

Restorative Experiences in New Wood-Based Accommodations: A Post-Occupancy Study

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Abstract

This pilot study explores the impacts of wooden accommodation buildings on occupant wellbeing and housing satisfaction using subjective post-occupancy evaluation. Drawing upon restoration theories from environmental psychology this study examines occupant perceptions of accommodation room interiors and their surrounding environments in relation to wellbeing, satisfaction, sleep quality, and stress. The study took place at a newly built massive-wood based facilities in Finland, in 2024. Data were collected with a combination of existing and newly developed instruments to assess indoor space and the surrounding environment. 81 respondents completed the survey. The results revealed that indoor comfort and eco-friendliness were strongly associated to occupant satisfaction and stress, while experienced accommodation safety and healthfulness played important roles, too. Although environmental features and wellbeing were associated stress, no environmental features were associated with sleep quality, wellbeing was the strongest indicator for these two factors. The validity and reliability of the developed new instruments were also assessed to be satisfactory, but the overall composition of the survey questionnaire could be simplified. Overall, the results contribute to increased knowledge about the role of the built environment on occupant experience of wellbeing and satisfaction in accommodation settings, and thus also provide a novel post-occupancy evaluation tool for future research.

1. Introduction

Accommodation buildings, such as dormitories, hotels, residential complexes and detached dwellings, serve as crucial environments for residents' daily lives and wellbeing as the built environment significantly influences physical and psychosocial wellbeing (Altomonte et al., 2020; Dolan et al., 2016). In modern lifestyles, people spend most of their time indoors making Interior design choices that affect indoor environmental quality critical decision points (Klepeis et al., 2001). Interior attributes like material selection, lighting, layout, and decorative elements can affect measured and perceived attributes like room temperature, indoor air quality, lighting, and comfort that affect occupant's satisfaction and perceived wellbeing indoors. In addition to design choices, providing control options for these functions can contribute to occupant comfort and satisfaction as well (Hellwig, 2015).

As the demand for more sustainable construction increases, bio-based and natural materials, like wood, have come to the forefront of the discussion surrounding sustainability in the construction sector. Bio-based materials, often have a more favourable environmental impact which may add to the aesthetic, functional, and biophilic attributes of buildings (Burnard & Kutnar, 2015; Sinha et al., 2013). The concept of biophilic design emphasizes inborn human connection to nature and suggests that natural elements in indoor environments can enhance restoration, reduce stress, improve cognitive function, and improve overall wellbeing (Kellert & Calabrese, 2015; Ojala et al., 2023). As humans spend over 80% of the day indoors, it is important not only to make wise and informed decisions regarding indoor design and environmental control, but also to assess the success (or failure) of design decisions on occupant

wellbeing and satisfaction. This makes data collection methods like post-occupancy evaluation important in understanding the effects buildings have on occupants.

This study's novelty is twofold. First, it provides new insights into the relationship between accommodation environmental quality and building occupants' experienced wellbeing and satisfaction. Second, it addresses the development, testing, and assessment of a new post-occupancy survey instrument to support future long-term data collection on occupant self-evaluation of accommodation characteristics and well-being. Follow-up studies can utilize the proposed instrument and insights to further investigate these relationships.

1.1. Theoretical background: Restorative environments, human wellbeing and wood

Restoration is a process of renewal that replenishes an expended social, psychological, or physical resource (Collado et al., 2017). Restorative environments are those places that improve the restoration process and are often linked to nature (S. Kaplan, 1995). Studies have investigated the restorative properties of forests and urban green spaces, for example, finding increased recovery from mental fatigue, stress, and physical exertion (Hansen et al., 2017; Tyrväinen et al., 2014).

Driven in part by the biophilia hypothesis and the demand for sustainable construction, researchers have investigated bringing elements of nature indoors to provide improved restoration where people spend most of their time, while also reducing the environmental impact of building (Bringslimark et al., 2009; Burnard & Kutnar, 2015; Klepeis et al., 2001). Moreover, relationships with nature have been linked to wellbeing, social connection, and positive environmental behaviour (Lengieza & Aviste, 2025). Elements of nature indoors, such as natural light, plants, water features, and natural material use as well as design choices in line with restoration theories are potential mechanisms for bringing nature indoors.

Wood is of particular interest because it is often recognised as natural, its additional sustainability potential, and its ease of use in construction and furniture production (Burnard et al., 2017; Kotradyova et al., 2019). Studies examining the health and wellbeing impacts of wood use indoors have found evidence suggesting a positive impact of wooden interiors on occupants (Cavaliere et al., 2026; Ikei et al., 2017; Lipovac & Burnard, 2020).

Many studies investigating the restorative and wellbeing impacts of buildings have been inspired by foundational theories from environmental psychology such as Attention Restoration Theory (ART) developed by Kaplan and Kaplan (1989) and Stress Reduction Theory (SRT) developed by Ulrich (1984). Later explorations of restorative environments have led to improved tools and understanding of the phenomenon, yet remain largely focused on outdoor environments in both urban and natural settings (Hartig, 2004; Hartig et al., 1997). While helpful in framing the broad field of research examining restorativeness, ART has proven difficult to translate to indoor environments and both ART and SRT have been challenged by more recent explanations of nature's role in restoration (Joye et al., 2024; Lipovac &

Burnard, 2020; Ojala et al., 2023). Alternative frameworks, like the goal-discrepancy account of restoration, needs-based frameworks, and person-environment fit highlight the necessity of designing spaces that align with human psychosocial and physiological needs (Altomonte et al., 2020; Joye et al., 2024; Van Vianen, 2018). The goal-discrepancy account suggests that nature can resolve discrepancies between one's (undesired) perceived situation and their desired situation to mitigate a source of stress and therefore provide restoration. It may do this directly, by experiencing nature, or indirectly, through thoughtful consideration of nature that may put one's perceived situation in a context that reduces the stress experienced by the individual (Joye et al., 2024).

Dolan et al. (Dolan et al., 2016) categorised the attributes of indoor environments that affect occupants into the SALIENT checklist which has seven critical categories that should be considered. These elements are: Sound, Air, Light, Image, Ergonomics, Nature, and Tint (colour). In connection of SALIENT framework, wood plays an important role in all of the seven dimensions, as it can help moderate relative humidity and temperature indoors (Air), (Alapieti et al., 2020) its interaction with light must be considered for optimal design (Light), (Jafarian et al., 2018) the complex patterns present in wood (i.e., grain, knots) can be visually stimulating but cultural preference moderates the benefits (Image), (Demattè et al., 2018) the haptic and olfactory aspects of wood use are important ergonomic considerations, (Bhatta et al., 2017; Podrekar Loredan et al., 2022) wood is known to illicit recognition of nature and naturalness, (Burnard et al., 2017) and woods varying colours can be utilised to address occupant preferences (Tint) (Lipovac & Burnard, 2020).

Wood, as a building material, is used in structural applications, cladding, flooring, wall paneling, ceilings, furniture, and decorative elements. The perceived quality of wooden building materials is affected by attributes such as sensory, social, economic, technical, and sustainability properties, along with personal variables like socio-demographic, cultural, and psychological aspects. Its widespread use is attributed to its durability, renewability, and ability to create warm and inviting atmospheres. People perceive wooden buildings and materials as aesthetically pleasant, ecological and healthy (Gold & Rubik, 2009; Larasatie et al., 2018; O'Connor et al., 2004; Rice et al., 2007). For example, studies indicate that occupants in Finnish wooden apartment buildings would prefer to see more wood in visible surfaces than is currently provided (Jussila et al., 2024). However, individual differences exist related to the acceptance of wooden surfaces among Nordic consumers as they change due to aging (Gustavsen et al., 2025). Additionally, socio-economic status has been found to influence attitudes toward wood use in buildings, with younger and more educated individuals showing a stronger preference for wood in construction (Harju, 2022; Häyrynen et al., 2020).

Numerous studies have demonstrated that the presence of wood in interior spaces contributes to psychological and physiological benefits, including lower stress levels, improved mood, and increased productivity (Burnard & Kutnar, 2015; Ikei et al., 2017; Lipovac & Burnard, 2023; Zhang et al., 2017). Nonetheless, studies addressing the health benefits using real indoor wooden environments suffer from several methodological shortcomings including small sample sizes, missing before-after measures, or specific control conditions in the research design, (Lipovac & Burnard, 2020) which make it difficult to

precisely measure the effects of wood material on humans and how wood material relates to theoretical frameworks such as Attention restoration theory (ART) and Stress recovery theory (SRT) (Ojala et al., 2023).

1.2. Post-Occupancy Evaluation (POE) – an approach for assessing occupant experiences of building interiors

Post-occupancy evaluation (POE) is a general approach of obtaining feedback about a building's performance in use, including indoor environmental quality and occupant satisfaction (Li et al., 2018). Over the years, researchers have utilized post-occupancy surveys to study green building certification and to understand occupants' satisfaction, identify performance deficiencies, and inform improvements in these buildings. POE thus plays an important role by providing feedback to a building life cycle with an occupant survey or interview as a typical research method (Li et al., 2018).

Aligning with the accommodation spaces considered in this study, POE has been previously applied to studies in campus residential facilities in various settings. These studies have identified specific issues such as floor plan configurations and occupants' ability to navigate in the buildings, (Weisman, 1981) HVAC and lighting systems, (Sanni-Anibire & Hassanain, 2016) variances in occupants' thermal preferences, acoustics and comfort in living spaces, (Bourikas et al., 2020; Xu et al., 2020) and diverse environmental strategies within the buildings (Lawrence et al., 2019) to affect occupant satisfaction with the spaces. POE has also been applied to timber buildings, having found quality of life did not differ between timber and non-timber buildings, that although occupants were concerned with durability, safety, and costs, they were satisfied with the overall appearance and architecture of their timber buildings, and that even in short-exposure studies, occupants rated comfort, satisfaction, and overall perceptions positively in a wood room compared to a non-wood room (Karjalainen & Ilgin, 2022; Lindblad, 2019; Watchman et al., 2017).

