & Brandt's Median Absolute Deviation (MAD) [72,73] is also reported to account for raters' bias and scale limitations.

While agreement indices inform on how much people within a group agree, reliability tests such as Intraclass Correlation Coefficient (ICC) (1) and ICC (2) are different measures that inform on how stable and generalizable the votes are. Bliese [74] and others (e.g., Kozlowski & Hattrup [75]; Tinsley & Weiss [76]) often provide complementary information to agreement measures. The trends were further explored in extreme assessments where the "view owner" rated the view as "very satisfactory" (scores 8–9 in the Likert scale) and "not at all satisfactory" (scores 1–4).

Further, it was also explored whether "view observers" assess the quality of the window view differently when provided with additional contextual information. Specifically, it was examined whether indoor contextual factors, such as furniture arrangement or interior design elements, as well as partitioning and operation of windows, influence their perception. Additionally, it was investigated whether outdoor contextual information (including surrounding buildings, greenery, or urban elements) affects their assessment of the view. These considerations help to understand how context shapes the perception of window views. Finally, the responses expressed by the "view observers" before and after the "view owners'" narratives were compared. Through the narrative, the "view owners" described their relation to the view through their sensory experiences, thoughts, and feelings, while "view observers" were looking at the postcard—photo 1.

The last focus of the study was the perception of the night view. While the view from a window is primarily experienced during the day, modern lifestyles, especially

among young individuals such as students, have increased its relevance at night. The impact of the night view on overall view quality was integrated into the "view owner's" assessments, while "view observers" provided separate evaluations for the daytime and night-time views.

The statistical tests used in the study are also shown in Table 2.

Table 2. Statistical tests applied in the study.

Full Name/Abbreviation	Type	Application	Comments
Shapiro–Wilk	Normality test	Most reliable for platykurtic distributions (kurtosis < 3)	Kurtosis is a measure of peakedness of a distribution
Shapiro–Francia	Normality test	Most reliable for leptokurtic distributions (kurtosis > 3)	
Kolmogorov–Smirnov	Normality test	Non-parametric test comparing empirical and reference CDFs	
James, Demaree & Wolfâ	Agreement index	Measures within-group agreement for single/multi-item scales	Values close to 1 = strong agreement; cut-off: $r_{\omega g} > 0.7$
Brown & Hauenstein	Agreement index	Captures average deviation (AD) from a central measure	Lower AD = stronger agreement
Lindell & Brandtâ	Agreement index	Accounts for rater bias and scale limitations	Uses Median Absolute Deviation for robust estimation
Median Absolute Deviation (MAD)	Robust variability measure	Used to assess dispersion; robust to outliers	Often used in combination with $r_{\omega g}$ and AD
Intraclass Correlation Coefficient (ICC)	Reliability	Assesses consistency and generalizability of ratings across raters or groups	ICC (1) = reliability of single rater; ICC (2) = reliability of group mean
Kruskal–Wallis	Non-parametric test	Tests for differences in distributions across groups	Non-parametric alternative to one-way ANOVA
Dunn Test	Post hoc test	Post hoc comparisons following Kruskal–Wallis	Used when Kruskal–Wallis indicates significant difference
Wilcoxon signed-rank	Non-parametric test	compares two paired samples	used with corresponding rank-based 739 effect size was rank-biserial r (rb)

3. Results

Before delving into the view assessment results, it is important to mention that most of the views assessed in the article are urban or semi-urban, and buildings are present in most of the views. The fact that 37.2% of "view owners" reported greenery visibility of 0–20% indicates that a large proportion of participants have only minimal greenery visible in their view. On the other hand, the sky is visible in more than 80% of the views. Considering the high amount of data collected during the workshop, and for the sake of brevity and consistently with the goal of research questions highlighted in Section 1., the results presented in the next sessions are concerned with questions on a sub-dataset of results, particularly concerning the satisfaction level with views expressed by "view owners" and "view observers" ("*how satisfied are you with this view?*"), comparing their assessments. The remaining questions included in the survey, see Appendix A, will be object of other forthcoming, dedicated publications.

3.1. Comparison of Votes Expressed by the "View Owner" and "View Observers"

The overall assessment of the view by the "view owner" occurs at level 4 of the preparation procedure (see Figure 2), where he/she rates the view on a scale of 1 to 9 in response to the question:

"View Owner" Q1: How satisfied are you with the quality of this view?

In this section, the vote expressed by the "view owner" was compared to the ratings of photos 1 and 2 given by "view observers" who used the same scale and answered similar questions (Observer Q1–2). At this stage, "view observers" rated the images based solely on visual information, without any comments/descriptions from the "view owner".

"View Observer" Q1–2: How satisfied are you with the quality of this view?

The violin plot in Figure 4 shows the spread, probability density, and skewness of the responses. The violin plots used in this figure and in this section show the distribution of responses; the white circle indicates the median, and the black vertical line represents the interquartile range (25th–75th percentile). It can be observed that the violin plot for "view owner" vote is wider and more spread out, suggesting a broader range of responses (mean 6.2, median 7.0). In contrast, the votes expressed by "view observers" of the postcard view (photo 1) show a narrower distribution, with a lower mean centered around ≈ 5.1 (median ≈ 5.5). This suggests that "view owners" rated their views more favorably than "view observers". Additionally, the variability is higher among "view owners", while "view observers" have a more consistent response. A similar trend is observed for the panorama image (photo 2). The votes expressed by "view observers" remain more compressed, with a mean of 5.3 and a median of 6.0. However, compared to the postcard image, their votes appear to be slightly more varied, suggesting more mixed perceptions of the panoramic view.

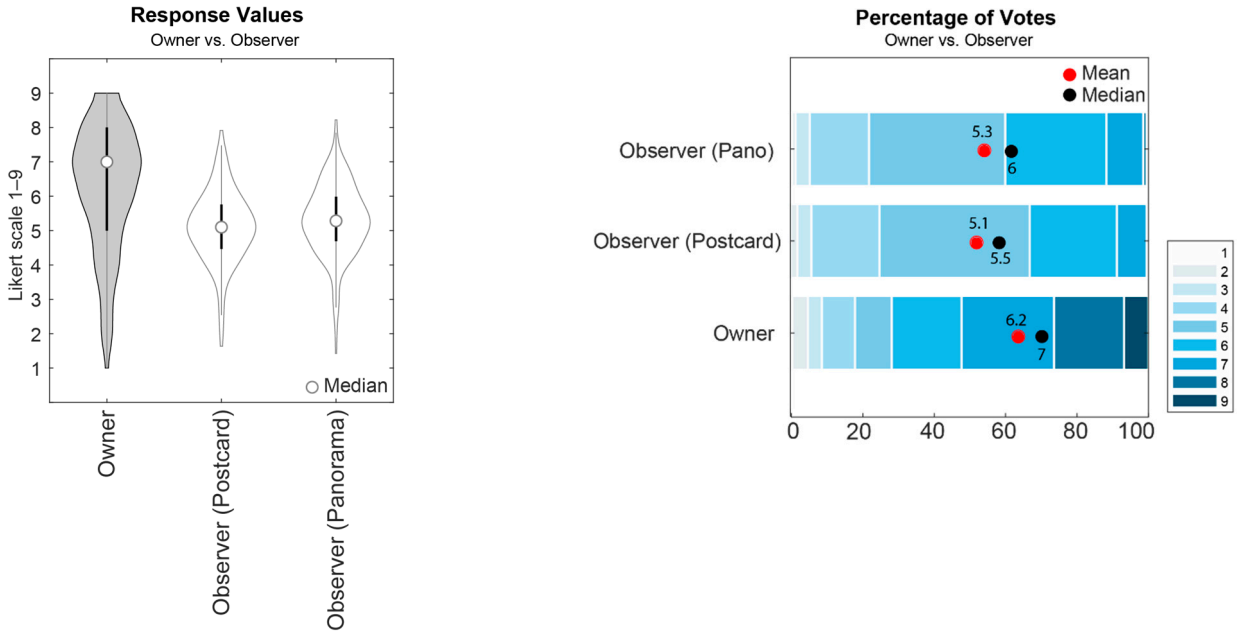


Figure 4. The distribution of the response values for "view owners" (Q1) and "view observers"(Q1–2) of 207 participants: (**a**) violin plots, (**b**) chart plots showing percentage of votes and the non-aggregated mean and median. White circles denote medians; black vertical lines indicate the interquartile range (25th–75th percentile).

