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View Quality Assessments: A Pilot Study of Field Methods

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ABSTRACT

This paper describes findings from a workshop during which participants evaluated a series of window views. An explorative approach was applied to identify issues and testing methods useful in daylight research. The participants visited nine rooms with views of varied content, complexity, and viewing distance under the overcast sky. Participants used surveys with quantitative and qualitative questions, hand drawings, illuminance measurements, and photography to appraise the view quality. Subsequently, daylight simulations and neurocognitive tests have been carried out in two rooms with "bad" and "good" views. Multi-directional views were valued more than narrow or single-directional views. The cognitive testing showed numerical differences in several measures and a significant correlation between the difference scores for sadness and the difference scores for Trail Making Test-B across two rooms. The study identified that buildings of historical value, a presence of greenery, colored building facades, or a presence of people (content) contribute to a positive assessment of the view but are not included in the assessment criteria.

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17-037; daylight recommendations; explorative research approach, quantitative and qualitative evaluation; view out; view quality

1. Introduction

Interest in the nature and quality of views out of windows have been central in the architectural world since the Roman Empire and its early use of glass, as evidenced by the writing of Vitruvius (Vitruvius 1874). Framed views of landscapes, gardens and cities are prevalent in many cultures' art such as Chinese, Japanese, and European paintings from the Middle Ages onward, clearly illustrating cultural attitudes and philosophies of their time and place. The late 19th century and early 20th century saw the rise of many design guidelines stressing the importance of window views, especially in schools (Baker 2011; Heschong et al. 2002).

Beginning in the 1950s and 60s, the postwar building boom in Europe and the Americas brought up issues of how to plan modern cities that would maintain the health and well-being of urban dwellers. In his book "Image of the City" Kevin Lynch emphasized the importance of landmarks for people to create "cognitive maps" of where they were (Lynch 1960). Jane Jacobs, with her concept of "eyes on the street," argued for the importance of visual connections between indoors and out to maintain social cohesion (Jacobs 1961).

The extreme physical and social isolation created by the Covid pandemic lockdowns in 2020 saw a surge of interest in window views as one of the few remaining (non-digital) connections of an individual to the larger world, inspiring a renewed interest in the value of windows (Batool et al. 2021) and widespread enthusiasm for sharing personal window views with a global on-line community (VFMW team and Duriau 2020).

However, disciplined research interest in views has been recent, and generally driven by concerns

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of the time (such as security, energy efficiency or visual comfort) or interest in novel technologies (such as automated shading controls or virtual reality research methods). In the past twenty years there has also been a concerted effort to develop view metrics and design standards, such as in LEED (United States Green Building Council 2020), WELL (WELL 2018), and EN 17,037 (2018). However, the resulting metrics are often more based on consensus than definitive research and lack corresponding field studies to verify their benefits or priorities.

This paper reports on an effort to further explore primary factors of view quality. A multi-disciplinary gathering of daylighting experts experimented with a variety of methods to document their own reactions to a variety of view conditions, including structured questionnaires, cognitive tests, narratives, sketching, photography, and illuminance mapping. The findings from these efforts can potentially inform both future field research methods and refinement of current daylight metrics.

1.1. Literature review

In 1975 Belinda Collins, then at the United States National Institute of Building Science (NIBS), produced one of the earliest literature reviews on the costs and benefits of windows in buildings (Lowenhaupt Collins 1975). Her focus was largely on the well-documented construction, energy, and maintenance costs of windows, compared to often claimed, but poorly studied benefits. Since Collin's time, the positive benefits of view have become a more frequent subject of study, such as by Roger Ulrich and Lisa Heschong (Heschong 1999; Ulrich 1984).

Jennifer Veitch produced a series of literature reviews in the early 2000s, largely focusing on the building energy versus occupant health impacts of various lighting strategies (Aries et al. 2010; Farley and Veitch 2001; Galasiu and Veitch 2006; Newsham et al. 2009; Veitch and Galasiu 2012; Veitch et al. 1993). In 2020 Barbara Matusiak led an IEA task group conducting a literature review comparing research available for electric lighting and daylighting metrics, including those addressing view and privacy, and the perceived quality of the indoor environment (Amorim et al. 2022; Vasquez et al. 2022). More recently Eleanor Lee's group provided an overview of recent research on the occupant benefits of view versus potential conflicts with energy efficiency and climate goals, in order to recommend needed research to develop better design metrics and guidelines (Lee et al. 2022). A similar team led by Gentile summarized findings from 25 monitored, case studies of high-performance buildings which pursued both energy efficiency and the well-being of occupants via integrated lighting and daylighting design (Gentile et al. 2022). Also in 2022, Won He Ko and 54 other coauthors penned a short position statement laying out the scope of current knowledge about window views and identifying research gaps (Ko et al. 2022). In that effort, and a companion paper Ko and colleagues recommended three over-arching factors when studying window views: Content, Access and Clarity (Ko et al. 2021). They emphasized the need to recognize "the complexity of relationships between windows, indoor and outdoor conditions, and occupants," and especially the potential interactions among all these factors.

Steven and Rachel Kaplan, and generations of their students at the University of Michigan, promulgated an "attention restoration theory" (ART) that claims that the "nature" views function as a form of stress reduction (Kaplan 2001). With their efforts, and those of others, studies of views of nature are among the most common in the recent research literature. However, the definition of "nature" in these studies is often ambiguous, or treated as dialectic, with "natural" versus "urban" being the only two qualities considered.

Frumkin et al. (2017) looked more broadly into the many potential health benefits of "nature contact," defined as "ranging from plants in a room to views through windows, camping trips and virtual reality imagery. The public health team reviewed over 250 research studies drawn from a wide range of disciplines. They found reliable evidence for 20 different types of beneficial human health outcomes, and proposed a multifaceted research agenda (Frumkin et al. 2017). And yet, despite this paper's comprehensive approach to the subject of "nature contact," there is essentially no discussion of window views as a form of "nature contact," nor discussion of circadian stimulus as a likely mechanism for health benefits.

In 2017, Leila Mirza and Hugh Byrd followed a similar nature-benefit hypothesis in arguing for the validity and importance of including view access and quality as a requirement in the New Zealand Building Code (Mirza and Byrd 2018). They included a range of studies that suggested prioritization for various types of view content. For example, while nearby greenery was strongly preferred over a view of nearby buildings, a distant view was much preferred over nearby greenery. However, both nearby greenery and nearby buildings were acceptable when even a small view toward the sea was also included. Overall, they found that the extent of a view of a water feature was less important than its mere presence. In a previous study, Mirza found that views of landmarks had an oversize impact on subjects' evaluation of and memory of a view, as if a view of a distant landmark could function as a mnemonic anchor (Mirza 2015).

Drilling into measurable cognitive benefits of view, Jamrozik et al. at the WELL Living Lab performed an experiment (2019) that compared workers ($n = 10$) over an extended time in the same office environment with and without a view (Jamrozik et al. 2019). The experimental set up included two solar glare control options, roller blinds and electrochromic glazing, which were randomly alternated every two weeks with the baseline condition using blackout blinds to block views out of the windows while maintaining equivalent room illumination. They found that, with both solar control options cognitive performance, improved equally over the baseline with no view, while task switching performance showed no difference among the three conditions. Noting interactive effects among multiple sensory stimuli, the researchers also found that when the occupants did have access to window views, they rated noise, temperature, and privacy as equally important factors to improve people's effectiveness at work. However, when they had no access to a view, 70% of the respondents rated "window access" as the most critical factor.

Clearly, one of the challenges for current view researchers is to start to sort out these many possible interactions of view characteristics relative to context (Hellinga 2013; Hellinga and Hordijk 2014) and find a way to prioritize the characteristics of views which are likely to have the most potent positive benefits.