1.3. Developing conceptual framework for the study

To understand these connections between indoor and outdoor environments and occupant satisfaction and wellbeing, a conceptual framework was developed (Fig. 1). The framework links subjective evaluations of accommodations (both their indoor attributes and the surrounding environment) to respondent evaluations of their overall satisfaction, sleep quality, and stress as indicators of wellbeing. These effects are anticipated to be moderated by demographic characteristics, experience with wood, forestry, architecture, and construction, and nature relatedness in our framework. The discrepancy between ideal indoor and outdoor accommodation environments and ratings of the current environment are also considered.

1.4. Research objectives

Despite promising evidence, the impact of wood material on human health and wellbeing is still not fully understood. While existing research supports the psychological and physiological benefits of wood,

further empirical studies are necessary to quantify the role of multi-sensory based perceptions and effects on occupant wellbeing, comfort and satisfaction, and how these are linked with each other as well as with the qualities of wooden buildings and their environments. Methodology has also varied considerably between previous studies, so we propose and evaluate a novel instrument that fills a gap in accommodation assessment that may be applied in future studies.

To address the complexity and thus challenges of understanding the restorative effects of nature in indoor settings, we also consider identifying discrepancies between one's ideal accommodation and their current accommodation as a potential source of stress.

The overall aim of this study is to investigate the impacts of wooden accommodation buildings to occupant wellbeing and satisfaction. Given this context we attempt to answer the following research questions:

RQ1

How do aspects of an accommodation's indoor quality and its neighbourhood quality affect occupant perceptions of wellbeing and satisfaction?

RQ2

Do occupants' expectations about their ideal accommodation compared to their current accommodation impact their perceptions of wellbeing and satisfaction?

RQ3

Does the new accommodation assessment instrument provide reliable information that can be assessed for research purposes?

2. Methods and data

2.1. Study setting

The study employs a post-occupancy survey to investigate the relationship between goal-discrepancy and restorative nature experiences in accommodation buildings. The survey included questions assessing visitor's current and ideal accommodation settings, perceptions of nature in their accommodation environment, sleep quality, stress levels, and satisfaction. Additionally, occupants are asked to provide feedback on the presence of nature elements and potential mismatches with their goals in the accommodation setting.

The study took place in University of Helsinki's Hyytiälä Forest Station, which is situated in Juupajoki municipality in Finland, and operates as an international hub for top-level forest and climate research and education. The forest station includes newly constructed wooden accommodation buildings (2023)

alongside a cafeteria, teaching facilities and offices. Located in the countryside, surrounded by forests, peatlands and lakeside views, the location is ideal to study the human-nature connection, and how the built environment affects it, in a real-world setting.

Only forest station buildings are visible from the site, which is surrounded by forests and a lake, thus limiting perceptions and experiences of respondents to any other buildings or building environments, that was the target of this study. The accommodation spaces include 36 nearly identical rooms for short term visitors, most with a capacity of up to 2 persons. The accommodations and cafeteria were built with sustainable construction and biophilic design as priorities. Wood is the primary structure material and is visible on most interior surfaces.

2.2. Data collection tool: Survey questionnaire design

The post-occupant survey focuses on investigating perception of wellbeing effects experienced by the occupants (e.g., psychophysiological self-evaluation, quality of sleep, relaxation, concentration and satisfaction with the accommodation). In addition, participants were asked to provide subjective evaluations of various aspects of the building indoor environment quality (e.g. ambiance, indoor air quality, acoustics, lighting and thermal comfort) as well as their perceptions of the broader surrounding environment (e.g. milieu, built environment, nature, activities and social interaction).

First, perceived wellbeing was assessed through self-reported stress levels, sleep quality, and overall wellbeing, supplemented by the Restoration Outcome Scale (ROS), (Hartig et al., 1997; R. Kaplan & Kaplan, 1989; Korpela et al., 2008; Ojala et al., 2023). Second, accommodation quality was measured using a combination of 17 items that reflect SALIENT factors (Dolan et al., 2016) other than tint and housing attributes, (Jussila et al., 2024; Kauko, 2006) which we refer to as the accommodation indoor quality scale (AIQS). The surrounding environment was evaluated using eight locational quality attributes, (Jussila et al., 2024; Kauko, 2006) which we refer to as the accommodation neighbourhood quality scale (ANQS). Third, nature connectedness was assessed with the 6-item Nature Relatedness Scale (NR-6) (Nisbet & Zelenski, 2013). Fourth, demographic background information of the respondents was included, including gender, purpose of the visit, household income, education level, household size, housing type, apartment ownership, area of residence and the respondents' possible connection to construction sector or forestry or wood material sciences. Finally, feedback was sought on the survey.

The survey was available in both Finnish and English, with translations provided and confirmed by native speakers within the research team. The study did not require full ethical review based on the ethical guidelines of the authors' university, which is committed to the Finnish national board on research integrity. Instead, an informed consent document and data management plan were created. Separate consent forms were distributed and collected prior to participation, accompanied by a privacy notice prepared in accordance with data protection standards for scientific research. The data management plan for the study was publicly available for participants and others to review. Data were collected using the Webropol online platform, and access to the survey required a password to ensure participant confidentiality and data integrity.

2.3. Data

Data was collected between April – November 2024. Eleven visitor groups accommodating in the research station responded to the survey. The participants of the groups consist mainly of researchers, academic professionals and students taking part in organized seminars in the Hyytiälä Forest Station. Motivation to participate in the study was explained and encouraged by organizers of each visitor group. The study reached a total 296 visitors, of which a total of 81 responses were received resulting in a 27% response rate (Table 1). Of the 81 respondents, 67 provided responses to the optional open-ended questions about the accommodation. Due to empty responses (i.e., NA) in some variables, the number of observations varied by regression model as indicated *Regression analysis* section below.

Table 1
Targeted visitor groups and the study sample size.

Visitor Group	General group profile	Visit time (month)	Group size	Number of respondents
Group 1	Research & teaching	April 2024	15	13
Group 2	Student	April 2024	13	3
Group 3	Research & teaching	May 2024	17	2
Group 4	Research & teaching	May 2024	16	6
Group 5	Research & teaching	September 2024	47	4
Group 6	Research & teaching	September 2024	32	11
Group 7	Professional	September 2024	14	5
Group 8	Student	October 2024	42	14
Group 9	Professional	October 2024	25	5
Group 10	Student	November 2024	30	10
Group 11	Student	November 2024	45	8
Total			296	81

Table 2 shows the respondent characteristics and demographic breakdown (total sample n = 81). A majority of the respondents were female (63%), while 32% were male and 5% identified as non-binary or preferred not to say. For around half of the respondents, the purpose for the visit was related to studies, while the other half consisted of professionals (33%) or research and teaching (16%). The average household income was around 40,000 euros / year, approximately the same level with general population in Finland (Official Statistics of Finland, 2025d). As our respondents mainly consisted of students and academic professionals, our respondent profile leans towards higher education level (94% with university degree in the sample, while 33% in general population) (Official Statistics of Finland, 2025b).

Table 2
Sample characteristics and demographic breakdown

Respondent characteristics (total sample n = 81)	Frequency (n)	Percent (%)	General population, % (Official Statistics of Finland, 2025d, 2025b, 2025a, 2025e, 2025c)
Gender			
Male	26	32	50
Female	51	63	50
Non-binary	3	4	N/A
Prefer not to say	1	1	-
Purpose of visit			
Student	39	48	N/A
Professional	27	33	N/A
Research & teaching	13	16	N/A
Leisure	2	2	N/A
Household total income (eur/year)			
0–19 999	24	29	20
20 000–39 999	18	22	30
40 000–69 999	13	16	27
70 000–99 999	11	13	14
100 000–119 999	5	6	4
120 000–149 999	3	4	3
150 000 or over	4	5	2
Missing	3	4	-
Educational level			
Primary school	-	-	25
High school or vocational school	5	6	41
University degree	56	68	32
Doctoral degree	20	24	1
Household size			

Respondent characteristics (total sample n = 81)	Frequency (n)	Percent (%)	General population, % (Official Statistics of Finland, 2025d, 2025b, 2025a, 2025e, 2025c)
Single	27	33	47
2 people	36	44	32
3 or more people	18	22	22
Area of residence			
City centre	20	25	39
Urban (dense)	43	53	24
Urban (scattered)	9	11	11
Rural (dense)	2	3	12
Rural (scattered)	6	7	13
Something else	1	1	-

In addition to the sample characteristics shown in Table 2, respondents' year of birth ranged from 1957 to 2005 with mean year of birth at 1985 (standard deviation 14.8 years). In addition, most respondents, 70%, live in apartment buildings, while 30% reside in detached or semi-detached houses. Regarding apartment ownership, just over half (53%) of the respondents rent their apartments, while 47% own or co-own their apartments. Regarding their professional relationships, only a small percentage of respondents (7%) work or study in a field related to construction or architecture, whereas larger proportion, 21%, have a professional or academic background in forestry or wood materials.

The results of the post-occupancy survey were analysed using both quantitative and qualitative methods to gain insights into the impact of design elements in wooden buildings and its surrounding nature on occupants' wellbeing.

2.4. Survey instrument analysis and simple comparisons

A preliminary assessment of the AIQS and ANQS was conducted to assess its reliability and latent variable structure. To test the reliability of the instrument we additionally calculated intraclass correlation coefficients. Additionally, we split the respondents into two groups (1–5 and 6–11 in Table 1) and compared ratings for each of the 17 items on the AIQS and the 8 items on ANQS for both the current environment and the respondent's ideal environment. These comparisons were made by using Bayesian Mann-Whitney U test for independent samples (Chechile, 2020). This test focuses on the U statistics for two groups (say, A and B). U_A is number of times the value of the observation in A is greater than the observation in B; U_B is the opposite. The test considers a population parameter, Ω_A , which is the ratio between U_A and the sum of ($U_A + U_B$).