The following conclusions can be formulated:

- "View owners" rate their views with significantly higher scores than "view observers", indicating a potential bias or an emotional connection with the outdoor space.
- "View observers" tend to provide lower but more consistent voting, while "view owners" votes show greater variability.

To explore this trend, a statistical analysis was run to identify significant differences between the scores expressed by "view owner" and "view observers" votes. Two tests were performed: the normality test, followed by a group comparison, and the agreement test.

The normality tests, Shapiro–Wilk and Shapiro–Francia, were performed using swft (Gardner-O'Kearny, [77]) and kstest in MATLAB R2023b environment and rejected the null hypothesis as shown in Table 3. To compare the two groups of independent responses of "view owners" and "view observers" for non-normally distributed data, a non-parametric Wilcoxon Rank Sum (which is equivalent to the Mann–Whitney test) was used through the rank sum in MATALB 2023. The results of the pairwise comparison of the "view owner" vote against the "view observers" vote on the postcard (p-value 2.6×10^{-16}) and the panorama (p-value 2×10^{-13}) showed significant differences.

Table 3. Test of normality.

View Quality Assessment			Shapiro–Wilk	Shapiro–Francia	Kolmogorov–Smirnov
	H	Kurtosis	Sig.	Sig.	Sig.
Owner	1	2.9	<0.0001	<0.0001 *	<0.0001 ***
Observer from Postcard	1	3.8	0.0136	0.01	<0.0001 ***
Observer from Panorama	1	4	0.0128	0.008	<0.0001 ***

α is set as default 0.05. * $p \leq 0.05$, *** $p \leq 0.001$.

As for the agreement test, Table 4 shows the results of three Agreement indices—$r_{\omega g}$ (James, Demaree & Wolf's Agreement Index), AD (Brown & Hauenstein's Agreement Index), and MAD (Lindell & Brandt's Agreement Index)—on view quality vote.

Table 4. The results of the agreement tests.

Vote Category	$r_{\omega g}$ (James, Demaree & Wolf's)	AD (Brown & Hauenstein)	MAD (Lindell & Brandt)
Owner	0.18 (low)	1.44 (high)	1 (low)
Observer Postcard	0.72 (moderate)	0.78 (moderate)	0.63 (moderate)
Observer Panorama	0.70 (moderate)	0.81 (moderate)	0.65 (moderate)
	Strong: >0.7	lower values indicate stronger agreement	Strong: ≤0.50 Moderate–Strong: 0.51–0.75 Weak–Moderate: 0.76–1.00 Low: >1.00

The scores expressed by "view owners" on their view had the lowest agreement ($r_{\omega g} = 0.18$, AD = 1.45, MAD = 1.00), indicating more variation in their votes. Their responses were the most spread out, suggesting subjective preferences developed over time, which strongly influenced their ratings. This aligns with the idea that "view owners" have individualized experiences of their views, leading to greater variability compared to the "view observers". The difference in how the same view is perceived by "view owners" and "view observers" clearly influences the scores. This also includes the quality of the pictures and the fact that they only frame a limited portion of space compared to the real setting. This difference in how enjoying a view between the two groups could lead "view owners" to perceive higher differences in the view quality and reflect in their scores, using higher (or lower scores) on the 1–9 Likert scale, particularly expressing higher scores, thus

detecting more clearly 'satisfactory views'. In contrast, the "view observers" rate the same view (through pictures) using close to middle values in the Likert scale.

The scores expressed by the "view observers" on postcard images and panorama images show relatively strong agreement ($r_{\omega g} \approx 0.7$, AD ≈ 0.80, MAD ≈ 0.64), suggesting that they generally rated the postcard and panorama views consistently. Their ratings are more consistent than the ones expressed by "view owners", but some variation remains. The slight difference between postcard and panorama may reflect differences in the amount of visual information, as panorama images showed more of the outdoor environment, being taken from a vantage point close to the window.

Finally, a per-image analysis was conducted. As each view had only one "view owner" rating, formal significance testing was underpowered; we therefore report per-view effect size. Per-image analysis confirmed that "view owners" generally rated their views more positively than "view observers". Out of 207 images, 176 (85%) showed higher "view owner" rating ($\Delta > 0$), with a median $\Delta = +1$ (IQR: 0 to +2). Given the 9-point rating scale, this corresponds to a small typical shift in perceived view quality, despite being directionally consistent across images. A minority of images (15%) showed "view owner" rating lower than "view observers" ($\Delta < 0$). Differences were largest for a few extreme cases (Δ up to +7), while most views fell within a narrower range of 0 to +2, see Figure 5, indicating that the effect is statistically detectable at the image level but typically small in magnitude. Owners are slightly, but consistently, more positive about their own views than external observers. The difference is typically limited to one score.

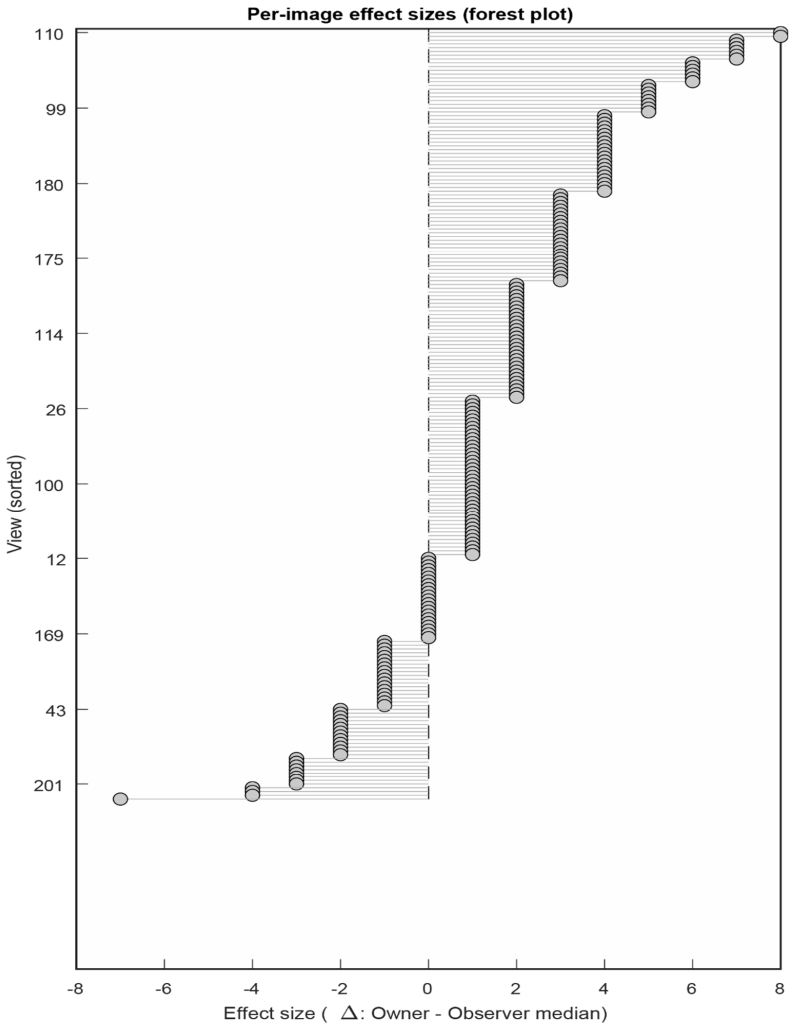


Figure 5. Per image analysis performed by using one owner vote vs. multiple observer votes per view.