1.2. View quality metrics

To date, a variety of view quality metrics and criteria have been included in standards and certification programs. The EN-17037 daylight standard (2018) relates the view quality to a single viewpoint. It uses a "better-to-best ranking" system for three criteria: the width of the window (≥14° wide horizontal sight angle minimum), distance to outdoor obstacles (≥6 m minimum), and number of view layers seen from indoors. The U.S. Green Building Council's Leadership in Energy and Environmental Design (LEED) version 4.1 (U.S. Green Building Council 2020) provides one credit for a building when there are unobstructed lines of sight to the outdoors for 75% of regularly occupied floor area and when two out of four additional criteria related to view are also met, such as multiple lines of sight or views of nature.

The 2021 International Green Construction Code (International Code Council 2022) and ASHRAE Standard 189.1–2020 (American Society of Heating Refrigerating and Air-Conditioning Engineers 2020) include new provisions for certain space types whereby at least 50% of occupied floor area shall have a direct line of sight 1.07 m above the floor and within 12.2 m from the view window, with a glazing area greater than 7% of the floor area.

Except for the view type (nature) in LEED most of these existing view quality criteria are based on geometrical relationships of the rooms and windows to an occupant's position. The intention seems to be primarily to make them simple to calculate and verify from plan sets. Newer metrics proposed by Mardaljevic (Mardaljevic 2019) (percentage distribution of sky-landscape-ground in the view hemisphere) or Turan (Turan et al. 2021) (spatially distributed view access) also follow this geometric trend, although they rely upon computer calculations.

In an effort to harmonize these many approaches, Ko et al. (Ko et al. 2021; Konstantzos et al. 2015) proposed an assessment framework and view quality index derived from a comprehensive review of the literature and view-related standards. Three categories of variables – view access, content, and clarity – are included in the index and are each normalized to a value between zero and one. Using this assessment framework both geometrical features, like distance from the window, and some non-geometrical, like movement or dynamic content can be included.

The evaluation of view using newly developed metrics has often been implemented in daylight simulation programs, often before adoption by standard-setting organizations and before any verification with human-subject tests (Waczynska et al. 2020). Indeed, a leading simulation program author, Christoph Reinhart of MIT, has commented: "it remains unclear whether these new metrics correspond to occupant evaluations" (Reinhart 2022).

In summary, knowledge about the view quality is limited, in-depth understanding of importance of view elements is missing, the minimum necessary access to the view is under discussion and the impact of various aspects of view quality on neurocognitive and/or psychological aspects is not well verified.

1.3. Study objective

In response to the lack of field studies, an interdisciplinary group of scientists, aimed to find out missing issues in present view recommendations. For this reason, a workshop was organized in Trondheim 15–17.06.2022 attended by experts. Members of the workshop visited and evaluated a range of view conditions using a wide variety of methods, survey with quantitative and qualitative questions, hand drawings, photography, and simple illuminance measurements. Subsequently, daylight simulations have been made. In addition, neurocognitive tests have been carried out in two of the rooms.

The main research question was:

> Which rooms and views were most and least preferred by the participants and why?

For brevity, the sub research question(s) are given in the sub-chapter(s) addressing the respective methods.

2. Methods

2.1. Explorative research

Taking into consideration the research aim, the explorative research method appeared as the most appropriate one for this study. According to R. Stebbins "Social science exploration is a broad-ranging, purposive, systematic, prearranged undertaking designed to maximize the discovery of generalizations leading to description and understanding of an area of social or psychological life. Such exploration is, depending on the standpoint taken, a distinctive way of conducting science – a scientific process – a special methodological approach" (Stebbins 2011, 3). He claims that the definition addresses all sciences.

In explorative research a single exploration can develop to concatenated exploration, that refers to a research process in the form of a chain, leading finally to inductively generated theory. Studies near the beginning of the chain, like the present one, are wholly or predominantly exploratory in scope. Any initial weaknesses in sampling, validity and generalizability are to be corrected over the course of next studies in the chain.

In the present study the exploratory method has been used to discover which qualities of the view are important and why, and which methods are applicable to evaluate view quality. Both qualitative and quantitative methods were used, as advocated by Stebbings. The quantitative methods resulted with numerical records referring to view quality attributes and neurocognitive tests, while the qualitative resulted with word clouds. In addition, a purely visual evaluation was tried, just drawings that participants were asked to make during workshops were analyzed for content and compared to photos.

The project was structured in a series of workshops. As it started during the COVID-19 lockdown the first workshop was carried out digitally. Four to six of the workshop participants gathered on a series of video calls, with the objective of comparing the lived experience of a personal relationship to a window view with that of only a digital description of the view. The obtained insights from these digital calls were used to inform the subsequent in-person workshop that is described in this paper.

2.2. Participants

The participants were drawn from the following professions: architecture, engineering, lighting design, psychiatry, fine art, and environmental psychology, and were affiliated mostly at universities and research institutions except for one retired researcher. Among the participants were newly graduated M. Arch. (2), PhD-candidates (2), researchers (2), associated professors (4) and full professors (2). Participants were two males and ten females, the age of participants varied from 25 to 70 years old, the median was 41, mean 44.4 and SD 13.9. The common feature of the participants was their experience and knowledge in the field of daylight and view out of the window. Not all participated in the whole procedure. Two of the participants from the first day were replaced by a one during the second day, and additional two others participated only in the cognitive tests.

2.3. Locations

The locations were selected from public spaces in Trondheim (Fig. 1) easily accessible during the two-day workshop program. Particular attention was paid to generating a variety of view features: long distance, short distance, panoramic, narrow, dominated or not by greenery, with and without a historical value, crowded or not, large, or small rooms in new and old buildings. The detailed presentation of each location, together with the results at the individual level, is given in Table 1 and Appendix 2.

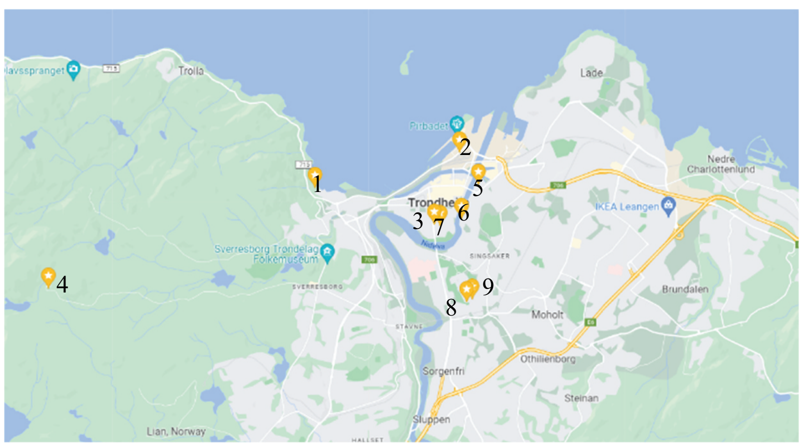

Fig. 1. Location of the places selected for the study on the map of Trondheim, Norway. Map by Google Maps.

Table 1. Places visited during the workshop in the visiting order.

	Address/name	Room	View
1	Mellomila 96	A room for social gatherings for the local community	A view to the street and apartment blocks, with narrow openings to the fjord
2	Rockheim	A cafe at the top floor of the museum of the rock music.	A panoramic view to the harbor, fjord, and a small island and partly towards industrial and residential areas of the city and toward distant hills
3	To Tårn	A modern cafe/shop for tourists visiting the cathedral	A view to the place and the west facade of the mediaeval cathedral and the bishop residence.
4	Skistua	A small ski lounge on the outskirts of the town	The view to the evergreen forest, both near and far view
5	Cafe Løkka	An extension of an old cafe in the city center	A mixture of urban elements, including old and new brick buildings pedestrian bridge, trees, and a lawn.
6	Kaffebrenneriet	A small cafe located in a 200-years old wooden house in the old part of the town	Short distance view to the pedestrian street in the old town characterized by wooden houses and many colors.
7	Cafe Ni Muser	A rather small cafe room in a 100-years old brick building	Four-steps stairs connects it with a patio garden with very high trees, a small pavilion, and a fountain.
8	University Library (U1)	A study room located in the basement, a part of library	Very short distance view toward a narrow internal alleyway without greenery.
9	University Cafe Realfagkantina	A very large cafe at the NTNU campus.	The view dominated by closely located trees, partly distant view to the other side of the city.