Bayesian Wilcoxon signed-rank tests (Chechile, 2018) were used for comparisons between paired ratings of the respondent's ideal accommodations and the Hyytiälä accommodations for each item on the AIQS and ANQS. A Bayesian Wilcoxon test considers a test statistic, Φ_w , which is the proportion of positive differences between paired ratings. Φ_w was estimated using beta approximation as sample sizes were sufficiently large (> 24). Bayes factors are reported to indicate the strength of evidence related to the difference in values for both the Mann-Whitney U test and the Wilcoxon signed-rank tests (thresholds explained in the *Reported Indicators section, below*).

2.5. Accommodation quality dimensions perceived by occupants

We were interested to determine if the items on the AIQS mapped to a latent variable structure that matched the SALIENT factors (Sound, Air, Light, Image, Ergonomics, and Nature; Tint was excluded as no AIQS item matched that factor). Confirmatory factor analysis was conducted in a Bayesian setting using the blavaan R package (Merkle et al., 2021). However, the SALIENT structure could not be reliably fit with the items on the AIQS. Instead, an exploratory factor analysis (EFA) was conducted to determine what latent variable structure, if any, could be found in the AIQS and ANQS using the BayesFM packages (Piatek, 2016). Prior to conducting CFA or EFA, ratings were scaled and centred.

To assess factorability, several steps were taken. Visual inspection of the correlation matrix of the scale items revealed no excessively correlated off-diagonal pairs (i.e., Pearson's $\rho < 0.8$) for either the indoor or outdoor quality scale. Two formal tests were conducted to determine if the data was likely to be factorable using the psych R package (Revelle, 2025). The Kaiser-Meyer-Olkin (KMO) index of the indoor quality scale was 0.86, about half-way between meritorious and marvellous outcomes (Kaiser, 1974). Bartlett's test strongly indicated that the correlation matrix of the indoor quality scale was not an identity matrix (χ^2 : 738.12, degrees of freedom: 136, p-value < 0.001). The KMO index of the outdoor scale was 0.79, and Bartlett's test strongly indicated the correlation matrix was not an identity matrix (χ^2 : 244.37, degrees of freedom: 28, p-value < 0.001).

2.6. Thematic content analysis on the factor structure

The survey included optional open-ended questions on accommodation spaces and to provide feedback on the questionnaire. A thematic content analysis was used for these, to identify recurring themes and patterns related to occupants' experiences to "specific notes on accommodation spaces" and "pleasant and unpleasant aspects in the room" to gain deeper understanding on how the respondents evaluate the current accommodation spaces and the factor structure. The content analysis was conducted in Microsoft Excel to for categorization and summarization of the responses. The responses were coded and categorized using the AIQS (17 housing variables used in the questionnaire). A total of 67 out of 81 respondents included open-ended responses.

2.7. Regression analyses on factors contributing to occupant wellbeing

The factors contributing to overall satisfaction, sleep quality, and stress while accommodating were assessed using regression analysis in a Bayesian setting. Satisfaction and sleep quality were modelled using ordered beta regression as the responses were bounded between 0 and 100 which was scaled to (0,1), including the scale endpoints. Ordered beta regression differs from standard beta regression in that it models both the degenerate values (0, 1) and support values ($0 < y < 1$). Stress was modelled with a standard beta regression as there were no degenerate values in the dataset.

The variables under investigation were as follows:

Dependent (response) variables:

- Overall satisfaction: $0 \leq y \leq 1$ ($n = 78$ after removing empty responses)
- Sleep quality while accommodating: $0 \leq y \leq 1$ ($n = 80$ after removing empty responses)
- Stress while accommodating: $0 < y < 1$ ($n = 80$ after removing empty responses)

Independent (predictor) variables:

- Nature relatedness: mean score of the NR-6 items, scaled and centred (mean = 0, standard deviation (SD) = 1)
- Wellbeing: mean of the ROS scale items, scaled and centred (mean = 0, SD = 1)
- Factor scores, which are scaled and centred (mean = 0, SD = 1)
- Difference between importance of the scale item in an ideal accommodation and the rating of the Hyytiälä accommodation (Ideal - Hyytiälä)
- Sleep quality rating, scaled and centred (mean = 0, SD = 1)
- Difference in stress rating (usual – current), scaled and centred (mean = 0, SD = 1)
- Wellbeing rating, scaled and centred (mean = 0, SD = 1)

Priors for the regressions were largely uninformative, set to $N(0,5)$ for intercepts and predictor variable coefficients, which are on the logit scale. Each regression was fit using 4 chains with 20000 iterations of which 5000 were warmup iterations. Posterior predictive checks were used to assess fit, along with ensuring that all Pareto k estimates were < 0.7 . There were no divergent chains or other sampling problems. $\tilde{R}$ was approximately equal to 1 in all cases, with effective sample sizes ranging from 43051 to 46110 for the sleep model, 39577 to 66505 for the stress model, and between 39496 and 45673 for the overall satisfaction models. Models fit with different combinations of independent variables were compared using leave-one-out cross validation. The model with the greatest estimated pointwise predictive density is reported. Model fit, in all cases, was moderate, with the posterior following observed data but with a noticeable uncertainty.

Due to scaling and centring continuous independent variables, the associated effect sizes reflect a change of one standard deviation in the independent variable. Likewise, when dependent variables are scaled and centred, the effect size indicates a change in standard deviations of the dependent variable.

2.7.1 Reported indicators

The results of the Bayesian analyses we conducted are reported with indicators that are different than frequentist analyses produce. A brief explanation of each follows:

- Highest density probability intervals (HPDI) are used to describe uncertainty and reflect the narrowest region of the posterior distribution where 95% values of the plausible values are located. Probability of direction (PD) is reported to indicate the level of evidence that there is a non-zero effect. PDs range from 50% to 100% and indicate the percent of the posterior distribution that shares the same sign as the estimated effect size. At this pilot stage, we consider $90\% < PD < 94.9\%$ weak evidence and $95\% < PD < 97.5\%$ suggestive evidence, and $PD > 97.5\%$ strong evidence of an effect.
- Region of practical equivalence (ROPE) is a region that covers values which may not have practical significance, despite a high PD. ROPE was set to ± 2.5 scale points and is reported for the marginal effects of independent variables. If a significant proportion of the 95% HDPI falls within ROPE one should treat the estimated effect with care as it may not have practical significance.
- Bayes factors are reported as evidence of a difference in medians between rating periods and between current ratings and ideal location importance (using Bayesian Mann-Whitney U tests and Bayesian Wilcoxon signed-rank tests, respectively). The Bayes factor reported here is the ratio between the posterior probability of a null hypothesis (i.e., H_0) and an alternative hypothesis (i.e., H_1) and is denoted BF10 to indicate the relationship between the hypotheses. Conservatively, a $BF10 > 3$ provides suggestive evidence, while $BF10 > 20$ provides strong evidence, and $BF10 > 150$ provides convincing evidence. The inverse applies as well (i.e., $BF10 < 1/20$ provides strong evidence, etc.). A BF10 between 1 and 3 is unlikely to indicate any meaningful difference (cf. Kass & Raftery, 1995). Notably, Bayes factors can provide evidence in favour of a null (small BF10) or alternative hypothesis (large BF10).
- Bayesian root mean square error approximation (BRMSEA) is a fit indicator for factor structures identified through factor analysis and is reported for the factor analysis of the AIQS and ANQS.

In the case of the Bayesian Mann-Whitney U test, the null hypothesis is that the population parameter, Ω_A , is less than or equal to 0.5. For the Bayesian Wilcoxon signed rank tests, the null hypothesis is that the proportion of positive differences between paired ratings, Φ_w , is less than or equal to 0.5. In both cases, the prior was an uninformative uniform Beta(1,1).

Marginal effects are also reported but are conceptually the same under Bayesian and frequentist analyses, though the calculations are carried out differently.

2.7.2 Additional analytical software and tools

Data analysis was conducted in RStudio (Posit Software, PBC, 2026) using R version 4.5.1. (R Core Team, 2025) The packages brms (Bürkner, 2017) and ordbetareg (Kubinec, 2023) were used for fitting

regressions. The bayesics (Sewell & Arakkal, 2026) and DFBA (Barch & Chechile, 2023) packages were used to conduct Mann-Whitney U and Wilcoxon signed-rank tests comparing ratings, and the bayesboot package (Bååth, 2016) was used for bootstrapping (Rubin, 1981) in a Bayesian setting. Support packages including tidyverse (Wickham et al., 2019) for data manipulation and visualisation, bayestestR, (Makowski et al., 2019) bayesplot, (Gabry et al., 2019) and tidybayes (Matthew Kay, 2024) for working with regression models and outputs, and marginaleffects (Arel-Bundock et al., 2024) for calculating marginal comparisons and their credible intervals. Full processing code, with data, can be found online (DOI to be updated upon publishing).

3. Results

3.1. Questionnaire reliability

To evaluate the reliability of our scales developed for this study for occupant ratings of their accommodation rooms (AIQS) qualities and features of areas surrounding the accommodations (ANQS) we evaluated the data stability over time, interrater reliability, and the internal consistency of our factors, finding each to be satisfactory.

We compared the AIQS and ANQS between groups that were split in time to assess stability over time. The first half consisted of groups 1 through 5 in Table 1 and the second half consisted of groups 6 through 11 in Table 1. The AIQS was consistent between groups; none of the 17 items on the list showed a statistically significant difference between groups for the ratings of the Hyytiälä accommodations. Of the ANQS items, only Atmosphere (i.e., milieu rather than air quality) and Social factors had a statistically significant difference between groups. Group A rated Atmosphere higher (difference in medians: 10, BF10: 48.7) as well as Social factors (difference in medians: 7, BF10: 20.3) than group B. The second group (B) visited later in fall, when temperatures were dropping, potentially limiting their evaluation of the Atmosphere and Social factors as there were likely fewer outdoor social experiences. Even with these differences, which are 10% of the scale or lower, consistency between groups was evident. Figure 2 illustrates the consistency between groups of raters for both the current and ideal accommodations and their neighbourhood.