From a methodological perspective, these findings highlight that even small owner–observer discrepancies should be accounted for in future view-quality research, particularly in studies relying on photographs, renderings, or short-term exposure to real views as proxies for lived experience. While the magnitude of the bias is modest at the level of individual views, its consistency suggests that short-duration assessments may systematically underrepresent experiential aspects of view quality that emerge through prolonged, everyday exposure. Future studies would benefit from incorporating longer exposure periods or repeated assessments over time, in order to better capture the dynamic and experiential dimensions of view quality that are not accessible through short-term or image-based evaluations.

3.2. Comparison of Scores Expressed by "View Owner" and "View Observers", High-Rated vs. Low-Rated Views

The "view owners" may consider past experiences, familiarity, and daily interactions with the view, which may influence their extreme satisfaction or dissatisfaction. On the other hand, "view observers" evaluate the view (shown on photos) without these experimental biases, which allows a stronger influence of context and a more objective visual assessment. By focusing on the extreme votes (the highest and the lowest ones, that is, the scores 8–9 versus 1–4), it is possible to assess the extent to which additional contextual information and experiences affect perception. The thresholds (8–9 vs. 1–4) were introduced as an analytical device to contrast clear extremes on a 9-point scale, rather than as a theory-driven classification of view quality. As pointed out earlier, if "view observers" give more neutral votes while owners are polarized, this suggests that the life experience of the real setting (view) significantly influences perceptions of view quality. If "view owners" with strong opinions about their views have consistently different votes from "view observers", this may indicate and confirm fundamental differences in the criteria each group uses to assess quality. This information is valuable for understanding whether objective features (e.g., greenery, open sky, or urban elements) align with subjective satisfaction.

Among the 207 analyzed views, 69 received ratings of 8 or 9 on the Likert scale, indicating a high level of satisfaction from the "view owners" and were thus categorized as 'very good' views. Conversely, 44 views received low satisfaction ratings of 1–4, and were thus categorized as 'very bad' views. Examples of very good and very bad views are shown in Table 5.

Table 5. Examples of very good and very bad views, as rated by the "view owners". Images are illustrative, some are a little cropped for layout; original data were unaltered landscape photos.

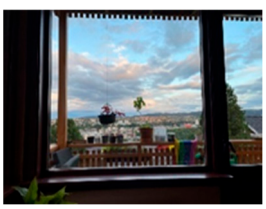
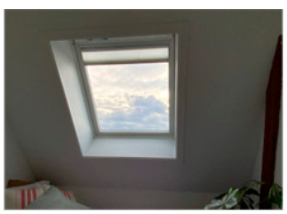
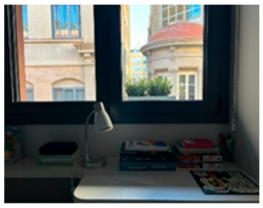
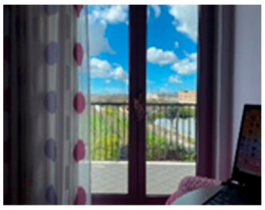
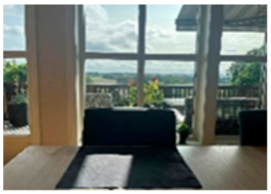
Very Good Views	Comment	Very Bad Views	Comment
	Good access, green content, horizon, high transparency		Very limited view access, due to the considerable distance from the siting position to the window
	Good access, varied and interesting content horizon, high transparency		Only one view layer is included, the sky

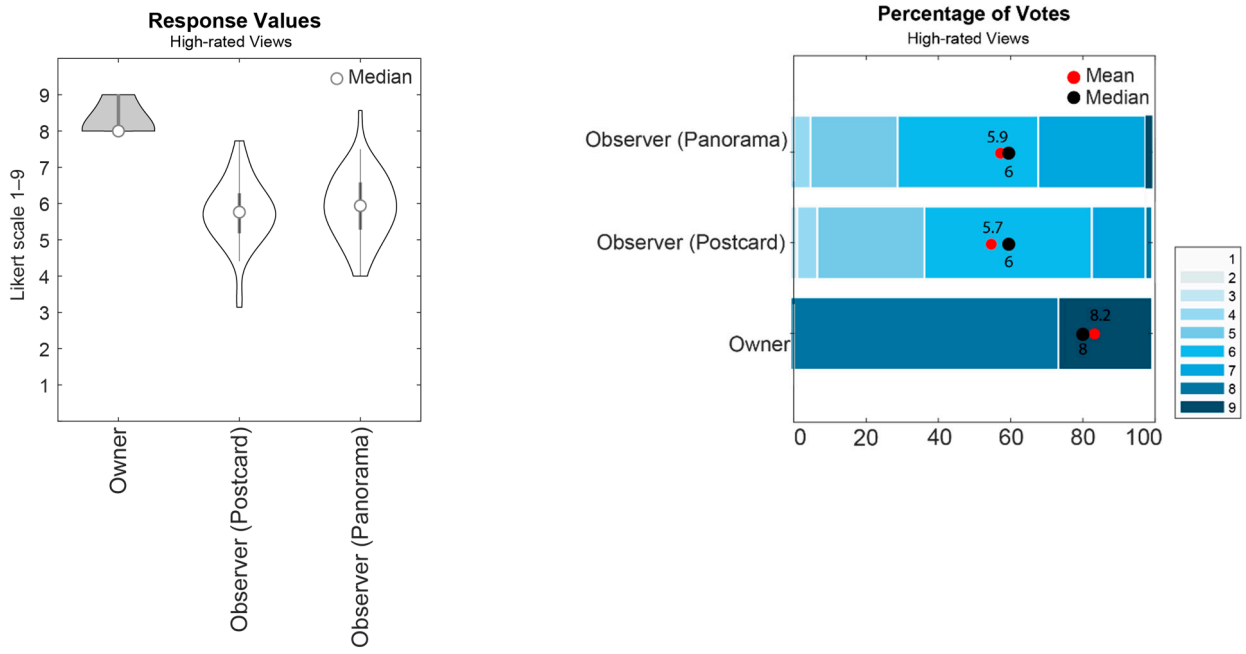
Table 5. *Cont.*

Very Good Views	Comment	Very Bad Views	Comment
	Good access, beautiful, old and well-kept buildings, high transparency		Rather short view distance, uniform and repetitive content
	Good access, greenery, water, buildings in a distance, horizon, mostly high transparency		Short view distance, uniform content, partly low transparency
	Good access varied and green content, horizon, high transparency, division of the window glass into large pieces		Short view distance together with reduced transparency
	Very large view distance, to the horizon, the partitioning of the window surface into rather large pieces does not disturb the view		Unbalanced view composition, very short view distance on the left side

Figures 6 and 7 show responses expressed by "view owners" and "view observers" for, respectively, high-rated (votes 8 and 9) and low-rated (votes 1 to 4) views. These visualizations illustrate the distribution of responses and highlight differences in perception between those who experience the view regularly and those evaluating based on photographs.