2.4. Procedure

The workshop was carried out over two days. Five places were visited on the first day, and four on the second day. Each visit lasted 30–40 min, except for the first one (Mellomila 96) where the participants got acquainted and discussed the procedure before they started to work on the questionnaire, which took about one hour altogether. During the visit the participants were asked to identify their preference for the best available sitting place in the room; to sit down and get a first overall impression of the room, and then of their view out of the window. Both qualitative and quantitative questions were included in the evaluation form, Appendix 1. The qualitative questions were open-ended, and probed for opinions, thoughts, associations, memories, and feelings generated during the visit. The quantitative questions used a consistent list of attributes (Kaplan 1985) graded on a 7-step Semantic Differential Scale. Participants were also asked to make a quick sketch of their chosen view, first using a line drawing, then using fat-colored crayons. In addition, the participants were asked to use their cell phone's camera to document their view and setting, and to use a portable lux meter (Hagner, EC1) to record vertical illuminance at their eye and the horizontal illuminance at the desk level.

During the second day a battery of neurocognitive tests was administered to each participant during their visits to rooms 8 U1 library and 9 Realfagkantina with two test sessions, each approximately 1½ h across those two rooms. For simplicity room no. 8 (U1 library) is labeled "Bad Room" and the room 9 (Realfagkantina) "Good Room." The two test sessions took place on the same day, with a break in between, one in the morning and one in the afternoon. In each session, participants were given five cognitive tasks (three pen-and-paper tasks and two computerized), as well as a questionnaire assessing their current mood. Participants were randomly assigned to have their first session done in either the "Good Room" or the "Bad Room." Test versions and room conditions were counterbalanced between participants. The description of the neurocognitive, emotional cognitive and clinical and demographic measures is given in Appendix 3.

3. Results

3.1. The results at the individual level of each location

All the collected results (qualitative, quantitative, photos, hand drawings and daylight simulations) at the individual level of each location are to be found in Appendix 2.

3.2. Quantitative analyses across locations

The subjective impressions of a space involve not only the visual aspects, but also the emotional aspects of the observer. This corresponds to both scalable and non-scalable evaluations of space, as defined by Tiller and Rea (1992). The present study includes both subjective impressions of the study rooms, and of each participant's specific view within these rooms. To study the subjective impressions, 9 perceptual attributes were studied for the evaluation of the rooms, whereas 8 were studied for the evaluation of the views. In addition, the overall impression of the room and the first impression of the view was also evaluated for each visited space. Each of these attributes were evaluated using a 7-step Semantic Differential Scale containing bipolar adjectives at each end of the scale (1-the most negative, 7-the most positive) (Osgood 1952; Osgood et al. 1975) [Appendix 1].

As stated in Section 2.2 the sample size consisted of 12 participants. This could be considered a small sample size presenting a low statistical power. Indeed, the calculated statistical power of the sample was analyzed using the G*Power software 3.1.9.7 (Faul et al. 2007). This was performed using power analysis for *F* tests – linear multiple regression considering the number of participants and the number of predictors. The results indicated a power of 0.53 and 0.54 for the evaluations of the rooms and the views, respectively. Although the calculation of the statistical power suggests a low probability of statistically valid conclusions, the sample size is still between the range of 10 to 40 as recommended for pilot studies (Hertzog 2008). Moreover, it is important to remember that this paper presents a pilot study with an exploratory aim, in which the evaluation of the methodological approach was prioritized over specific hypotheses with defined predictors. As such, the results presented in this paper serve to have a first overview of the possible effects that specific attributes can have on the general impression of a room or a view.

Considering the nature of the pilot study with an exploratory aim, the data was analyzed focusing on the following sub- research questions (RQ):

RQ1: Which rooms and views were most and least preferred by the participants?

RQ2: Which attribute(s) of the room affect the overall impression of the room?

RQ3: Which attribute(s) of the view affect the first impression of the room?

RQ4: Is there an effect of the room on the impression of the view, and/or vice versa?

To be able to answer RQ1, the data was analyzed using descriptive statistics for all studied variables to allow comparison with the literature and for a first evaluation of the preferences for both room and view. To answer RQ2 to RQ4, the data was explored by using a correlation statistical test to uncover possible associations between the studied variables across all rooms and views. Finally, a Linear Mixed Model (LMM) analysis (McCulloch and Searle 2001) was used to estimate the impact of personal characteristics.

3.2.1. Subjective responses

The data means (M) and standard deviations (SD) of all studied attributes evaluated across all the rooms and views are reported in Table 2. Moreover, the graphical representations of the data depicting the evaluations for each visited room and view (scale 1–7) are shown for each of the nine studied attributes in Fig. 2 and the comparison between the scenes is shown in Fig. 3.

The results from the descriptive statistics show that the evaluations of the rooms and views were predominantly of a neutral rating (i.e., 4.0–5.0). Slightly more positive evaluations were found for the attributes *Familiarity* and *Openness* in the evaluations of the rooms, and for the attributes *Familiarity, Inviting* and *Beauty* in the evaluations of the views.

Table 2. Data means and standard deviation of the studied attributes – M (SD).

Room	Overall impression	4.78 (1.43)
	Friendliness	4.95 (1.47)
	Uniformity	4.38 (1.83)
	Size	4.73 (1.60)
	Openness	5.17 (1.48)
	Familiarity	5.02 (1.43)
	Playfulness	4.26 (1.67)
	Beauty	4.49 (1.68)
	Comfort	4.59 (1.56)
	Order	4.63 (1.56)
View	First impression	5.27 (1.68)
	Excitement	4.78 (1.73)
	Uniformity	4.48 (1.99)
	Distance	4.27 (1.85)
	Familiarity	5.25 (1.58)
	Inviting	5.37 (1.60)
	Beauty	5.11 (1.72)
	Naturalness	3.96 (2.09)
	Order	4.99 (1.44)

The results regarding the attribute *Familiarity* are particularly interesting: not only because it received similar evaluations for both factors (room and view) but also because of what it represents. *Familiarity* means the “close acquaintance with or knowledge of something,” according to the Oxford Dictionary (Oxford Dictionary 1989). Considering that most of the participants of the study were visiting the evaluated rooms for the first time, it becomes interesting to see the positive ratings given to the familiarity of the rooms and views. These results could suggest that for the evaluation of *Familiarity*, people might make an association with a general idea of a room or view (e.g., a café, a library for a room; or a forest, a river for a view) that has been experienced before, without associating it to a specific place which they are using.

Although there were in general lines, slightly positive evaluations for all the attributes, the standard deviations range from 1.44 to 2.09, indicates few strong evaluations and moderate agreements among the participants.

For a more complete overview and deeper understanding of the participants’ evaluations, the graphical plots depicting the distribution of the responses for each studied attribute divided by visited room and assessed view, are presented in Fig. 2. It shows an overview of the scores for room and view impressions divided by the different evaluated spaces. The attributes used for room