There were also differences in the ratings of ones ideal accommodations. However, these are to be expected as variance between individuals for ideal settings may be large. The importance of items closeness to nature (BF10: 23.9), building appearance (BF10: 24.6), indoor air quality (BF10: 27.9), privacy (BF10: 31.5), atmosphere (BF10: 212.6), environmental friendliness (BF10: 253.7), feelings of safety (BF10: 324.0), and view outside (BF10: 3634.1) were all rated higher by group A than group B.

Interrater reliability was good to excellent, according to the suggested scale breakpoints in Koo and Li. (Koo & Li, 2016) We assessed two-way random effects intraclass correlation coefficients (ICC) for absolute agreement (ICC (2,k)) and two-way mixed effects ICC for consistency (ICC (3,k)) of ratings. Absolute agreement was good for the AIQS (ICC(2,k) = 0.90; 95% CI: 0.82 to 0.96) and excellent for the

ANQS (ICC(2,k) = 0.96; 95% CI: 0.9 to 0.99). Consistency assessments were similar. ICC(3,k) was 0.93 (95% CI: 0.88 to 0.97) for the AIQS and 0.97 (95% CI: 0.93 to 0.99) for the ANQS.

3.2. Comparing importance in ideal accommodations with ratings of the Hyytiälä accommodations

The overall assessment of the Hyytiälä accommodations indicated that it was rated slightly higher than respondents rated the average importance of all items on the Ideal accommodation (median difference: 2.4, IQR = 14). However, there were many individual differences in AIQS ratings, and the overall assessment was skewed heavily by the ratings of newness of the Hyytiälä accommodations (Fig. 3, Table 3). Fewer than half of the AIQS items – 7 out of 17 – were rated similarly between the ideal and Hyytiälä accommodations ($0.05 \leq \text{BF}_{10} \leq 20$): acoustic quality, feelings of safety, floor plan, light quality, natural light, pleasant appearance, and support for wellbeing. Evidence was strong that privacy, furniture comfort, indoor temperature, coziness aspects, coziness items from the AIQS were all rated higher for one's ideal accommodation ($\text{BF}_{10} < 0.05$). In contrast, beautiful materials, environmental friendliness, speech quality, and newness were rated higher at the Hyytiälä accommodation ($\text{BF}_{10} > 20$). Of the items on the ANQS only atmosphere ratings were similar between ideal accommodation and Hyytiälä ($\text{BF}_{10} = 1.25$). Important places access and essential services were rated lower at Hyytiälä compared to respondent's ideal accommodation ($\text{BF}_{10} < 0.05$), while the remaining ANQS items, pleasant appearance, social factors, outdoor activities, shared spaces and closeness to nature were rating higher at Hyytiälä than the ideal accommodation ($\text{BF}_{10} > 20$).

Table 3

Results of comparisons between ratings of an ideal accommodation vs. the current. IQR is the interquartile range. Ideal rating is the rating of importance of each item in the respondent's ideal accommodation. Rows in the bold indicate a high probability of a difference in meanings ($0.05 < = BF_{10} < = 20$). * The difference shown here was calculated by bootstrapping and may differ slightly from the simple arithmetic difference between the medians. Medians and IQRs are rounded to the nearest whole number. ** HDI is the highest density probability interval of the posterior distribution containing 95% of plausible values of the bootstrapped difference between medians. Rows with bold text indicate strong evidence of a difference in medians ($BF_{10} > 20$ or $BF_{10} < 0.05$).

Variable	Current rating median $\pm$ IQR	Ideal rating median $\pm$ IQR	Difference*	95% HDPI**	BF10
Acoustic quality	87 $\pm$ 20	92 $\pm$ 23	-5.5	-12 to 1	0.06
Atmosphere	84 $\pm$ 23	85 $\pm$ 15	-0.4	-8 to 7	1.25
Beautiful material	88 $\pm$ 29	72 $\pm$ 28	15.7	7 to 21	2844
Building appearance	91 $\pm$ 19	84 $\pm$ 24	8.4	3 to 16	122765
Closeness to nature	100 $\pm$ 9	90 $\pm$ 22	10.5	6 to 14	462407
Comfortable furniture	70 $\pm$ 33	80 $\pm$ 23	-10.9	-21 to -1	0.00
Coziness	78 $\pm$ 36	83 $\pm$ 28	-6.3	-16 to 5	0.01
Environmental friendliness	86 $\pm$ 22	77 $\pm$ 25	9.0	1 to 15	16153
Essential services	71 $\pm$ 39	85 $\pm$ 20	-13.7	-24 to -6	0.00
Feeling of safety	90 $\pm$ 26	90 $\pm$ 20	-0.5	-10.5 to 8	0.28
Floor plan	70 $\pm$ 24	70 $\pm$ 25	-0.6	-9 to 6	0.42
Indoor air quality	90 $\pm$ 17	92 $\pm$ 17	-2.1	-10 to 3	0.04
Important places	72 $\pm$ 34	85 $\pm$ 22	-14.9	-25 to -7	0.00
Internal temperature	82 $\pm$ 38	90 $\pm$ 22	-8.7	-16 to -2	0.00
Light quality	82 $\pm$ 32	82 $\pm$ 21	0.2	-7 to 9	0.73
Natural light	85 $\pm$ 38	81 $\pm$ 24	3.9	-5 to 11	0.93
Newness	100 $\pm$ 9	50 $\pm$ 47	52.4	45 to 62	Inf
Outdoor activities	94 $\pm$ 15	90 $\pm$ 25	5.2	-2 to 13	423.38
Pleasant appearance	85 $\pm$ 16	80 $\pm$ 23	3.8	-4 to 11	16.42
Privacy	77 $\pm$ 34	90 $\pm$ 20	-12.8	-22 to -1	0.00

Variable	Current rating median ± IQR	Ideal rating median ± IQR	Difference*	95% HDPI**	BF10
Shared spaces	83 ± 23	66 ± 32	15.3	8 to 24	1223
Social factors	81 ± 21	74 ± 26	7.2	-2 to 14	97.02
Speech quality	85 ± 20	79 ± 28	9.6	1 to 19	25082
Supports wellbeing	79 ± 27	80 ± 27	0.3	-7 to 8	0.43
View outside	80 ± 32	82 ± 21	-4.8	-15 to 5	0.01

3.3. Perceived wellbeing and satisfaction

Perceived wellbeing of occupants was measured using several variables. These considered stress level (current and usual as experienced by the occupant), sleep quality (during the stay and usual), evaluation of overall wellbeing, restoration outcome scale, nature relatedness scale and overall satisfaction. Descriptive statistics of these wellbeing assessments are listed below in Table 4. The mean value of the 6 unique items of restoration outcome scale was further calculated for ROS-6 mean and used for analytical purposes as presented in Table 4. Similarly, 6 items in the nature relatedness scale were combined to form NR-6 mean. The ROS-6 and overall wellbeing evaluations were similar, indicating both measures captured the same sense of wellbeing (overall wellbeing – ROS-6 = 0.4, 95% HDI: -6.0 to 6.5, BF10 = 8.9).

Table 4
Descriptive statistics for stress levels, sleep quality, wellbeing, and satisfaction. (IQR = Interquartile range, ROS = restorative outcomes scale)

Wellbeing and overall satisfaction (N = 81)				
Variable	Median	IQR	Min	Max
Current stress level	50	44	1	93
Usual stress level	50	20	1	82
Sleep quality during the stay	67	27	12	100
Usual sleep quality	72	18	10	100
Current overall wellbeing	76	19	30	100
ROS-6 mean	77	28	17	100
NR-6 mean	71	33	4	100
Overall satisfaction	88	20	1	100

Respondents generally considered their overall wellbeing good and were satisfied. While sleep quality at the accommodations was rated slightly lower than usual, the differences were not large (difference in medians: 5.6, 95% HDI: -1 to 12, BF10: 37.2). Responses to open-ended questions suggests the small differences may result from deviations to their everyday life. Furthermore, some respondents felt the bed in the rooms uncomfortable or indoor temperature too hot or too cold in their open-ended responses.

3.4. Factor structure – Accommodation quality structures via three inter-related dimensions

While we anticipated a factor structure in the AIQS based on 6 of the 7 items in the SALIENT model (all except Tint/colour), we could not confirm it with confirmatory factor analysis. Instead, exploratory factor analysis was used to identify any underlying structure in the scale. Exploratory factor analysis for both the AIQS and ANQS produced meaningful factor structures.

The identified latent variable structure indicated three groupings of items that we categorised as “Eco-friendly & cozy”, “Privacy & Light”, and “Safe & healthy” (Table 5). The factor structure excluded two items from the scale with probability of non-zero loadings below 60% for any factor. Mean BRMSEA for this model was 0.101 (95% HDPI: 0.79 to 0.121) indicate moderate fit.

Table 5
Factor structure for the AIQS with factor loading and (probability of non-zero loading for the specified factor)

Variable	Eco-friendly & cozy	Privacy & light	Safe & healthy
Environmentally friendly	0.74 (85%)		
Pleasant appearance	0.80 (93%)		
Beautiful materials	0.60 (87%)		
Internal temperature	0.45 (81%)		
Coziness	0.62 (86%)		
Comfortable furniture	0.62 (88%)		
Light quality	0.66 (93%)		
Acoustic quality	0.54 (74%)		
Privacy		0.81 (100%)	
View outside		0.85 (100%)	
Natural light		0.85 (100%)	
Feels safe			0.82 (92%)
Indoor air quality			0.69 (88%)
Supports Wellbeing			0.76 (86%)
Floor plan			0.59 (71%)

*Newness, and Speech quality had probabilities below our threshold of 60% and were excluded from the factor model.

We have described the identified latent variables from the ANQS as “Milieu” that included aspects of the physical and social setting and “Services” that included access to essential services and important places (Table 6). Mean BRMSEA for this model was 0.08 (95% HDPI: 0 to 0.144) indicating good to moderate fit.