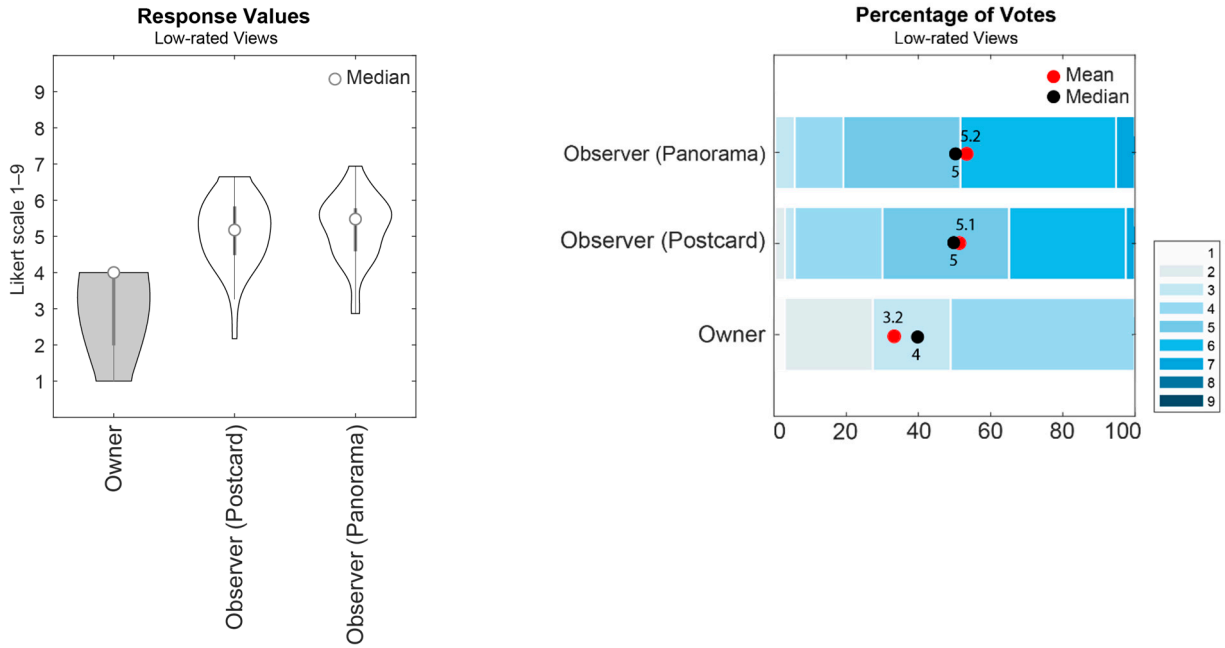
In Figure 6, it is possible to see that "view observers" assessing the same view, whether through postcard images or panoramic views, tend to give lower and evenly distributed votes. This reiterates that "view owners", likely due to personal attachment and familiarity, perceive their views more positively than external "view observers". In Figure 7, which captures cases where "view owners" rated their view poorly (scores 1 to 4), the distribution is more variable, though still biased towards lower votes. However, "view observers" again show a more moderate and spread-out assessment, indicating that they do not perceive the view as negatively as the "view owners" do.

Normality tests, Shapiro–Wilk/Shapiro–Francia and Kolmogorov–Smirnov, were performed using, respectively, swft (Gardner-O'Kearny, [75]) and kstest in MATLAB R2023b environment. The normality tests performed for high-rated and low-rated views (see Table 6) resulted in a conflicting outcome. Shapiro–Wilks and Francia has been shown to have higher statistical power compared to other tests (Mohd Razali & Bee Wah, [78]). Additionally, the frequency distribution check confirmed that the data is approximately normally distributed. Hence, parametric *t*-test was chosen to test the high-rated vs. low-rated views.



(**a**) (**b**)

Figure 6. The owner and observer responses for high-rated views: (**a**) violin plots, (**b**) chart plots and the non-aggregated mean and median. White circles denote medians; black vertical lines indicate the interquartile range (25th–75th percentile).



(**a**) (**b**)

Figure 7. The owner and observer responses for low-rated views: (**a**) violin plots, where the white circles denote medians; black vertical lines indicate the interquartile range (25th–75th percentile). (**b**) chart plots and the non-aggregated mean and median.

Table 6. The test of normality high-rated and low-rated views.

	Normality Tests			**Shapiro–Wilk**	**Shapiro–Francia**	**Kolmogorov–Smirnov**	
		H	Kurtosis	Sig.	Sig.	H	Sig.
High	Observer Postcard Vote	0	3.8	0.5	0.2	1	<0.0001 ***
	Observer Panorama Vote	0	3.1	0.8	0.6	1	<0.0001 ***
		H	Kurtosis	Sig.	Sig.	H	Sig.
Low	Observer Postcard Vote	0	3.9	0.1	0.08	1	<0.0001 ***
	Observer Panorama Vote	0	3.4	0.2	0.1	1	<0.0001 ***

*** $p \leq 0.001$.

The *t*-test, as shown in Table 7, for independent sample (*t*-test MATLAB R2023b), results confirmed that high-rated views were rated significantly differently by the "view observers" and the "view owners", both for postcard (*p*-value 5.9×10^{-25}) and panorama (*p*-value 2.9×10^{-23}) images. Also, low-rated views were rated significantly differently, for both postcard and panorama (*p*-value 1.1×10^{-9} and *p*-value 2.3×10^{-10}, respectively).

Table 7. T-test results comparing owner votes with high- and low-rated postcard and panorama views.

		H	**Stats**	**df**	**sd**	**Sig.**	**Mean Vote**
High	Owner Observer Postcard	1	18.66	53	0.99	5.9×10^{-25} ***	5.7
	Owner Observer Panorama	1	17.12	53	1.00	2.9×10^{-23} ***	5.9
	Postcard vs. Panorama	1	−1.05	53	0.9	0.007 *	
Low	Observer Postcard Vote	1	−8.7	72	0.9	5×10^{-13} ***	5.1
	Observer Panorama Vote	1	−9.6	72	0.9	1.2×10^{-14} ***	5.2
	Postcard vs. Panorama	0	−0.6	72	0.9	0.52	

* $p \leq 0.05$, *** $p \leq 0.001$.

Finally, the *t*-test for independent samples (ttest2 MATLAB 2023) was used to compare the scores of the high-rated and low-rated views. The results showed that there is no significant effect between observers' votes between postcard images and panorama images in either high-rated (*p*-value 0.3) or low-rated categories (*p*-value 0.5). On average, the "view observers" rated the panorama views slightly better in both high-rated views (mean values: postcard = 5.7; panorama = 5.9) and similarly in low-rated views (mean values: postcard = 5.1; panorama = 5.2).

Based on this analysis, the following conclusions were drawn:

- Both the high-rated views and the low-rated views are evaluated significantly differently by the "view owners" and "view observers". "View observers" are much closer to the middle of the scale in both high-rated and low-rated categories.
- In both high-related and low-rated views, the "view observers" have rated the panorama images slightly better than the postcard views; however, this effect is not significant.

These results suggest that the scores expressed by "view owners" are more polarized, influenced by their personal experiences and long-term interaction with the view. The "view observers", lacking this familiarity, provide more neutral evaluations, relying on visual communication through photos. It seems that personal engagement plays a crucial role in how a view is perceived by those who experience it daily. Personal engagement

refers to the long-term familiarity that "view owners" develop with their everyday views, rather than to physical window elements.

3.3. Influence of Contextual Visual Information and Verbal Description on View Perception

Unlike the view ratings based on photos 1 (postcard) and 2–3 (day vs. night panorama), which were shown without any verbal information during the workshops, starting from photo 4, each "view owner" not only showed photos but also added relevant information and comments that could enrich the understanding of the conditions by "view observers". In the present paper, we restricted the analysis to the statistical effects of the narratives on participants' evaluations; a systematic thematic coding of the narrative content is still in progress and will be reported separately.