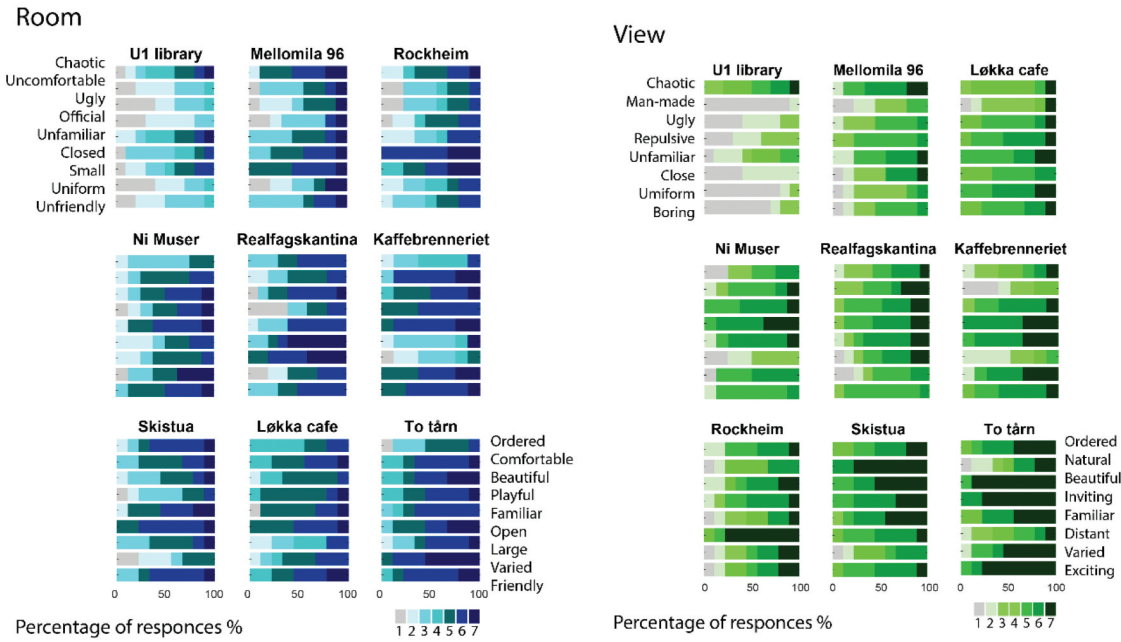

Fig. 2. Distribution of the responses in percentage (X-axis) for each studied attribute (Y-axis), divided by visited room (left) and view (right).

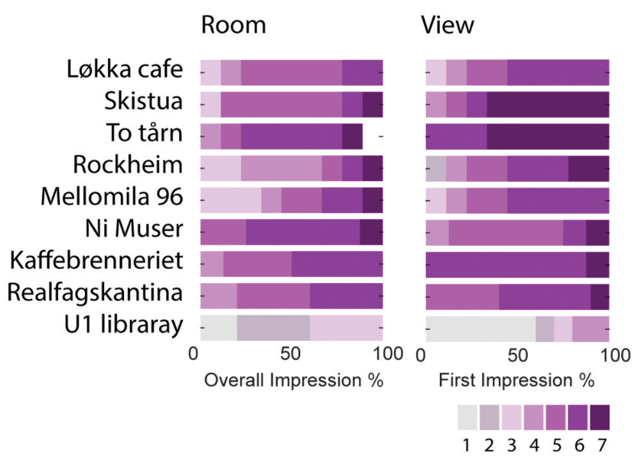

Fig. 3. Distribution of the responses in percentage (X-axis) for overall impression of the room and first impression of the view, compared between the 9 scenes.

and view differed from each other, yet 4 attributes were used for both factors: *Order*, *Familiarity*, *Beauty*, and *Uniformity*.

By making a visual inspection of the graphical plots, it is possible to have a better understanding of which spaces received higher ratings in the evaluations. The particularly evident results are that the café "To Tårn" received higher evaluations for both room and view, indicating a higher preference for this location. These results could be related to the fact that the café "To Tårn" is located next to the historical, cultural and most tourist landmark in the city of Trondheim, i.e., the Nidarosdomen cathedral. This could have influenced the ratings of both the room and the view (café with view to the cathedral through the glazed facade).

In contrast, the "U1 Library" received the lowest ratings for most of the attributes in both room and view. The "U1 Library" is a library at the NTNU university, located on the underground floor of one of the university buildings with close views to a similar nearest building.

Moreover, by visually assessing the attribute *Familiarity* (which received in average positive ratings for both room and view) for all the evaluated spaces, the graphical plots show that the spaces which received more positive ratings for familiarity were mostly the public cafés (i.e., To Tårn, Løkka, Skistua, Kaffebrenneriet, Ni Muser). The other evaluated spaces representing a library, social room, museum cafeteria and university cafeteria received lower ratings of familiarity compared to the public cafés. Being that public cafés are for the most part similar in different parts of the world, these results would support the notion that participants, despite being their first time in such spaces, rated the cafés as familiar in relation to the general idea of the space, and not about the specific space.

3.2.2. Correlation analysis

The level of measurement of the Semantic Differential Scales (SDS) has been discussed for long: some believe that they should be treated as ordinal scales, while others claim that the middle/neutral point of the scale serves as a 0 point, and thus should be treated as interval scales. There seems to be still no consensus regarding this point, and SDS are treated as both ordinal or interval scales within lighting and architectural research. In the present study, a close visual inspection of the normality of the data was carried out, which showed that the data presents a non-normal distribution, leading to the use of non-parametric tests. Consequently, Spearman's rho correlation test was used, as not only is a non-parametric test, but also because it is considered robust to non-normal distributions (Kowalski 1972; Yu and Hutson 2022).

The correlation statistical tests were performed across rooms and views to explore possible associations between the studied attributes. In particular, the analysis focuses on discovering which of the nine studied attributes have a stronger association with the overall impression of the room, and which of the eight studied attributes for view have a stronger association with the evaluation of the view's first impression (for addressing RQ2 and RQ3, respectively).

3.2.3. The overall impression of the room and the first impression of the view

The results show that the overall impression of the rooms is positively correlated with 8 of the 9 studied attributes, in which *Order* was the attribute that was not associated with the evaluation of *Overall impression* of the rooms, see Table 3. Moreover, according to the benchmarks provided by Cohen (Cohen 1988), in which 0.10, 0.30 and 0.50 represent small, moderate, and strong associations, respectively, the results indicate that *Overall impression* had a small association with *Openness*; a moderate association with *Size* and *Familiarity*; and a strong association with *Friendliness*, *Uniformity, Playfulness, Beauty* and *Comfort*. In particular, *Beauty* was the attribute that presented the strongest association with *Overall impression*. Interestingly, *Order* was the attribute that only presented two associations (to *Size* and *Openness*), both of a moderate nature.

A similar analysis was carried out for all the studied attributes regarding view. As previously discussed, the study focused on uncovering possible associations of the studied attributes with the first impression of the view, see Table 4.

The results show that all the 8 studied attributes related to view were associated with the evaluation of the *First impression*, showing positive correlations coefficients. These results indicate that as the evaluation of any of these attributes increases so does the evaluation of first impression, or vice versa. In particular, *First impression* presented moderate associations with 4 attributes (i.e., *Uniformity, Distance, Naturalness* and *Order*) and strong association with the other 4 attributes (i.e., *Excitement, Familiarity, Inviting* and *Beauty*). Interestingly, similar to the studied attributes for room, *Beauty* is also the attribute that presents the strongest association with the impression of the view.

3.2.4. Linear Mixed Model (LMM) analysis

In relation to each view and scene (room), our design allowed taking multiple measures per participant, Fig. 3. However, multiple responses from the same subject cannot be regarded as independent

Table 3. Spearman's rho correlation coefficients for the studied attributes for the evaluation of all the rooms.

	Overall impression	Friendliness	Uniformity	Size	Openness	Familiarity	Playfulness	Beauty	Comfort	Order
Overall impression	1									
Friendliness	0.768**	1								
Uniformity	0.614**	0.634**	1							
Size	0.308**	0.179	0.131	1						
Openness	0.296**	0.231*	0.106	0.622**	1					
Familiarity	0.332**	0.481**	0.365**	0.053	0.019	1				
Playfulness	0.624**	0.636**	0.713**	0.138	0.187	0.414**	1			
Beauty	0.837**	0.825**	0.671**	0.304**	0.281*	0.396**	0.671**	1		
Comfort	0.747**	0.808**	0.608**	0.151	0.195	0.464**	0.669**	0.823**	1	
Order	0.153	0.185	− 0.185	0.314**	0.371**	− 0.059	− 0.041	0.200	0.152	1

*Correlation is significant at the 0.05 level (2-tailed); ** Correlation is significant at the 0.01 level (2-tailed).

Table 4. Spearman's rho correlation coefficients for the studied attributes for the evaluation of all the views.