Table 6
Factor structure and loadings from exploratory factor analysis of the accommodation neighbourhood quality scale

Variable	Milieu	Services
Social factors	0.84 (97%)	
Atmosphere	0.69 (100%)	
Building appearance	0.63 (98%)	
Shared spaces	0.65 (96%)	
Closeness to nature	0.68 (75%)	
Outdoor activities	0.59 (75%)	
Access to important places		0.84 (98%)
Access to essential services		0.85 (98%)

3.5. Thematic content analysis of the factor structure

The factors resulting from the three-factor AIQS structure can be described as “Eco-friendly & cozy”, “Privacy & light”, and “Safe & healthy”. A thematic content analysis was conducted on open-ended questions related to “specific notes on accommodation spaces” and “pleasant and unpleasant aspects in the room”, to understand more deeply how occupants evaluate the accommodation’s indoor quality. The data was first categorized to 17 variables used in the AIQS. A total of 67 out of the 81 respondents provided answers to open ended questions and were included in the analysis. A detailed summary table of these variables as perceived by the occupants is included in Supplementary file S1.

The first factor, “Eco-friendly & Cozy” captures occupants’ aesthetic and emotional responses to the accommodation, with a strong emphasis on natural materials and a sense of warmth. This dimension includes items related to Image, Ergonomics, Sound, Light and Nature as included in the SALIENT model. Respondents repeatedly referenced the visual qualities of the wood as contributing to their sense of comfort and well-being. As one participant remarked, “What was pleasant was the amount of wood and the peace you get from the wood” (Respondent 4), highlighting the calming influence of natural materials. While newness was not included in this factor structure, some respondents emphasized the newness and aesthetic appeal of the space together with material assessment: “I like the wooden design and that everything is new, it is aesthetically pleasing” (Respondent 75). Although there were occasional concerns about specific ergonomic features such as steep stairs or lighting preferences, this factor reflects how eco-friendly design elements and cozy, visually pleasing interiors contribute positively to occupants’ experiences of the accommodation spaces.

The second factor, “Privacy & Light” reflects the tension between access to natural light and the need for personal privacy. This factor draws on elements such as light quality and visual connection to nature, emphasizing how architectural features mediate both exposure to nature outside and occupants’ sense

of privacy. Many respondents appreciated the large windows and natural views but also reported discomfort due to the lack of adjustable privacy options. As one occupant noted, “The views are great, but if one wants to make use of natural light – it is impossible to have any privacy” (Respondent 6). Another added, “The large window was great, but for privacy the curtain had to be kept closed, so you couldn't wake up to natural light in the morning” (Respondent 7). These insights suggest that while light and visual openness were highly valued by the occupants, the inability to adjust curtains can hinder the experience of comfort, pointing to the importance of flexible design solutions and control options for the occupants that support both visibility and privacy.

The third factor, “Safe & Healthy” includes indoor air quality and broader feelings of safety, perceived well-being and functional floor plan within the accommodation assessment. This factor is grounded in sensory and physiological impressions of the space and its indoor air quality, particularly those related to freshness, cleanliness, and air attributes. Several respondents appreciated the air quality and seemed to link it with the newness of the space with comments such as “The whole thing was harmonious, the room smelled good, clean, fresh” (Respondent 33) and “The indoor air is excellent, everything is new and beautiful” (Respondent 63). As for the floor plan, specific features like steep stairs were noted, the positive assessments of indoor air and environmental quality were evident: “Very steep stairs to the loft. Air quality was pleasant” (Respondent 21), references to natural scents, such as “Wooden smell” (Respondent 69), and to the peacefulness of the accommodation room “The tranquillity was pleasant” (Respondent 23), indicate the role of occupants’ sensory perceptions of indoor air quality in shaping feelings of safety and perceived wellbeing.

3.6. Satisfaction and wellbeing in relation to the accommodation setting

Regression models were fit to the response variables overall satisfaction, stress, and sleep quality. Predictor variables included the factor scores from the AIQS and ANQS scales, as well as sleep, stress, and the difference between ratings of the Hyytiälä setting and the importance of items in an ideal accommodation setting. Models were fit with these variables in addition to respondent characteristics (gender, nature relatedness, professional or education background in wood or forestry, and professional or education background in architecture or construction). However, model comparisons revealed that none of the respondent characteristics contributed to the explanatory power of the models and were left out of the reported models.

3.6.1. Overall satisfaction

Overall satisfaction with the accommodations and surrounding neighbourhood was generally rated well (median: 88, IQR 20; mean: 83, SD = 18). Ordered beta regression was used because approximately 22% of the ratings were at the scale maximum. The final model selection included the AIQS and ANQS factors along with wellbeing, sleep quality, stress difference, nature relatedness, and difference in ratings. Model fit was satisfactory, with a slight tendency to potentially overestimate the number of degenerate ratings.

There was convincing evidence that the “Eco-friendly & cozy” AIQS factor was associated with higher overall satisfaction ratings (estimate: 10.6 scale points; 95% HDPI: 6.9 to 13.9; PD: 100%) and suggestive evidence the “Safe & healthy” factor was associated with overall satisfaction (estimate: 3.5 scale points; 95% HDPI: 1.0 to 5.3; PD: 95.5%), although 28% of the HDPI was in ROPE (Table 7 & Fig. 4). There was weak evidence of an effect associated the “Services” ANQS with satisfaction (PD = 92.6%). Sleep quality was positively associated with satisfaction (estimated change: 3.2; 95% HDPI: 1.0 to 5.3; PD: 99.6%), however nearly 25% of its HDPI fell within ROPE, indicating the effect may not be practically meaningful. Larger rating difference ratings may be weakly associated with a decrease in overall satisfaction the effect is small and 51% of the HDPI of the estimate falls within ROPE (estimated change: -2.5; 95% HDPI: -5.7 to 1.1; PD: 94.3%). Nature relatedness and the AIQS factor, “Privacy and light” fell just below the threshold for weak evidence of an association, potentially signalling their relevance in future studies. The model estimates that 12.7% of responses would be at the scale maximum, while 22% of the observations were at the scale maximum (100), revealing the model’s tendency to underestimate very high ratings.

Table 7

Effects of investigated variables on overall satisfaction. HDPI = Highest Density Probability Interval. ROPE = region of practical equivalence. *A change in the listed variable by 1 standard deviation is expected to change one's satisfaction rating by the listed value. Difference in rating is the average rating for ideal accommodation minus the average rating of the Hyytiälä accommodations for each respondent.

Variable	Estimated change in satisfaction rating*	95% HDPI	Probability of direction	% in ROPE**
Eco-friendly & cozy	10.6	6.9 to 13.9	100%	0
Sleep quality	3.2	1.0 to 5.3	99.6%	25%
Safe & healthy	3.5	-0.32 to 7.3	95.5%	28%
Difference in rating	-2.5	-5.8 to 0.7	94.3%	51%
Services	-2.6	-6.5 to 1.0	92.6%	48%
Nature relatedness	1.4	-0.9 to 3.5	89.7%	86%
Privacy & light	-3.2	-8.3 to 1.8	89.7%	41%
Stress difference	-1.1	-3.4 to 1.2	83.7%	90%
Milieu	1.6	-2.9 to 5.7	77.6%	64%
Wellbeing	0.06	-2.6 to 2.6	53.2%	99%

3.6.2. Sleep Quality

Sleep quality was rated moderately well overall, but with significant variation (median: 67; IQR: 27). Ordered beta regression was used to analyse sleep quality ratings. There was convincing evidence that wellbeing was positively associated with sleep quality (estimate: 8.9 scale points; 95% HDPI: 4.7 to 13.2; PD: 100%, Table 8). Interestingly, there was no evidence of an association between sleep and any AIQS factor, but there was suggestive evidence a positive association between the ANQS factor "Milieu" sleep quality (estimate: 7.5 scale points; 95% HDPI: -0.3 to 15.0, PD: 96.6%). No other variables we assessed showed evidence of an association with sleep (Table 8). There was no reliable of an association for with any other variable, however. The model estimates that 11.4% of responses would be at the scale maximum (100), although only 6.3% of observations were at the scale maximum, showing its tendency to overpredict very high ratings.

Table 8

Effects of investigated variables on sleep quality. HDPI = Highest Density Probability Interval. ROPE = region of practical equivalence. *A change in the listed variable by 1 standard deviation is expected to change one's satisfaction rating by the listed value. Difference in rating is the average rating for ideal accommodation minus the average rating of the Hyytiälä accommodations for each respondent.

Variable	Estimate change in sleep quality rating*	95% HDPI	Probability of direction	% in ROPE
Wellbeing	8.9	4.7 to 13.2	100%	0
Mileu	7.5	-0.3 to 15.0	96.6%	8.0%
Stress difference	1.5	-2.4 to 5.3	77.1%	71%
Privacy & light	-3.4	-12.9 to 5.9	75.9%	34.0%
Eco-friendly & cozy	-3.0	-19.1 to 12.3	62.9%	25%
Safe & healthy	1.2	-8.5 to 10.6	60.5%	40%
Rating difference	-0.8	-6.6 to 5.0	60.1%	62%
Nature relatedness	-0.6	-4.9 to 3.8	59.3%	77%
Services	-0.2	-6.5 to 6.3	51.5%	58%

3.6.3. Stress

Our analysis of respondent's self-evaluated stress level revealed strong evidence that higher wellbeing ratings result in lower stress levels, as one might expect (estimate: -10 scale points, 95% HDPI: -16.2 to -23.4, PD: 99.4%). Interestingly, higher scores for the "Eco-friendly & Cozy" factor were associated with higher stress levels (estimated change: 22.6 scale points; 95% HDPI: 6.5 to 37.2; PD: 99.8%), perhaps indicating that stressed individuals may have experienced greater comfort in the accommodations and therefore rated it higher (Table 9, Fig. 5). However, the direction of this effect is not entirely clear and resolving directionally bears value for future studies. There was also weak evidence that the AIQS factor "Privacy and Light" was negatively associated with stress (estimate: -8.1 scale points; 95% HDPI: -19.6 to 3.6, PD: 90.8), although nearly 14% of the HDPI for this effect fell within ROPE. Nature relatedness was, again, slightly below the threshold for weak evidence (PD: 87.7%).