In this section, the ratings given by "view observers" for postcard (photo 1), for photos 4–5 (interior context) and for images 6–7 (external context) were compared, all rated during the in-person workshop. In addition, the scores given by "view observers" after hearing the narrative from the "view owner" were also included (Figure 8). For the postcard image (photo 1), interior images 4–5, and exterior images 6–7, after the narrative, the "view observers" answered the same question:

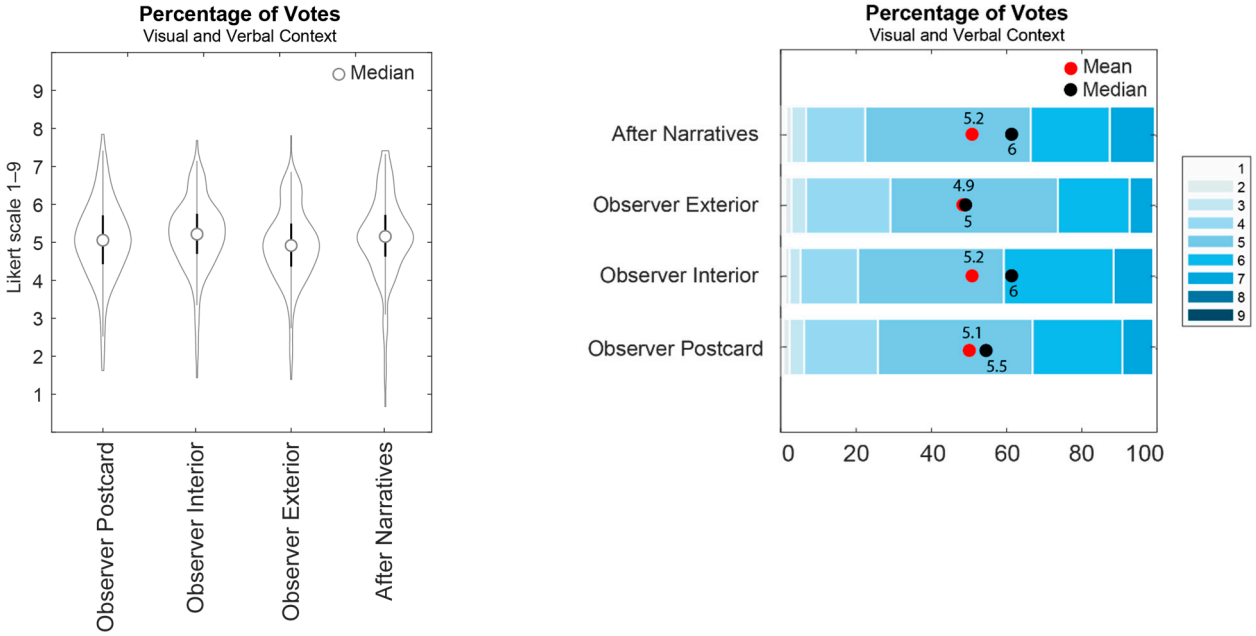


Figure 8. The distribution of the response values for "view owners" and "view observers": (**a**) violin plots, where the white circles denote medians; black vertical lines indicate the interquartile range (25th–75th percentile), (**b**) chart plots showing percentage of vote and the non-aggregated mean and median.

"View observers" Q4–8: How satisfied are you with the quality of this view?

The "view observer's" evaluations across all three conditions—interior photos, exterior photos, and after hearing narratives—consistently yield lower ratings than those of the "view owner's" (mean = 6.2, median = 7.0). The "view observers" gave interior photos a mean score of 5.2 (median = 6), while exterior photos received the lowest observer ratings (mean = 4.9, median = 5). After listening to the narratives about the significance of the window and its view, the ratings expressed by the "view observers" were modestly higher compared to Postcard (mean = 5.2, median = 6 vs. mean = 5.1 and median = 5.5), though still falling short of the evaluations expressed by the "view owner" (6.2 and 7.0). Notably,

"view observer's" ratings across all conditions showed more consistency and narrower distributions than those of the "view owner's", who exhibited higher variability. These results suggest that personal engagement and contextual meaning influence the higher scores expressed by the "view owners", while "view observers" maintain a more moderate and consistent assessment regardless of narrative cues.

To compare the effect of visual and verbal description, a nonparametric Kruskal–Wallis test was run, using Kruskalwallis function in MATLAB R2023b, as all distributions deviate significantly from normality, as shown in Table 8. The deviations are likely due to skewness and excess kurtosis, especially in "view observers" Interior and "After Narratives." The result indicates that the votes expressed by the "view observers" on the four photos are distributed significantly differently ($p = 0.012 < 0.05$). As shown in Figure 8a, the aggregated medians sit between ≈4.8 and 5.3, differ by <0.5 on a 0–9 scale in Figure 8. Hence, no significant difference between the medians can be detected, indicating that the practical differences may be modest.

Table 8. The test of normality.

High-Rated Views			**Shapiro–Wilk**	**Shapiro–Francia**	**Kolmogorov–Smirnov**	
View Quality Assessment	H	Kurtosis	Sig.	Sig.	H	Sig.
Observer Postcard	1	3.8	0.025 *	0.02 *	1	<0.0001 ***
Observer Interior context	1	4.5	<0.0001 ***	<0.0001 ***	1	<0.0001 ***
Observer Exterior context	1	3.9	0.002 **	0.0016 **	1	<0.0001 ***
Observer After Narrative Vote	1	5	<0.0001 ***	<0.0001 ***	1	<0.0001 ***

α is set as the default 0.05, * $p \leq 0.05$, ** $p \leq 0.01$, *** $p \leq 0.001$.

Dunn's post hoc test was then used for pair-wise comparison of the effects of visual or verbal context has an effect the votes expressed by the "view observers", with multcompare and the two options 'ctype' and 'dunn-sidak' MATLAB R2023b. Here, the initial votes from "view observers" on postcard images are considered as group 1, the votes on visual interior images are considered group 2, the votes on visual exterior considered as group 3, and the after-narrative votes as group 4. This method is particularly suited for non-parametric data and provides a reliable way to identify which specific conditions led to changes in ratings from the "view observers". The results, as shown in Table 9 and Figure 9 shows the results of the Kruskal–Wallis analysis using group-wise average ranks. Open circles denote the mean rank of each observer vote group, while horizontal bars indicate the dispersion of ranks within each group (as defined by the error measure used in the analysis). The vertical dotted line marks the overall average rank (414.5, based on 828 total observations).

Table 9. Test of normality.

Group Comparison	**Diff in Rank Means**	**95% CI**	***p*-Value**
1 vs. 2	−37.85	[−99.70, 24.00]	0.4941
1 vs. 3	35.31	[−26.55, 97.16]	0.576
1 vs. 4	−22.24	[−84.09, 39.62]	0.920
2 vs. 3	73.16	[11.31, 135.01]	0.011 *
2 vs. 4	15.62	[−46.24, 77.47]	0.986
3 vs. 4	−57.54	[−119.40, 4.31]	0.083

α is set as the default 0.05, * $p \leq 0.05$.

This result, indicate that Interior votes differ significantly from Exterior votes ($p = 0.011$, 95% CI = [11.31, 135.01]). All other pairwise comparisons were not statistically significant ($p > 0.05$). The comparison between Group and vs. Group 4 showed a marginal differ-

ence ($p = 0.083$), but did not reach statistical significance. As illustrated in Figure 9, the ranked groups exhibit broadly similar distributions, with mean ranks clustering around the overall average. Despite this proximity, the difference between Group 2 and Group 3 was sufficiently large and consistent to yield statistically meaningful results.