	First impression	Excitement	Uniformity	Distance	Familiarity	Inviting	Beauty	Naturalness	Order
First impression	1								
Excitement	0.761**	1							
Uniformity	0.370**	0.542**	1						
Distance	0.403**	0.394**	0.311**	1					
Familiarity	0.508**	0.439**	0.345**	0.216	1				
Inviting	0.721**	0.777**	0.423**	0.260*	0.600**	1			
Beauty	0.787**	0.795**	0.353**	0.395**	0.554**	0.809**	1		
Naturalness	0.460**	0.462**	0.233*	0.563**	0.342**	0.501**	0.621**	1	
Order	0.372**	0.345**	− 0.111	0.171	0.153	0.299**	0.392**	0.242*	1

*Correlation is significant at the 0.05 level (2-tailed); **Correlation is significant at the 0.01 level (2-tailed).

from each other. Every person has personal characteristics and differences, and this is going to be an idiosyncratic factor that affects all responses from the same subject, thus rendering these different responses inter-dependent rather than independent. To take this into account we added a random effect to the subjects. This allows us to resolve this non-independence by assuming a different "baseline" value for each subject. In LMM, this randomness is defined by considering different intercept values to each subject. Thus, the model expects that there's going to be multiple responses per subject, and these responses will depend on each subject's baseline level. This effectively resolves the non-independence that stems from having multiple responses by the same subject and taking the analysis beyond mere average over items for a subjects-analysis (each data point comes from one subject, assuring independence). Moreover, random slopes can be considered in the analysis to emphasize the subject-specific effects in the relationship between the predictor and outcome variables (Baayen et al. 2008; Barr et al. 2013; Clark 1973; Forster and Dickinson 1976; Locker et al. 2007; Raaijmakers 2003; Raaijmakers et al. 1999; Wike and Churchand 1976).

Adopting this approach for better understanding the relation between the attributes and the view/scenes while taking the participant-specific effects into account, we started by two main hypotheses and base models. The models below were selected based on the first step analysis incorporating random intercepts (1,3) and random slopes (2,4) to account for variation among individuals in their baseline levels of all responses to "First Impression" and "View Type" as view-out assessment.

$$\textit{First Impression} \sim X_F + \textit{Participant}_{\mathrm{R}} \tag{1}$$

$$\textit{First Impression} \sim X_F + X_R + \textit{Participant}_{\mathrm{R}} \tag{2}$$

$$\textit{View Type} \sim X_F + \textit{Participant}_{\mathrm{R}} \tag{3}$$

$$\textit{View Type} \sim X_F + X_R + \textit{Participant}_{\mathrm{R}} \tag{4}$$

Table 5 provides a comparison of the effect of explanatory variables on "First Impression," i.e., model (1 & 2), sorted by Akaike information criterion (AIC). In this comparative step, the variables most explaining the "First Impression" of the view are presented first as a fixed effect and random intercept and followed by random slope determined by the participant's number. Based on AIC value the models were sorted to show how well the models fit the data. In this analysis View Clarity, View Access, and View Content were excluded due to lack of responses. Table 5 shows the models 1 and 2. Table 6 shows the same comparison of the effect of explanatory variables on "View Type." Similarly, the variables are sorted to show how well the models fit the data.

Both tables depict the coefficient and intercept of each model, and the significance of the effect is shown based on random and fixed p values. In several cases, the better fit has been when both a random intercept and random slope were allowed. The order of the attributes as shown in the tables shows which attribute fits the data better and hence can explain the "First Impression" of the room better.

Almost all models show that the interdependence of the responses are significant for all attributes. The results show that there is a significant difference between how the participants used the

Table 5. Estimates and intervals for the linear mixed effect model (1) and (2) for "First Impression".

Fixed terms	Coefficient	Intercept	Type
$Excitement_R$	0.8***	0.84	Categorical
$Inviting_R$	0.9	0.92	
$Aesthetics_F$	0.8***	0.82	
$Uniformity_R$	0.5***	0.51	
$Nature_F$	0.6***	0.61	
$Distance_F$	0.4**	0.43	
$Familiarity_F$	0.5***	0.52	
$Ordered_F$	0.3***	0.32	

***$p < .001$, **$p < .01$, *$p < .05$.

Table 6. Estimates and intervals for the linear mixed effect model (3) &; (4) for "view type".

Fixed terms	Coefficient	Intercept	Type
$Distance_R$	0.7	1.8	Categorical
$Excitement_F$	0.7	1.3	
$Beauty_F$	0.7	1.3	
$Inviting_F$	0.7	1.0	
$Uniformity_F$	0.5***	2.4	
$Nature_R$	0.3***	3.5	
$Familiarity_F$	0.4**	2.7	
$Order_F$	0.2***	3.74	

***$p < .001$, **$p < .01$, *$p < .05$.

different attributes in relation to the "First Impression" of the view. In the case of the view type as shown in Table 6, participants' responses agree better when evaluating the view type based on first Distance, and then the following order of Excitement, Beauty, and Inviting. While there is a larger disagreement in responses using attributes such as *Uniformity*, *Nature*, *Familiarity* and *Order*. In this table the order of attributes also indicates which attribute is better correlated with the responses related to the view type. In this analysis, while we could show the non-independency of the participants' responses, we did not explore which combination of the attributes define a view quality from each subject point of view.

3.2.5. Synthesis of LMM results

Independence is an important assumption when investigating subjective responses in relation to a phenomenon, here view and view quality. Since the subjects have provided several responses, as seen in Fig. 3 these cannot be regarded as independent. Adding a random effect to the subjects allowed to resolve non-independence by assuming different "baseline" levels of view-out assessment for each subject. In the correlation study, we investigated the relation between each attribute to first view impression. We could see that there is a positive correlation between the attributes and the "First Impression" of the view. Taking the analysis one step further, we resolved the non-independence of responses using LMM where we allowed for both random intercept and random slope.

The interdependence of the responses was significant for all attributes meaning that the participants have had very different interpretation of the context and hence their responses. This indicates that there are a combined set of attributes that define a view quality from each subject point of view.

"Excitement" can be considered an attribute that participants have agreed most about when describing their "First Impression" of the room. This is followed by, inviting, aesthetics, uniformity, nature, distance, familiarity, and order. The participants have had the least agreement in terms of how "ordered" the room's first impression or the view type is. While the two attributes as shown in the Spearman study correlate in a similar way to "First Impression" of the room, the order of attributes in terms of agreeableness between the participants is not the same in the two analyses.

One reason could be that the attributes could convey different meanings for different participants. Considering the diversity in terms of age and background between the participants, this can be anticipated. Hence, the relation between the meaning of the word and the view content becomes more complex and could be standardized between participants. In other words, more attention should be given to linguistics and semiotics.

The responses in relation to view type mostly agree when the distance to the window is in question, followed by excitement, beauty, inviting, uniformity, nature, familiarity, and order. Distance, while being intuitively an important aspect of view and fitting best based in this analysis, has not shown a significant effect on responses. Like "First Impression," the agreeableness between subjects' responses is least when asked about the attribute "ordered."

The view quality is complex to define, the synthesis of the spearman and the LMM study here, while highlights the complexity of the attempt to quantify the quality of view, it clearly shows agreements and stronger correlations toward certain attributes among the participants. A more in-depth study with a larger focus on the words and attributes and a standard introduction to them is needed.

3.3. Qualitative analyses across locations

The qualitative questions aimed to determine not only which rooms and views were most or least preferred but also the reasons behind these preferences. The results have been collated in form of word clouds and are shown in Appendix 2 for each location. In the following two subchapters we sum up observations across locations.

3.3.1. The rooms

Interestingly, the words (characteristics) used in descriptions of most rooms are *large*, *open*, and *spacious*, even though the rooms vary greatly in size. In addition, these mutual characteristics refer to the visual perception of the rooms, the lighting, and the color palette, not to other sensory experiences (loud/noisy – calm/quiet). Most rooms are described with one or two positive attributes, such as *welcoming*, *nice*, *cozy*, *warm* and *calm*. Two rooms (no. 2 and 8) stand out, as the descriptions include none of those mentioned above characteristics but instead are described with words such as *dull*, *boring*, *empty*, *hard surfaces* and *industrial*. Generally, the descriptions of the rooms focused on characteristics related to the indoor setting except for one location, where the garden view was mentioned, making a connection to the outdoor environment.