Table 9

Effects of investigated variables on stress level. HDPI = Highest Density Probability Interval. ROPE = region of practical equivalence. *A change in the listed variable by 1 standard deviation is expected to change one's satisfaction rating by the listed value. Difference in rating is the average rating for ideal accommodation minus the average rating of the Hyytiälä accommodations for each respondent

Variable	Estimated change in current stress*	95% HDPI	Probability of direction	% in ROPE
Eco-friendly & cozy	22.6	6.5to 37.2	99.8%	0
Wellbeing	-10.0	-16.2 to -3.4	99.4%	0
Privacy & light	-8.1	-19.6 to 3.6	90.8%	14%
Nature relatedness	3.3	-2.2 to 8.9	87.7%	39%
Mileu	-4.3	-15.6 to 7.1	77.0%	26%
Rating difference	2.9	-5.1 to 10.7	75.8%	39%
Services	-1.1	-8.8 to 6.6	60.6%	48%
Sleep	-0.6	-6.4 to 65.2	57.6%	63%
Safe & healthy	-1.3	-14.5 to 12.2	57.4%	29%

4. Discussion

The study aimed to assess the relations between built environment to human well-being and satisfaction in novel wooden buildings, and to test the applicability of the developed post-occupancy survey instrument. The findings contribute to understanding how occupants perceived accommodation indoor and neighbourhood qualities are associated with their perceived well-being (satisfaction, sleep quality and stress).

First, the results indicate acoustic quality, indoor air quality, and internal temperature, together with privacy and safety as the most important variables for ideal accommodation. Meanwhile newness, floor plan, and material choices (beautiful materials) were considered the least important. Interestingly, these results highlight privacy and safety considerations over functional floor plan or aesthetics design choices.

Second, we assumed that the perceptions of the accommodation and built environment quality would be structured into a few broader dimensions (factors) following the SALIENT model. However, our data did

not support this factor structure (Dolan et al., 2016). Instead, our results indicate a three-factor solution: “Eco-friendly & cozy”, “Privacy & light”, “Safe & healthy”. These groupings suggest that certain environmental qualities are more closely linked in user perception than originally proposed. For example, elements such as image, sound, ergonomics and nature were clustered under “Eco-friendly & cozy”, suggesting intertwined experience of aesthetic, functional and natural qualities of the accommodation spaces, including the building materials. These results align well with the aesthetic and eco-friendly image of wooden buildings for Finnish residents in earlier literature (Harju, 2022; Karjalainen & Ilgin, 2022). Similarly, light was perceived in connection with feeling of privacy and the views outside the accommodation room, forming a factor “Privacy & light”. This group crosses separate categorisation of visual privacy apart from amount of light as basic and proportional factors for office spaces (Kim & De Dear, 2012), potentially demonstrating the importance of context in understanding which features contribute to satisfaction across building typologies. While this connection might stem from specific design feature of the study site with the accessibility of the buildings through terrace corridors that requires walking past the large windows, these results align with earlier research on importance of natural light for human wellbeing (Dolan et al., 2016; Smolders & De Kort, 2014). The indoor air quality was linked with “Safe & healthy” factor, which aligns with previous findings as IAQ is connected directly through health via toxicity and contamination factors and comfort through thermal comfort, CO₂ quantities, and several sick building syndrome attributes like drowsiness, nausea, and fatigue amongst others (Abdulaali et al., 2024). Meanwhile, attributes related speech quality and newness were not included in any factor. Although the importance of sound for wellbeing has been highlighted in earlier research (Alvarsson et al., 2010) and acoustics plays an important aspect for wooden buildings with mixed experiences by occupants both in the factor structure of the study and in earlier research (Jussila et al., 2024; Karjalainen & Ilgin, 2022), speech quality may have been difficult to assess for those accommodating alone in their rooms, leaving this aspect difficult to judge or integrate in an evaluation. Newness was rated as the least important aspect of respondent’s ideal accommodate and was consistently rated very high (58% of ratings were at the scale maximum and 80% were above 90), making its association with any specific factor difficult to discern. Additionally, tint (colour) was excluded from the scope of the study.

Third, the moderating factors in our conceptual framework were revealed to have little importance in respondent assessments of their wellbeing and satisfaction within the Hyytiälä setting. Nature relatedness fell slightly below the evidentiary threshold for both satisfaction and stress. This is surprising as earlier research has suggested the sense of natural connection beneficial for well-being, social connection, and environmental behaviour (Lengieza & Aviste, 2025). Similarly, the respondent characteristics that we assessed (gender, previous work or study experience in construction, architecture, wood, or forestry) contributed no credible explanatory power in respondent evaluations of satisfaction, stress, or sleep. This might be due to small sample size, or other respondent background variables such as high education level, education background mostly in forest and natural sciences, and overall strong relationship to nature (median nature relatedness = 71.5). Thus, testing the survey

instrument and results with larger samples and more variation in demographic backgrounds is necessary.

Fourth, accommodation ratings showed associations between self-reported satisfaction and wellbeing, changes in sleep quality and changes in stress levels. Respondents who rated their accommodation more positively in terms of indoor environment quality, reported higher levels of satisfaction. A recent literature view (Abdulaali et al., 2024) highlighted similar connection between IEQ and satisfaction across multiple studies. Similarly, higher rated sleep quality had a strong association with satisfaction, but approximately 21% of the HDPI fell within the ROPE, suggesting the practical effect of the association may be limited. Interestingly, no significant relationships were found between accommodation neighbourhood quality and satisfaction. Furthermore, the study shows strong evidence that wellbeing and stress (difference) play a key role in better sleep quality. Occupants' current stress levels were negatively associated with their perceived wellbeing (as wellbeing increased, stress decreased), but the accommodation attributes of the "Eco-friendly and cozy" latent variable was strongly negatively associated with stress suggesting that certain attributes of the built environment may have more direct impacts on occupants perceived wellbeing than others. However, the direction of the relationship between ratings for "Eco-friendly and cozy" attributes require further investigation. While it may be that those who felt more stressed assessed these attributes higher because they were more comforting and thus impactful on one's stress, a causal direction cannot be directly determined from our data.

Fifth, the results on associations between built environment attributes and occupants perceived wellbeing grant feedback for the development of residential and communal spaces. Features contributing to "Eco-friendly and cozy" are important in building design, as they are closely tied with occupant satisfaction and their current stress levels. This factor is also the most closely linked to use of wood materials as it includes variables such as aesthetics of the materials, furniture and eco-friendliness (Harju, 2022; Karjalainen & Ilgin, 2022). While prior research on wood materials has suggested positive psychological and physiological responses to wood-based interiors (Cavaliere et al., 2026), the present study adds empirical support by demonstrating that occupants' subjective evaluations of eco-friendliness, coziness, safety and privacy are core attributes of occupant satisfaction. This reinforces the importance to use of wood-based building materials not only to promote sustainability, but also to increased occupant wellbeing and satisfaction. On the other hand, characteristics such as sound insulation, temperature and good air quality are important for almost any occupant, and these create a sort of baseline for high-quality accommodation experiences that is also necessary for wellbeing and stress management, forming a kind of baseline quality for accommodation, following a hierarchical needs perspective (Maslow, 1943). These attributes are followed by higher-level needs that might better explain the subjective experience and differentiate accommodation according to the occupant preferences, providing space for design considerations, material choices and comfort choices, following needs-based perspective of wellbeing (Altomonte et al., 2020).

Finally, our study suggests several directions for further research. The study affirms that post-occupancy surveys offer a viable method for evaluating occupant well-being and satisfaction in accommodation settings. With continued methodological refinement, including more systematic assessment of pre- and post-occupancy status, the observed outcomes could be better attributed to the accommodation experience. Furthermore, linking subjective survey data to objective environmental measures could contribute to more rigorous results on occupant comfort and practical design features. The results of this study also require further testing in follow up studies. This would presume larger and less homogenous survey samples, surveys in several regions and countries and also examining how cultural background might influence the expectations and evaluations of spaces and perceived well-being effects. Questions of directionality of the effects discovered in our analysis should be further investigated, especially the apparent strong association between higher “Eco-friendly and coziness” ratings and higher levels of self-reported stress.

5. Conclusion

The study explored connections between built environment and occupants’ perceived well-being through a post-occupancy evaluation for accommodation spaces. The study explored connections between built environment and occupants’ perceived well-being through a post-occupancy evaluation for accommodation spaces. Overall, the study affirms that post-occupancy surveys offer a viable and informative method for assessing accommodation spaces and subjective wellbeing in built environment.

Through exploratory factor analysis, the study identified three categories of accommodation attributes (AIQS), namely “Eco-friendly & Cozy”, “Privacy & Light” and “Safe & Healthy”. Notably, there was strong evidence that “Eco-friendly & Cozy” and “Safe & Healthy” qualities are important factors for occupant satisfaction. These findings are particularly relevant in the context of wooden buildings, where material choices are closely linked to perceptions of sustainability, warmth and aesthetics.

Two factors related to the surrounding environment (ANQS) were identified as “Milieu” and “Services”, yet seemed to have little influence on satisfaction or stress levels, but “Milieu” was positively associated with sleep. Overall, the results on ANQS variables suggests that, within similar accommodation contexts, accommodation interior qualities and material-related perceptions may play a more prominent role in shaping occupant wellbeing than external environmental features.

The results additionally underline the importance of balance between privacy and safety against the views outside and natural light to the accommodation space. In modern wooden buildings, where large windows and exposed wood surfaces are often used to promote biophilic design and restoration, providing occupants with control options, such as adjustable curtains and indoor conditions, appear to be important for improved occupant experiences.

Declarations

Author Contribution

J.J. contributed to the conceptualization and methodology, data collection, data analysis and writing of the study. M.B. was responsible for methodology, data analysis, data quality and writing. R.T. was responsible for supervision, methodology and writing. All authors reviewed the manuscript.