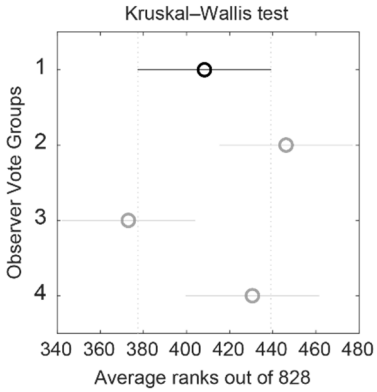


Figure 9. The graph shows the average ranks and the 95% Confidence Interval (CI) for the four groups. Circles denote mean ranks; bars show variability; dotted line indicates overall mean.

3.4. Perception of Night View vs. Day View

The view from the window is mainly perceived during the day, but also at night, with the current lifestyle. This is particularly true for young adults, such as the students attending the workshops. The influence of the night version of the view on the overall quality of the view is included in the "view owner's" assessment, while the "view observers" were asked to give separate assessments for the day and night views (panorama photos during day and night). In this section, the ratings of image 2 panorama (day view) and image 3 panorama (night view) expressed by the "view observers" during the in-person workshop were compared. They answered the same question:

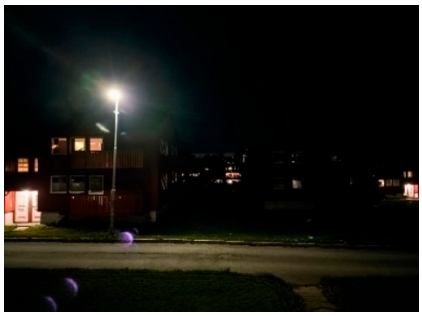
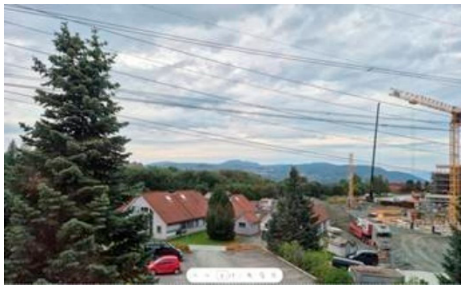
View Observer Q2–3: How satisfied are you with the quality of this view?

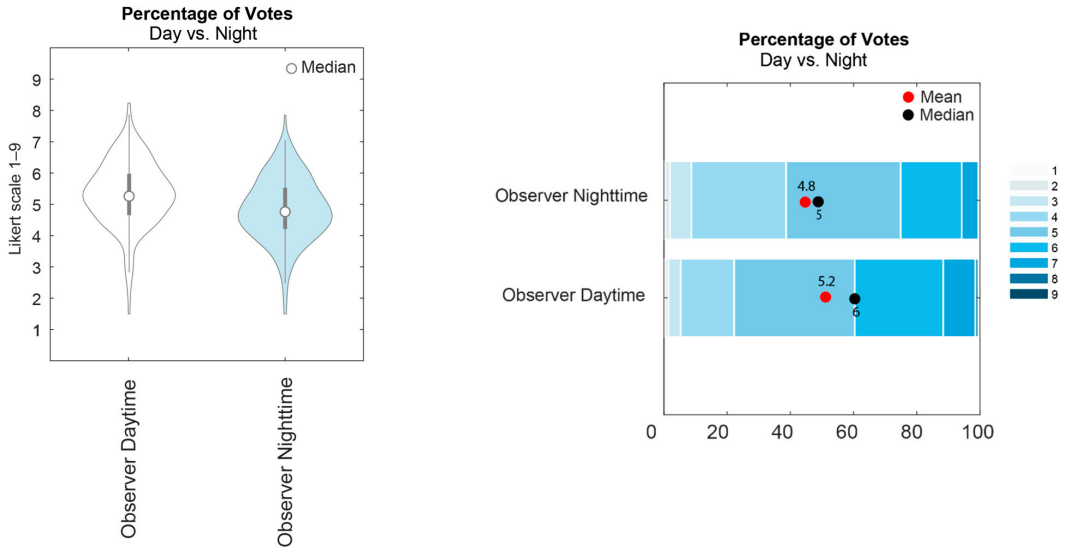
A closer look at a few examples of views in which the difference in the "view observers" assessment between day and night panoramic photos is greater than one point may give a clue about some reasons for the difference in assessment (Table 10). The outdoor lighting can increase the perceived quality of a view if attractive or beautiful elements are well lit and ugly elements are not, and conversely, it can reduce the quality of a view if the lighting is poorly designed. In any case, electric lighting (apart from some Christmas decorations) does not change the content of the view. The location, size, and materiality of the view elements are the same. The night lighting reinterprets the view.

The response values given by "view observers" for day/night panorama and the response by the "view owner" are presented in Figure 10. Table 11 shows the normality test results. Daytime votes by image viewers clearly violated the assumption of normality, with all three tests—Shapiro–Wilk, Shapiro–Francia, and Kolmogorov–Smirnov—yielding significant results ($p < 0.05$). The Nighttime Votes by view observers showed mixed results: the Shapiro–Wilk test approached significance ($p = 0.05$), while the Kolmogorov–Smirnov test strongly rejected normality ($p < 0.0001$). Given the ordinal scale and the non-normal distribution of at least one group, a non-parametric Wilcoxon Rank-Sum test (Mann–Whitney U test) was selected to compare the distributions between the two conditions. A Wilcoxon signed-rank test indicated that view observers rated daytime views higher than nighttime views ($p = 7.37 \times 10^{-23}$, two-sided; normal approximation $z \approx 9.84$). The absolute magnitude of the shift was modest (mean Day − Night = 0.43 points; median = 0.36; IQR = 0.07 to 0.72 on a 1–9 scale), and the two distributions showed substantial overlap ($|\text{Day} - \text{Night}| \leq 1$ for 88.9% of images). The corresponding rank-based effect size was rank-biserial $r_{r\beta} = 0.80$,

indicating a consistent tendency for higher daytime ratings despite the small absolute change $A = \pi r^2$.

Table 10. Examples of day view and night view with the mean rating by the observers. Photos taken by the participants of the study.

Day View	Night View
	
Observers: 5.6, Owner 7.0	Observers: 3.9, Owner:7.0
The night view is less attractive due to the glare from the nearest light pole and very week lighting from distant buildings, which makes the viewing distance shorter.	
	
Observers: 6.0, Owner: 8.0	Observers: 7.5, Owner: 8.0
The construction site with a tall crane dominates the view during the day, but as neither construction site nor crane is illuminated during the night, the night view appears nicer than day view. Thousands of light spots from remote settlements catch the eye instead.	



(**a**) (**b**)

Figure 10. The "view observer's" vote of panorama Day and Night views: (**a**) violin plots, where the white circles denote medians; black vertical lines indicate the interquartile range (25th–75th percentile), (**b**) percentage chart plots and the non-aggregated mean and median.

Table 11. The test of normality.

High-Rated Views			**Shapiro–Wilk**	**Shapiro–Francia**	**Kolmogorov–Smirnov**	
View Quality Assessment	H	Kurtosis	Sig.	Sig.	H	Sig.
Observer Daytime Vote	1	4.7	0.02 *	0.01 *	1	<0.0001 ***
Observer Nighttime Vote	0	3.3	0.05	0.3 *	1	<0.0001 ***

α is set as the default 0.05, * $p \leq 0.05$, *** $p \leq 0.001$

4. Discussion and Future Work

The photos of views were provided by students living in various conditions and locations, some of whom lived in family houses or apartments, while others resided in dormitories. The views were typically captured from the student's bedroom or home office area (e.g., kitchen or living room), which, in the case of dormitory residents, often served as their primary living space. The settings of these views varied, ranging from rural to urban environments. Notably, the concept of "ownership of the view" was understood as the experience of living with a particular view for at least six months.