3.3.2. The view

For most rooms, the natural elements are mentioned as a part of the view, e.g., *sky*, *clouds*, *stone*, *water*, *river*, and *greenery*, regardless of the distance from the room. The descriptions are made in general terms i.e., *greenery*, *plants*, *trees*, and *leaves* without specific details or types/species. Also, the word *water* is used not outlining if it is the ocean or a river.

Interestingly, when greenery is mentioned, the view is described as *cozy*, *realistic*, *pleasant*, *lavish*, and *interesting*. Further, as being *depth*, *distance*, *long*, *prospect*, and *far*.

Interestingly, the view with *water*, *sky*, *clouds*, and the *color grey* the view is described as *sad*, *gloomy*, *dull*, and *boring*. Further, as *blocked*, *small*, *narrow*, and *distant*.

The descriptions of the view range from being coherent to complex and varied, but they do not show any specific connection to other aspects of the views.

3.4. Visual communication through sketches and photos

The aim of visual communication through sketches was to give participants the possibility to communicate non-verbally. As Arthur Brisbane said, a picture is worth a thousand words (Pomerantz 1958). The question was if hand drawings contain information that have not appeared in verbal answers of a comprehensive survey?

The monochromatic and colorful sketches for rooms 1–7 done by the participants were examined by two experts with higher degrees in art. All the sketches were scanned and printed out in the same size format. The visual analyses of the drawings focused on visual elements depicted and not depicted by the participants.

The sequence for the analysis were:

- Marking of the participants' view choice on the collected photos of the spaces

- Description of depicted and not depicted elements of the chosen view
- Description of dominating colors chosen by the participants to convey the impression of the view
- Average overall rating of the view delivered by the participants in numerical scale 1-7 (min. 1; max. 7)

The results were discussed during an online and an in-person meeting.

The results indicate that most of the drawings capture the long perspective views (panoramic views) despite other available choices. The complexity of the drawings was higher for views with a higher average overall appreciation score. The views enabling few viewing directions were more appreciated than narrow views with one direction, which also was expressed by the number of details included in the drawings. Greenery was depicted by all participants for 6 out of 7 visited spaces. Four participants' drawing skills improved over time during the time of the workshop. Overall, all participants appreciated similar views with small disparities and no view was rated inadequate.

The limitation of the sketches and drawings analysis were:

- The usage of different drawing tools (markers, crayons, pens) makes a comparative analysis of the drawings difficult.
- The choice of the elements drawn by the participants could be affected by the level of drawing abilities, time, or tool limitation (e.g., avoidance of drawing complex things like a car or a yacht or others).
- The drawings did not capture the changes within the view (car, birds, moving people).
- Limitations of drawing tools' color palettes impacted the choice of colors within the drawings.
- The digital processing of all images may affect the quality of scans and prints (scan, 2D software, cutting tool).

The future recommendation includes use of only one type of drawing tool, a separate piece of paper in a certain format for all the drawings. The size of the paper may affect the choice of the scale of the drawings and the depicted details. As found in relevant literature (Beute 2014; Mirza 2015) an option to put words describing certain elements of the view (equalizing drawing abilities) within the drawing limits the uncertainties related to the drawing skills of the participants. Also, it should be suggested to communicate appreciation through the elements depicted within the drawings. The participants should be encouraged to put comments recording the elements of the inferior and the liked views directly on the drawings.

The photos taken by the participants were also commented by an artist who did not participate in the workshop. The photos and comments are partly included in Appendix 2.

3.5. Results of cognitive testing

Does the perceived quality of visual environment have an impact on cognitive ability and emotions? Such a question cannot be answered in the context of the workshop with a rather small number of participants, limited time, and resources, but some tendencies may appear.

Paired samples t-tests were used to examine the performance in the Good (Realfagkantina) and the Bad Room (U1 library) across non-emotional and emotional cognitive tasks. Emotionality bias scores were calculated for Facial Expression Recognition Task (FERT) and Emotional Categorization Task ECAT by subtracting mean accuracy for negative stimuli from that of positive stimuli for faces and words, respectively. To streamline interpretation, the calculation of reaction time (RT) bias in these tasks was reversed, with RT during positive trials being subtracted from negative trials. Thus, for all four bias measures, higher positive scores indicate larger positive biases, whereas more negative scores indicate negative emotional biases. Additionally, we conducted correlational analyses between difference scores in Visual Analog Scale (VAS) and difference scores in cognitive tasks, as well as paired samples t-tests across rooms on the VAS-scores that were significantly associated with cognitive measures. Analyses were performed with Statistical Package for Social Sciences (SPSS, version 25.0.0.2, IBM, NY, USA). Effects are reported as significant at $ps \leq .05$ (two-tailed).

3.5.1. Non-emotional cognitive tasks TMT-A, tmt-B and SDMT

There were no significant differences in the Trail Making Test-A (TMT-A) and the Trail Making Test-B (TMT-B) – performance between the Good and the Bad Room ($ps \geq .12$), neither was there any significant difference in Symbol Digits Modalities Test (SDMT)-performance between the rooms ($p = .19$). However, descriptive statistics showed a numerical tendency toward better performance in the Good Room across all tasks based on mean performance scores (Figs. 4 and 5).

3.5.2. Emotional cognitive tasks FERT and ECAT

There were no significant differences in Facial Expression Recognition Task (FERT) and Emotional Categorization Task (ECAT)-biases between the Good and the Bad Room, neither on bias within accuracy ($ps \geq .43$) or RT ($ps \geq .07$) during the facial expression recognition and emotional categorization tests. However, descriptive statistics showed a numerical tendency towards more positive/less negative bias in the Good Room across all measures based on mean bias scores (Figs. 6 and 7) revealing the same trend as the non-emotional cognitive tasks.

3.5.3. Correlations with mood and performance

Larger difference scores in ratings of anxiety were associated with larger differences in performance on TMT-B ($r = .88, p = .001$) (Fig. 8a), indicating that less anxiety was associated with better performance on this task. Based on descriptive statistics, there was a non-significant tendency towards lower levels of anxiety in the Good Room($p = .18$) (Fig. 8b). Additionally, larger difference scores in ratings of sadness between the rooms were associated with larger differences in performance on TMT-A ($r = .67, p = .035$), suggesting that those who experienced more sadness in the Bad vs the Good Room also showed larger performance differences between the rooms. All other correlations between ratings of mood and performances were not significant($ps \geq .051$).

3.5.4. Post-hoc power analyses

Post-hoc power was considerably low for all tasks, $power \leq 45.7$, most likely due to the small sample size). See Table 7 for the number of participants required to achieve adequate (≥80%) statistical power.

4. Discussion

The study was limited to public or semi-public (cafe and library at the university campus) places because of easy access, long opening hours, and superb possibility for food intake in breaks. Public places are often located in attractive places and are characterized by pleasant and comfortable furniture. Consequently, most of the views were liked well or very well, just the middle score for *the first impression of the view* was higher than the middle value 4.0 (figure X1) for eight of nine views. Also, the rooms were liked quite well as *the overall impression of the room* was higher than 4.0 for seven of nine rooms. The disadvantage of using public places was the presence of other people (not participating in the workshop) that limited the choice of sitting places and could have an impact on noise level or smell, which indirectly may have impacted *the overall impression*.