Data Availability

The dataset and R processing code for Restorative Experiences in New Wood-Based Accommodations: A Pilot Post-Occupancy Survey Study are available at Zenodo (DOI: 10.5281/zenodo.16902203)

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Figures

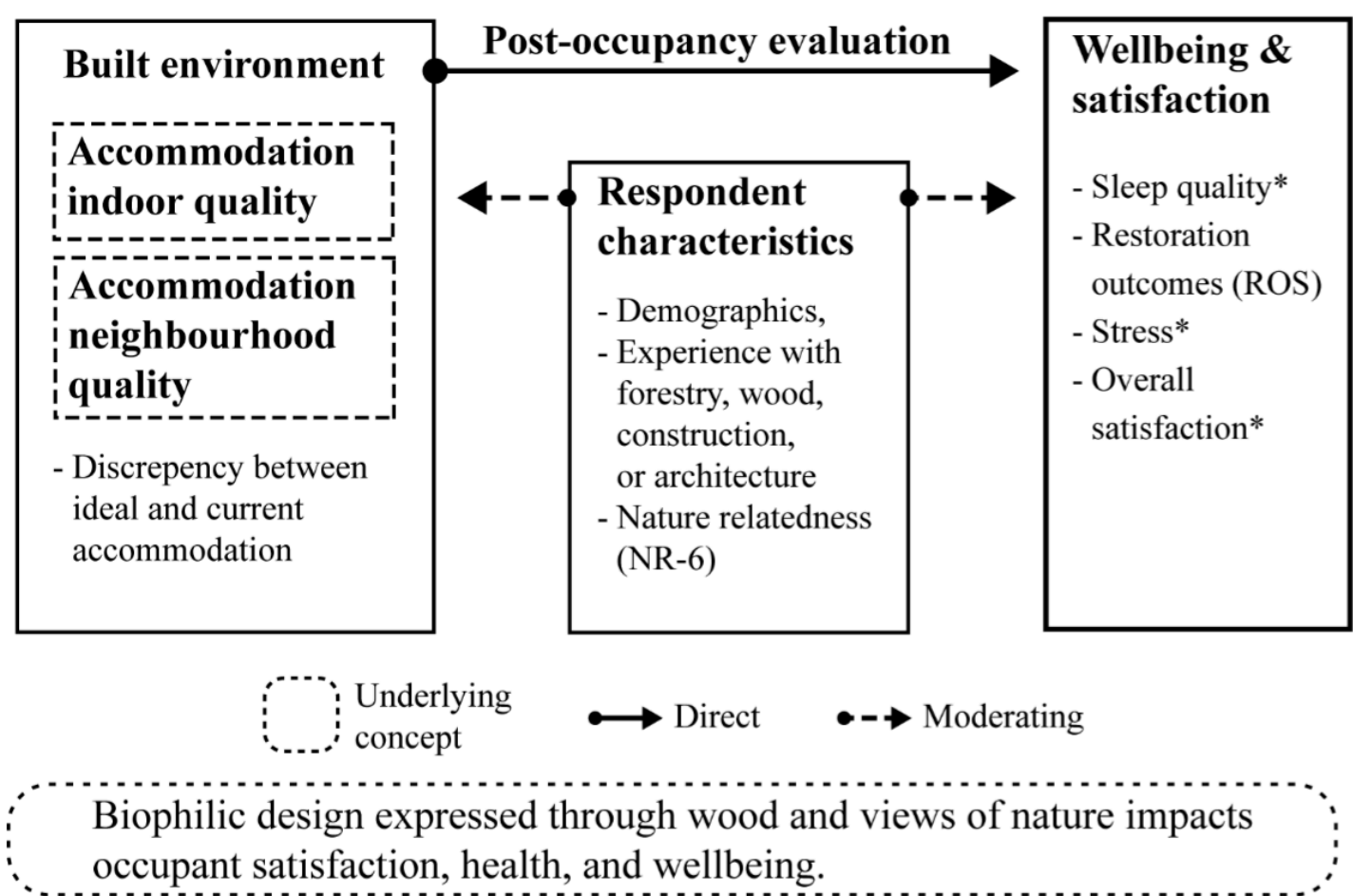


Figure 1

Conceptual framework for the study. NR-6: nature-relatedness 6 (Nisbet & Zelenski, 2013); ROS: restorative outcomes scale (Hartig et al., 1997); * Sleep quality, stress, and overall satisfaction were self-evaluated on a scale of 1 to 100.

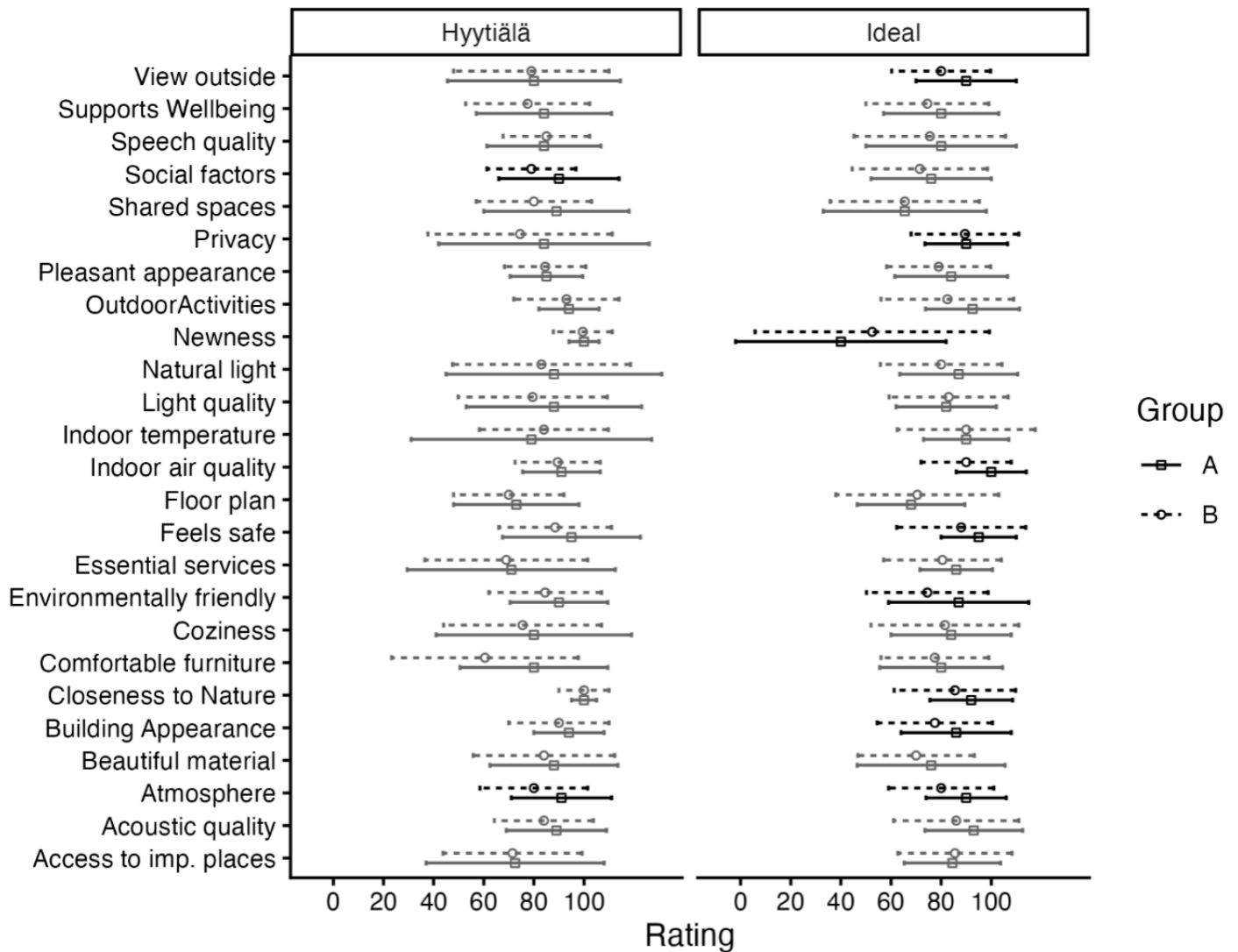


Figure 2

Median ratings $\pm$ interquartile range of the Hyytiälä setting and the ideal setting for two groups (A, first half of the visitors compared to B, the second half, time-wise). Black lines indicate strong evidence of a significant difference was found between the groups ($BF_{10} \geq 20$ or $BF_{10} \leq 0.05$). Note: the median + interquartile range may extend beyond the maximum possible value in the scale.