4.1. Differences in View Assessment Between "View Owners" and "View Observers"

As shown in the Section 3, the assessment of a view received higher scores from "view owners" who had personal experience of that view, than from "view observers" who observed only static photographs of the view, with mean scores of (Owners 6.2 vs. Observers postcard 5.1). Furthermore, "view owners" gave their views more varied ratings, reflecting the familiarity and emotional bond developed through longer exposure. In contrast, "view observers" provided lower yet more consistent evaluations, suggesting a narrower perception of view quality. The same trend was confirmed splitting the analysis of the view scores into high-rated and low-rated views.

In general, self-ratings may be influenced by a person's personality traits, such as a tendency to exaggerate or underestimate one's self-worth. The votes expressed by the "view observers" are often more objective, but they may be affected by a lack of context or familiarity with the place. The significant difference in view ratings between "view owners" and "view observers" can be explained in several ways. First, "view observers" assessed photographic representations rather than experiencing the actual view, which limits their ability to fully perceive its quality. More importantly, the personal connection that "view owners" develop to their view—shaped by time, history, and lived experience—is not possible to convey through photos or even with verbal descriptions. These results suggest that judging a view, especially its quality, through indirect media, like photos, is inherently limited.

4.2. Low Impact of Contextual and Verbal Information

The study investigated whether information about indoor contextual factors, such as window location, furniture arrangement, or interior elements, conveyed orally by the "view owner", influences the "view observers'" perceptions. In addition, the study investigated whether outdoor contextual information conveyed by the "view owner", including surrounding buildings, greenery, or urban elements, influenced their assessment of the view.

Surprisingly, interior information had only a small impact on the votes given by observers, and external contextual information did not affect observers' votes at all. Observers probably treated such information as irrelevant to the assessment of the quality of the view.

Furthermore, the verbal information given by the "view owner" at the end of the presentation in the form of a narrative had little effect on observers' votes. This is even more surprising, since it contained the owners' long-term experience with the view. Prob-

ably the visual information in the form of a photo was considered solid fact, while the narrative was considered vague, inaccurate and not convincing. Whether the influence of the narrative might be greater if observers had to read it instead of hearing it is an open question. Regardless, in the scope of this study, visual communication is more persuasive than auditory.

4.3. Merits and Limitations of the Study

The main merit and the innovation of the study lie in the comparison of the judgments on the quality of a view to the outside by two different groups of participants, "view owners", who have prolonged, personal experience of their view, and "view observers", who judged that view based on static photographs of it. To the best authors' knowledge, there is no similar approach in the literature. In addition, a large sample of participants were collected (207 students) to participate in the workshop: the students mostly belonged to international curricula, thus assuring a great variety of personal backgrounds to be included in the study.

On the other hand, an in situ study with 207 participants has some limitations related to its protocol and methodology. Each participant had a dual role, acting both as a "view owner" who assessed his/her own view and then as a "view observer" who evaluated the views of others. This dual role could have introduced potential bias, as participants' experiences as the "view owner" might have influenced their evaluations as the "view observer". To minimize such potential bias in view assessment and thus on the results to be collected, the view ratings by the "view owner" were expressed in different stages of the research. Each participant assessed his/her own view, took photos, and prepared a PowerPoint presentation of their views (as "view owner") in advance, during the preparation phase, typically two weeks prior to the workshop. During the workshop, each "view owner" just presented his/her own view without assessing it, thus assessing the other participants' views as a "view observer". In this way, the two roles did not overlap.

Another bias could be linked to the homogenous sample population of the workshop, as all the participants were students in architecture or architecture related studies. This provides them with expertise focused on building quality, which includes sensitivity to aesthetic features. This specific training could represent a bias compared to the general population, thus limiting the external validity of the results. On the other hand, there is no difference between architecture students and laypeople when it comes to perceiving the most typical elements of a view: the sky, the horizon, greenery, water, as well as the brightness of interior and exterior spaces. Consequently, it may be assumed that the student population can be considered a representative sample of the full population, and the results found in the study can still be considered as quite general to draw design indications and guidelines aimed at enhancing the important role played by the quality of view to the outside.

Also, other factors may be crucial in affecting the view evaluation and could be considered, such as the influence of nationality or environmental conditions during upbringing. In this study, those aspects were not analyzed.

Another limitation relates to the variability in photo quality, as images were taken with different cameras (mostly mobile phones) by different users. While this could have influenced the perceived view quality, it is important to note that the photos were taken by the "view owners" themselves, suggesting that they likely captured the aspects of the view they considered most significant.

In the present study, "view owners" were exposed to their views repeatedly over periods of at least six months, corresponding to cumulative exposure on the order of tens to hundreds of hours, whereas "view observers" typically assessed each view for a few

minutes during the workshop. This large difference in exposure duration highlights a fundamental methodological distinction between short-term assessments and lived, long-term experience. Moreover, residents interact dynamically with the view, allowing them to perceive changes in light, weather, season, and spatial depth, as well as people moving around or participating in events, enriching their overall assessment. This is a key point of the research, as stated in the goals of the research (see Section 1.3), showing that the use of static photography in research examining quality aspects of window view should not be fully trusted.

Nevertheless, research in environmental psychology and building performance often relies on photographs or renderings as proxies for real views, since they provide standardized and easily comparable stimuli [79–81]. While this approach facilitates experimental control, it may reduce ecological validity, as static imagery cannot fully capture the lived, multisensory, and temporally dynamic qualities of experiencing a view in situ [82]. Similar challenges arise in other fields where visual experience strongly influences human perception and decision-making. In real estate, for example, marketing often relies on photographs, yet potential buyers may form substantially different impressions when physically present in space, as real views convey depth, scale, and atmosphere that images cannot fully reproduce [83,84]. Therefore, it is worth stressing that the topic of the view out is even more important than actually stated in assessment methods, such as LEED, WELL, or standards (EN 17037:2018), which limit the view quality to minimum angles to be seen at fixed positions or to the number of layers that can be seen, among sky, landscape, or ground.

On the one hand, there is a need for simplified tools to be included in design guidelines, standards, and recommendations; on the other hand, the personal connection that may arise with a long-term experience with a view needs to be taken into consideration as well. More research is needed to clearly explain personal connections to window views: for example, one direction might involve using virtual reality tools [84,85].

Finally, night-time views need to be taken into consideration when assessing the quality of the view: due to the public lighting systems, the content and the quality of a view change significantly, including the presence of dark areas, which limit the perception of details of view elements (buildings, landscape, distant objects) or the presence of disturbing urban lighting, which could be obtrusive or glaring to some extent. Considering the nighttime quality of views is typically not addressed in recommendations and guidelines, nor is it addressed in the literature. This study encourages inclusion of nighttime views, including the impact of public lighting. This is a research gap that could be addressed by future research, for instance, through VR analysis, as pointed out in earlier comments.

5. Conclusions

Comparison of judgments from users with a personal prolonged, and dynamic experience of a view "view owners" and from external "view observers" who could solely see a static picture of the same view, is the main novelty in the approach adopted in this study, as no similar attempt has been made in other research.

The participants were 207 students on an education path in architecture (or similar), mostly on an international curriculum (which included a huge sample of personal experiences in the study) in six universities in five European countries. The research relied on a preparation phase, where each "view owner" assessed their views, and on successive workshops, where the views presented by each "view owner" were assessed by the "view observers". All the judgments were expressed on a 1–9 Likert scale.

The study shows that "view owners" rated views from their windows with significantly higher scores and with greater variability than the "view observers" (mean scores of

6.2 vs. 5.1 for postcard views, while scores were slightly more similar for the panoramic images), reflecting personal adaptation, familiarity, and perhaps emotional attachment to the view. In contrast, the "view observers" gave more polarized and average ratings because their assessment is based solely on visual perception without long-term exposure or personal connection. The same trend was confirmed, to an even greater extent, by analyzing the view scores separately for high-rated views (scores 8–9) and low-rated views (scores 1–4), with mean scores of 8.2 vs. 5.7 for postcard views, and with scores provided by "view observers" much closer to the middle of the scale in both high-rated and low-rated views. This confirms systematic differences in the criteria for assessing view quality, although the typical magnitude of these differences is small.