The weather was cloudy during the visit at all locations and even foggy at Rockheim. Interestingly, despite the bad weather conditions

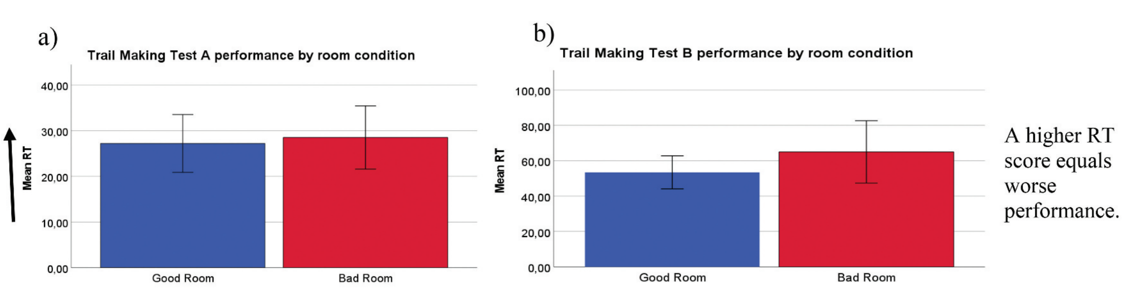

Fig. 4. Trial making test A (a) and B (b). Non-significant trends towards better performance in the good room compared to the bad room on TMT-A (a) and TMT-B (b). A lower score equals better performance.

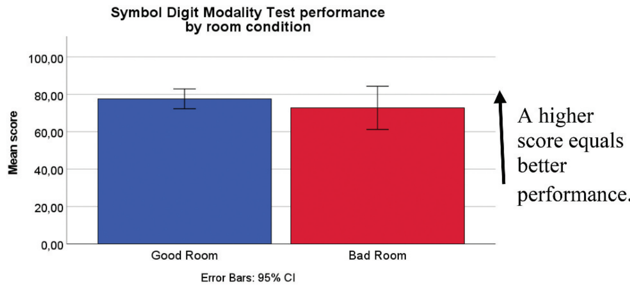

Fig. 5. Symbol digit modality test. Non-significant trends towards better performance in the good room compared to the bad room on SDMT. A higher score equals better performance.

(gray sky) the scores given for views were high. It seems that evaluating the quality of views participants were able to correct for this effect. If the scores could have been higher on a sunny day is an open question.

Considering the most liked and disliked views, their characteristics and view elements gave us valuable insight. The view from To Tårn (mean score for *first impression* 6,6) was dominated by the artistically designed, well-proportioned and richly decorated (gothic details and sculptures) stone facade of the medieval cathedral of very high historical significance. Besides that, another historical medieval building was located on the opposite side of a large and well-proportioned place where tourists circulate, with their eyes often turned on the cathedral. A few large trees flanked the view on both sides. As the wall separated the room and the outdoors was a glass wall, the cathedral façade was in fact a part of the room environment, which contributed to a very high score for the overall quality of the room (5.9). This location scored very high for beauty, order, openness, naturalness, and historical significance. The view from Skistua (6.4), ranked as the second best, was dominated by boreal Norwegian forest stretching to the horizon, a mixture of full naturalness and a long distance. The appreciation of the view was strengthened by the framing of the view with wooden window frames placed rather low in the wall, like picture-frames. The third most liked view (6.1) was from Kaffebrenneriet toward a narrow street with 2–3-stories old wooden

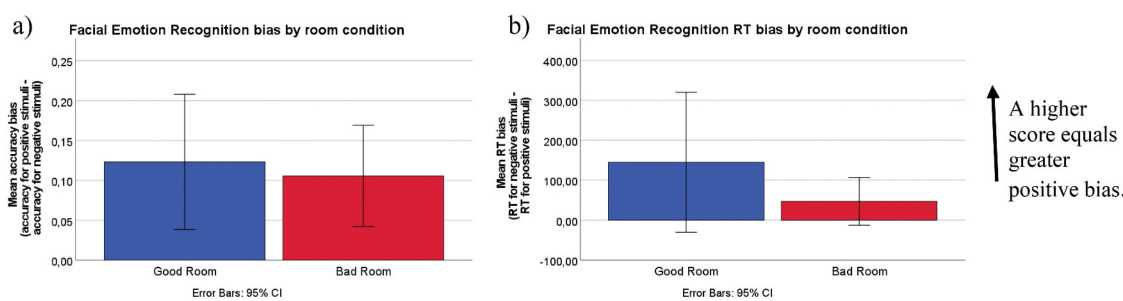

Fig. 6. Facial emotion recognition bias by room condition (a) and facial emotion recognition RT bias by room condition (b). Non-significant trends towards more positive bias in the good room compared to the bad room on accuracy (a) and reaction time (b) in the facial emotion recognition task. A higher score equals greater positive bias.

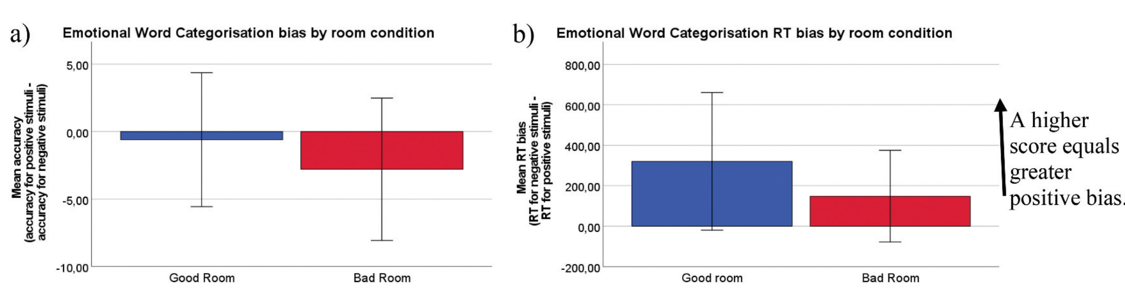

Fig. 7. Emotional word categorization bias by room condition (a) emotional word categorization RT bias by room condition (b). Non-significant trends towards less negative bias and more positive bias in the good room compared to the bad room on accuracy (a) and reaction time (b) in the emotional word categorization task. A lower score equals larger negative bias, and a higher score equals greater positive bias.

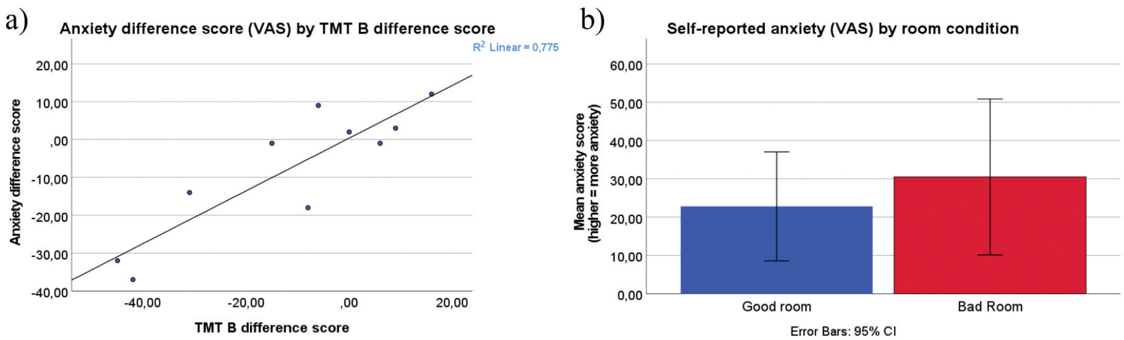

Fig. 8. Anxiety difference score (VAS) by TMT B difference score (a) self-reported (VAS) by room condition. (a) higher difference scores in anxiety-rating were associated with higher difference in performance on TMT-B. (b) there was a trend towards a higher level of anxiety in the bad room compared to the good room.

houses having original and reach detailing and painted in traditional chromatic colors (close to color harmony), with presence of people sitting on the street-cafes, going, or cycling slowly on the stone pavement.

The most disliked view U1 library (1.8) did not have any form of naturalness besides a small fragment of the sky (no sun) visible from the window, repetitive design of opposite building and short distance to it, no people or other living creatures included. Very large windows in the room contributed to high daylight level in this room, but they also had a negative effect on the overall impression of the room, as the boring façade of the opposite building became a part of the visual environments in the room as well (2.2). The second disliked view in this study, which got over middle scores (5.1) anyway, was the view from Ni muser. The view was very much dominated by greenery, but the view distance (outside the room) was short. This points in the direction that if trees are located close to the building obstructing the distant view, the view is liked less than if the trees are in a distance.