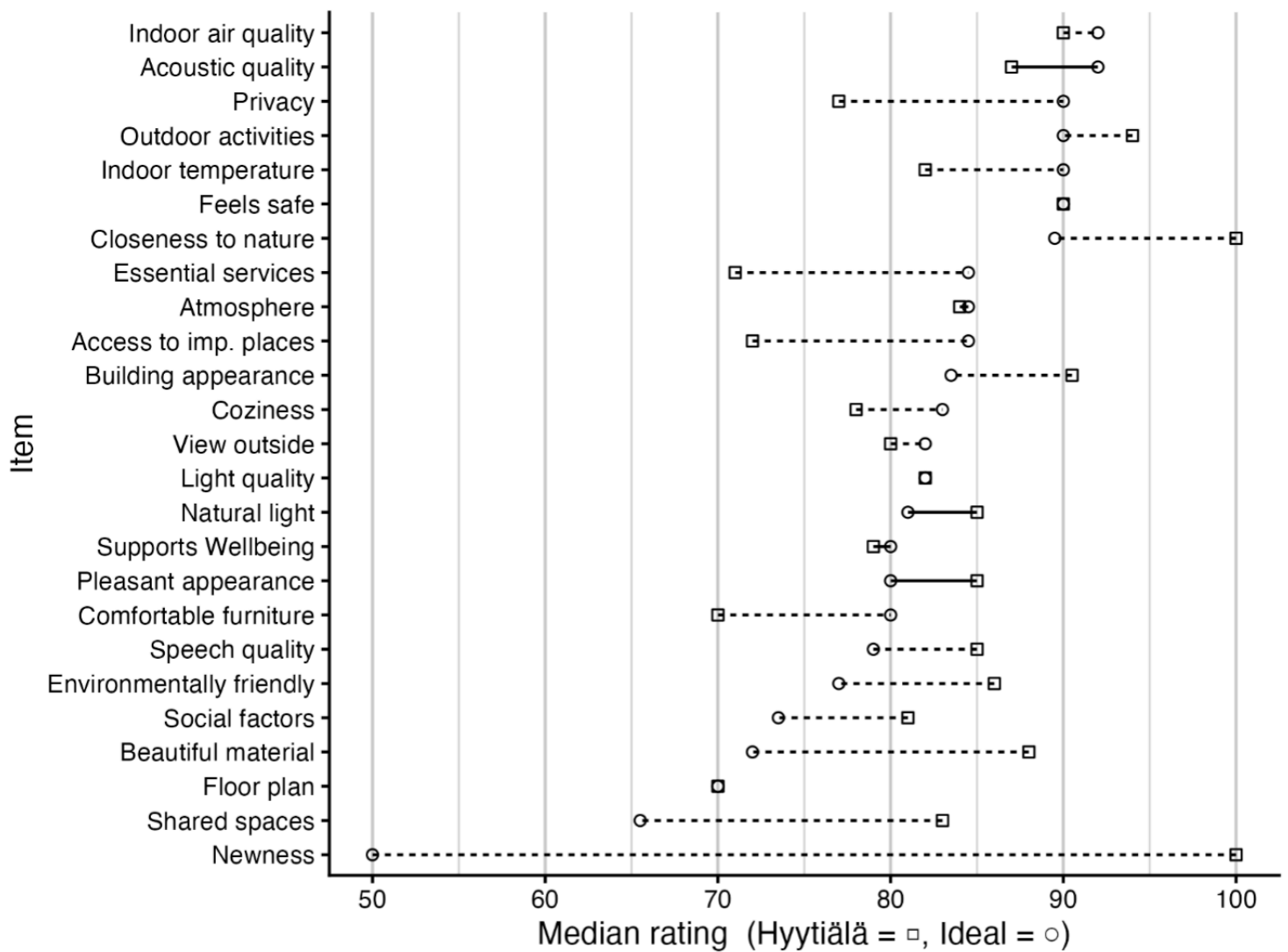


Figure 3

Raw difference in median rating for the Hyytiälä accommodations and importance in an ideal accommodation. Dashed lines indicate $BF_{10} > 20$ or $BF_{10} < 0.05$

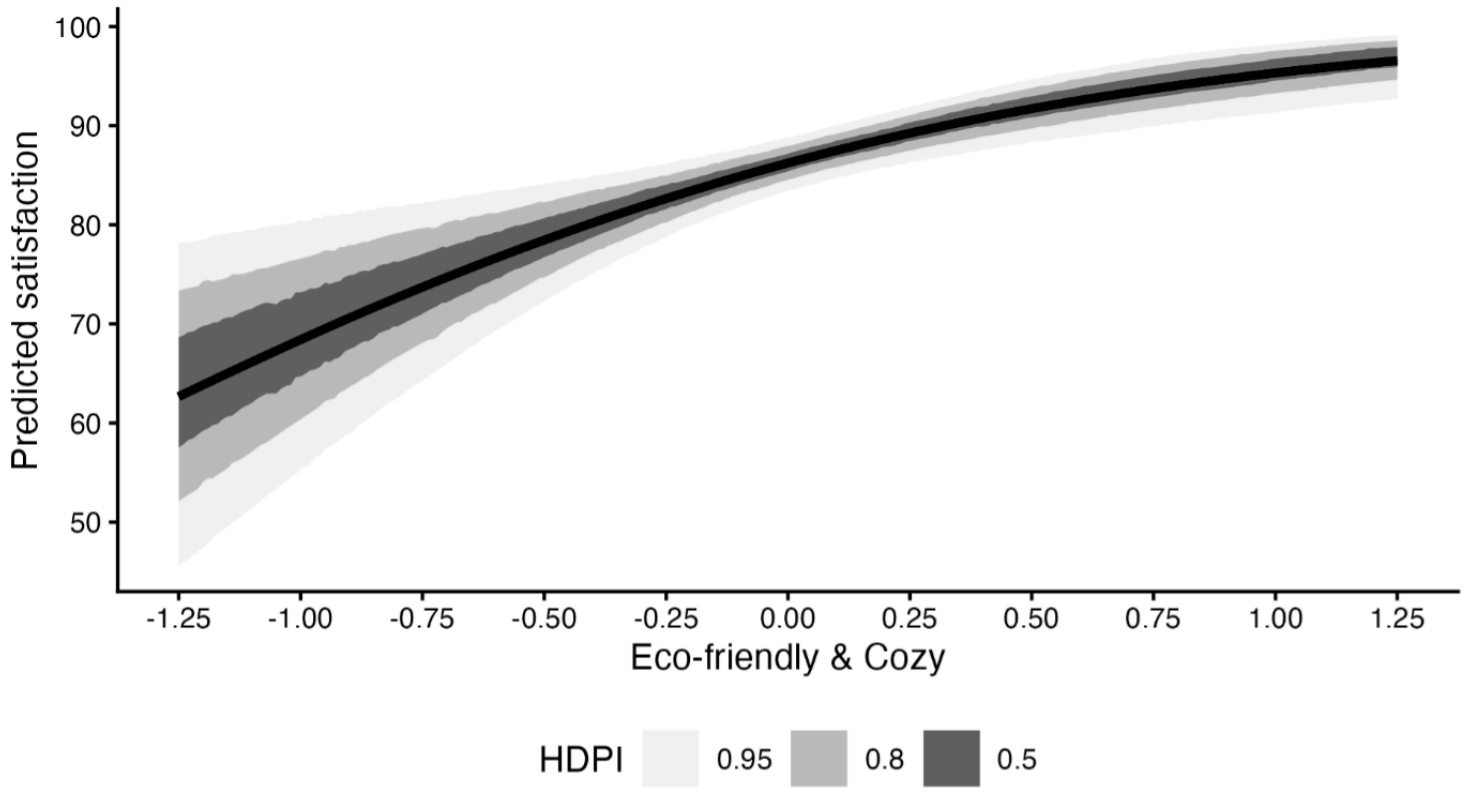


Figure 4

Anticipated change in satisfaction given respondents rating of Eco-friendly & Cozy factor items. HDPI = Highest density probability interval

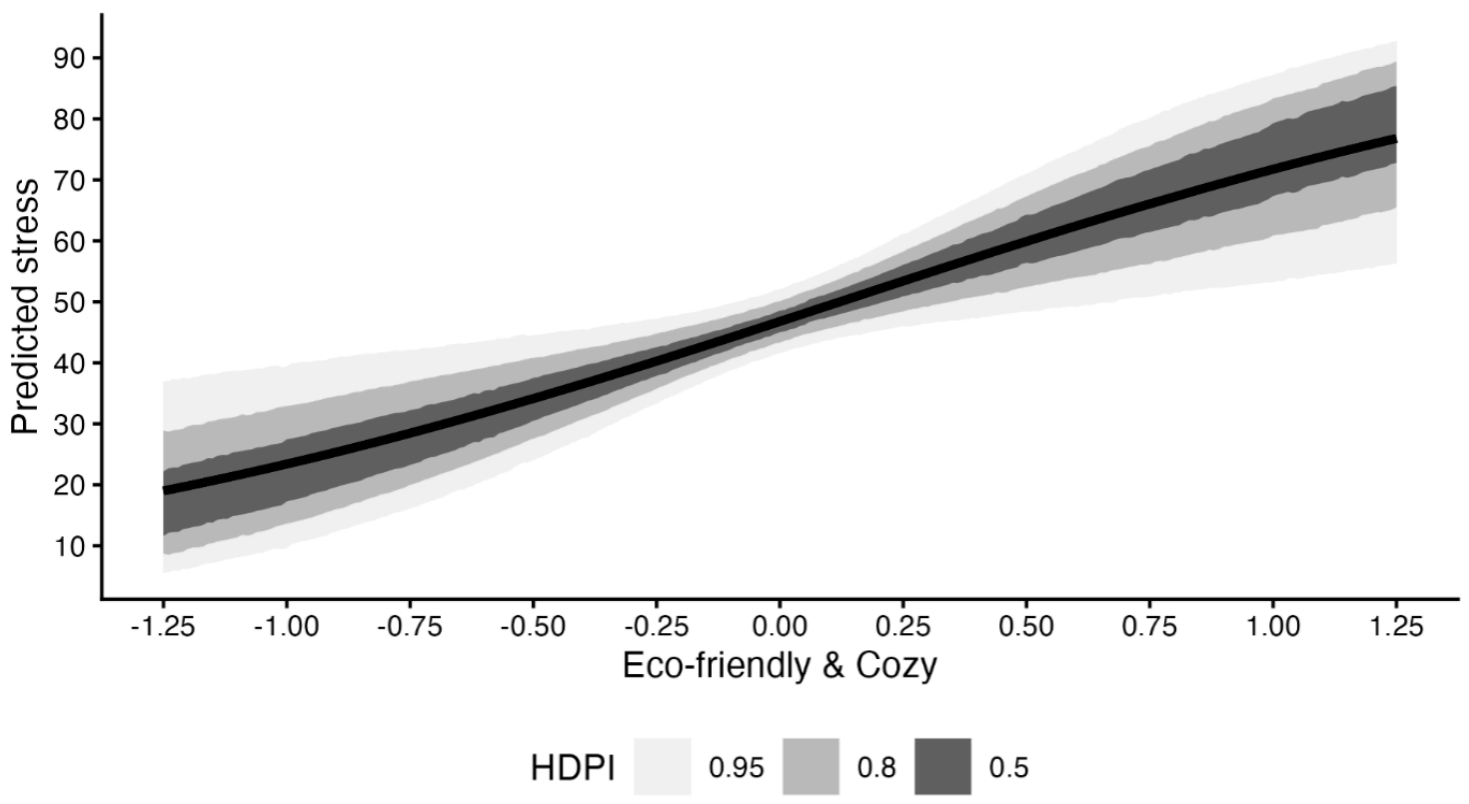


Figure 5

As the ratings for “Eco-friendly and Cozy” increased, so did stress rating. HDPI = Highest density probability interval

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