The view observers consider objective features and elements (e.g., greenery, open sky, or urban objects) and are not influenced by subjective satisfaction (in some cases dissatisfaction).

Overall, it testifies to the limitations of photo-based assessment, carried out by observers who do not have personal familiarity with the place.

The inclusion of visual and verbal information about interior context (e.g., room characteristics, how the window integrates into space, etc.) marginally improved the perceived quality of the view by "view observers". The addition of visual and verbal information about the exterior context (e.g., how the view connects to outdoor spaces) did not lead to notable shifts in assessments.

The narrative given by view owners, describing the personal and emotional connections with a particular view, only marginally improved the perceived quality of the view by "view observers". This points to a stronger impact of visual than oral-descriptive information.

Window view is predominantly experienced during daytime hours, but contemporary lifestyles also make nighttime perception increasingly relevant. This is especially the case for young adults, such as the students participating in the workshops. For this reason, the "view observers" were asked to assess a panoramic picture of the view (presented by each "view owner") taken during the day and one taken at night. The scores were observed to be significantly lower for night views than for day views (mean values: 5.2 vs. 4.8); however, the absolute difference is small, and the distributions substantially overlap, indicating a modest but systematic night-time effect.

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Data Availability Statement: The data collected through the workshops are available from the first author upon request.

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Appendix A. Assignment: My View

Individual assignment (Preparation for the workshop on 29 August 2023 and participation in this workshop)

The aim of the assignment is to reflect about the value and quality of the view out of the window. This is both the assignment text and the form that you are supposed to fill out.

Please write your full name here:

. . . . . .

This assignment is suitable for you who have a long-lasting experience with a certain view which means that you have perceived this view preferably during all seasons. It may be a view from a chair in your living room, your study place, reading place at a library, a chair at a coffeehouse etc. . . If you do not have a long-lasting experience with any place in Trondheim yet, you must work with the alternative assignment, see: AAR4850 Ass. 5 Library view.

PART 1. PREPARATION FOR THE WORKSHOP

LEVEL 1 WINDOW VIEW IN GENERAL

PHOTO 1: Take a post-card photo of the view from your typical sitting position (landscape layout of the foto). Put it into the template: AAR4850 Ass 5—My view_PHOTO template.pptx.

PHOTO 2: Go very close to the window glass and take a photo (landscape layout of the photo) of the outside trying to include as much as possible of the view content. Put it into the template.

PHOTO 3: Repeat the second point during night hours. Put it into the template.

LEVEL 2 SATISFACTION WITH THE VIEW IN RELATION TO THE INTERIOR

PHOTO 4 & 5: Take two photos of the interior to show the window size and position in relation to the function of the room and the furniture. Put it into the template.

Please answer the following questions:

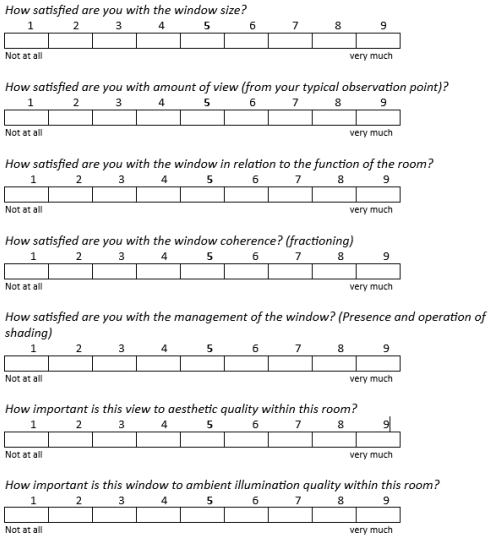


Figure A1. Questions to be answered by the "view owner" during the preparation phase.

LEVEL 3 SATISFACTION WITH THE VIEW IN RELATION TO THE INTERIOR

PHOTOS 6 & 7. Take two photos of the exterior showing the context of the building and the window. Put the photos in the template.

Please answer the following questions:

How satisfied are you with the view in relation to the context? (Historic urban centre, country farmhouse, etc...)

1 2 3 4 **5** 6 7 8 9

Not at all very much

How satisfied are you with the view in relation to its solar orientation?

1 2 3 4 **5** 6 7 8 9

Not at all very much

How satisfied are you with location of the window in this type of building?

1 2 3 4 **5** 6 7 8 9

Not at all very much

How satisfied are you with presence of external solar shading elements? (e.g. shades, nearby obstructions or trees?

1 2 3 4 **5** 6 7 8 9

Not at all very much

How important is this view to the overall building function?

1 2 3 4 **5** 6 7 8 9

Not at all very much

How important is this window for the perception of this building from the outside?

1 2 3 4 **5** 6 7 8 9

Not at all very much

Figure A2. Questions to be answered by the "view owner" during the preparation phase.

LEVEL 4 WINDOW VIEW AFTER ALL INFORMATION IS GIVEN BY THE VIEW OWNER

Use the space between the lines of bullet points, or write a short narrative at the end of this document, considering the following:

- When did you go there and why?
- How does it make you feel?
- What did you love about it?
- What annoyed you?
- What did it make you think about?
- How did you manage your relationship with the window (e.g., operating blinds, changing viewing direction)?
- Events of importance (e.g., greeting visitors, watching birds, opening the window for air, viewing a parade, etc. . .).
- Sensory experiences (e.g., sounds, thermal comfort, visual comfort (glare?), smells).
- How does your relationship or 'use' of the window change over time (e.g., daily, seasonally, or with more experience/memories)?
- Are you satisfied with the level of privacy that the window provides you?
- What else about the window is important to you or is something that you wish you could change?
- Are there other circumstances that are important for your relationship with the window/view out that have not been mentioned yet?

Make the final evaluation of your view (from the typical viewpoint):

How satisfied are you with the quality of this view?

1 2 3 4 **5** 6 7 8 9

Not at all very much

Figure A3. The final assessment of the view by the "view owner" during the preparation phase.

Appendix B. Template for the Evaluation Form

*Please write **your** name here: .....*

Stud. 1 Please write the presenting students name here: .....

PHOTO 1 *How satisfied are you with the quality of this view?*

1	2	3	4	5	6	7	8	9

Not at all very much

PHOTO 2 *How satisfied are you with the quality of this view?*

1	2	3	4	5	6	7	8	9

PHOTO 3 *How satisfied are you with the quality of this view?*

1	2	3	4	5	6	7	8	9

PHOTO 4&5 + comments *How satisfied are you with the quality of this view?*

1	2	3	4	5	6	7	8	9

PHOTO 6&7 + comments *How satisfied are you with the quality of this view?*

1	2	3	4	5	6	7	8	9

PHOTO 1 + narrative *How satisfied are you with the quality of this view?*

1	2	3	4	5	6	7	8	9

Stud. 2 Please write the presenting students name here: .....

PHOTO 1 *How satisfied are you with the quality of this view?*

1	2	3	4	5	6	7	8	9

Not at all very much

PHOTO 2 *How satisfied are you with the quality of this view?*

1	2	3	4	5	6	7	8	9

PHOTO 3 *How satisfied are you with the quality of this view?*

1	2	3	4	5	6	7	8	9

Figure A4. The evaluation form to be used by workshop participants.

Appendix C. Template for Preparing Photos for the Workshop



slide 1

Figure A5. *Cont.*

slide 2



slide 3



slide 4



Figure A5. *Cont*.



Figure A5. Slides from the preparation instruction file.

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