The most disliked room was U1, the only high score was for *order*, which turns out not to be enough for appreciation of the room. The second most disliked room was Rockheim (4.4), which is a bit puzzling as the totally glazed walls convey a distant view that was evaluated significantly higher than the room. The cause must be related to the interior design dominated by polished concrete floor, white – black furniture and hard surfaces: large glass areas on facades and on the ceiling. Additionally, lower daylight level than expected from the glass facades (protruding roof) may be a contributing factor.

Interestingly, the views from Løkka café and Mellomila scored equally on the *first impression* (5.3). Both had limited views toward water (the fjord or a river), red-brick buildings (new or older ones) and elements of greenery in the distance.

The cognitive testing showed numerical differences in several measures and a significant correlation between the difference scores for sadness and the difference scores for mental flexibility expressed with TMT-B across the two different rooms that were respectively Realfagkantina (view 5.7) and U1 library (view 1.8). To our knowledge, this is the first time a cognitive test battery has been used to investigate the impact of view out. The lack of significance could be due to a low sample size (Type II error). The post-hoc power calculation showed that for some tests such as the TMT-B as little as 29 test persons would be needed for significance. Future work in this field should

Table 7. Post-hoc power across tasks.

	Power (%)	Sample size required to obtain 80% power
TMT-A	6.0	709
TMT-B	33.6	29
SDMT 120	24.3	42
ECAT-bias (ACC)	9.7	162
ECAT-bias (RT)	45.7	21
FERT-bias (ACC)	11.6	116
FERT-bias (RT)	17.8	62

include cognitive testing on large samples. This could include school classes or university students.

4.1. Limitations

The present study was a pilot study with few limitations. The number of participants was rather small compared to the numbers advocated in the research. Nevertheless, the participants were experienced and well skilled in research tasks of that type, which means that mistakes due to the misunderstanding of questions and methodology have been avoided. Moreover, the participants were very knowledgeable, they helped to improve the procedure in advance and to its smooth implementation. They had genuine motivation to participate, as the workshop gave them experience relevant for their own research. All questions were answered thoroughly by all participants; additional comments were written if they were a little unsure; one participant responded even with sentences where single words were expected.

Also, the choice of locations was limited to public places, which, at least in Trondheim, are generally well designed, neat, and well maintained. Places of a very low quality are not included in this study.

The distribution of males and females was not balanced. This limitation may not have a negative effect on the reliability of the results. In the study "The Impact of a View from a Window on Thermal Comfort, Emotion, and Cognitive Performance" (Ko et al. 2020) researchers tested the effect of potential moderator variables (sex was one of few) on the effect of experimental conditions. They have found no effect of gender.

5. Conclusions

5.1. Quantitative evaluation

RQ1: The most preferred rooms were To Tårn (5.9) and Ni Muser (5.9), the least preferred were U1 library (1.8) and Rockheim (4.4). The most preferred views were To Tårn (6.6), Skistua (6.4) and Kaffebrenneriet (6.1), the least preferred were U1 library (1.9).

RQ2: The overall impression of the rooms is positively correlated with 8 of the 9 studied attributes, in which *Order* was the attribute that was not associated with the evaluation of *Overall impression* of the rooms. *Overall impression* had a small association with *Openness*; a moderate association with *Size* and *Familiarity*; and a strong association with *Friendliness*, *Uniformity, Playfulness, Comfort* and *Beauty* that was the attribute that presented the strongest association with *Overall impression*.

RQ3: All the eight studied attributes related to view were associated with the evaluation of the *First impression. The first impression* presented moderate associations with four attributes (i.e., *Uniformity, Distance, Naturalness* and *Order*) and strong association with the other four attributes (i.e., *Excitement, Familiarity, Inviting* and *Beauty).*

5.2. Qualitative evaluations

The qualitative evaluation helped to understand the reason behind the scores given in quantitative evaluation. For example, the view from Mellomila 96 did not get high marks as it was *blocked* and *narrow*, nor was the panoramic view from Rockheim as it was *gloomy* and with *clouds*. On the other side, the view that got the highest scores, To Tårn, was described with the words *historic* and *stone*, underscoring the historical significance of the cathedral. The view from Kaffebrenneriet was described with *old* and *colored*, pointing at the old wooden houses. Also, we may understand the reaction to the view better, for example words *boring*, *dull*, *grey*, *closed*, *repetitive*, and *small* in the qualitative evaluation of U1 library clarify what features of architectural design are associated with negative outcome.

The most liked view elements across the locations were nature (4), trees (2), water (2), colors (2), people, movement, sky, distant view, architectural details (cathedral) and structures (arches). In the case of very bad view (U1 library) the sky was the most liked. The most disliked view elements were blocked view (5), cars (2), garbage, fence, scaffolding, container, concrete pavement, obstructions, overhanging ceiling, hotel building, industrial buildings, and the gray sky (see 3.1).

Depending on the location, attention was toward the horizon, movement, cathedral, green, details and colors, fountain, water and people. Associations were also very much dependent on the location: view, movement, industry, history, religion, old, peace, exploring, nostalgic, memories, tourism, garden, relax, pleasant, dull, boring, trees and birds. Attention, depending on the location, was toward horizon, movement, cathedral, green, details and colors, fountain, water, and people. Associations were also very much dependent on the location: view, movement, industry, history, religion, old, peace, exploring, nostalgic, memories, tourism, garden, relax, pleasant, dull, boring, trees and birds.

Generally, the descriptions of the rooms were focused on the indoor setting with one exception where a connection was made to the outdoor setting as "garden view;" otherwise, the descriptions of the view were in general terms and no specific mention of plant species (except in one case).

5.3. Analysis of drawings

The majority of the drawings capture the long perspective views (panoramic views) despite other choices available. The complexity of the drawings was higher for views with a higher average overall appreciation score. The views enabling few view directions were more appreciated than narrow views or views with only one direction, which also was expressed by the number of details included in the drawings. Greenery was depicted by all participants for 6 out of 7 visited spaces. Four participants' drawing skills improved over time during the time of the workshop. Overall, all participants appreciated similar views with small disparities and no view was rated inadequate.

5.4. Neurocognitive tests

The cognitive testing showed numerical differences in several measures and a significant correlation between the difference scores for sadness and the difference scores for TMT-B across two rooms, one of them having lowest score for the overall impression of the view (and the room) the second evaluated as over middle good view (and room).

5.5. In general

The main goal of this project was to find missing elements in view out standards and recommendations. The elements that contribute positively and negatively to the view quality are shown in Table 8.

Additionally, we found that the overall impression of the room may be increased/decreased by the high-quality/low-quality of the view, especially in the case of a very large glass area like glass-façade (To Tårn/U1 library). The quality of the view may be strengthened by well-designed framing of the view (Skistua). On the other hand, a nice view cannot guarantee the quality of the room, even if it is dominated by a distant and good view (Rockheim).

We also learned that the evaluation of views is very much dependent on the context. A distant view is not expected in the narrow streets of an old city, nor naturalness. Just the attributes *distance*

Table 8. Positive and negative view elements.

Positive	Negative
Buildings of artistic significance,	Blocked view, e.g., by overhangs or nearby obstructions
Buildings of historical significance,	Cars
Elements of nature: -water (large and small scale), -healthy and well-kept trees besides trees obstructing distant view, sky, especially in cases without other natural elements	Hard surfaces like concrete walls and pavements that constitute a large part of the view.
Presence of people sitting, walking, or cycling,	Industrial buildings besides of well-kept old brick ones
Architectural detailing (around windows, doors, or portals)	Garbage, fences, scaffolding, containers,
Color on facades (in harmony with architecture and the context)	

and *naturalness* are not relevant and should not be used in studies of such places. On the other side, a distant view and naturalness is expected from a high-raised building located near a fjord.

All the methods used in the study contributed to understanding the quality of the views and the spaces in different ways. The quantitative method appears to be the most precise, the qualitative method helped to identify qualities and relationships that might otherwise have been omitted or not fully understood. Drawings provided additional information that was not included in verbal responses. Photos helped to better understand the relation between space and view and to remember places. Daylighting simulations helped to understand the impact of window design on the level and distribution of daylight in the room.

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