Supplementary Material: Statistical analyses

This supplementary material provides a detailed description of the procedure and the results of the statistical modelling of perceived restorativeness as mentioned in the sections 2.5 and 3.5 of the manuscript. The reproducible repository is available on <https://github.com/LGraz/wsl--prs-analysis> with a permanent availability at <https://doi.org/10.5281/zenodo.15722826> .

## 1. Variable description

**Geodata**

|  |  |
| --- | --- |
| **Acronym** | **Explanation** (\* means square-root transformation) |
| RL\_NOISE | mean road traffic noise in 250 m buffer around RL |
| HM\_NOISE | person’s noise exposure at home (facade) |
| RL\_NDVI | mean NDVI in 250 m buffer around RL |
| HM\_NDVI | mean NDVI in 50 m buffer around HM |
| DISTKM\* | Euclidean distance between home and RL |
| JNYTIME\* | travel time from home to RL (as indicated in the survey) |
| SPEED\_log | Logarithm of distance / journeytime |
| LCARTIF\* | proportion of artificial surfaces within 250 m buffer |
| LCFOREST\* | proportion of forest within 250 m buffer |
| OVDIST\* | distance to the nearest public transport stop |
| STRIMP123 | length of roads with high traffic intensity |
| STRIMP999\* | length of other roads (low traffic intensity) |
| HETER | land cover heterogeneity in 250 m buffer |
| VIS5K\* | percentage of visible area within a radius of 5 km |
| LANG | Language region according to respondent’s address |

**Mediator variables (questionnaire responses)**

|  |  |
| --- | --- |
| **Acronym** | **Explanation** |
| FEELNAT | Feeling of being in nature (1=strongly disagree; 7 = strongly agree) |
| LNOISE | Overall soundscape quality (1 = very bad; 5 = very good) |
| LOC\_SENS | Sensations; e.g. wind in hair (1=strongly disagree; 5 = strongly agree) |
| LOC\_SOUN | Sounds; e.g. birds (1=strongly disagree; 5 = strongly agree) |
| LOC\_SCEN | Scents and odours (1=strongly disagree; 5 = strongly agree) |
| LOC\_VISE | Visual elements (1=strongly disagree; 5 = strongly agree) |
| LOC\_VEGE | Vegetation and its changes (1=strongly disagree; 5 = strongly agree) |
| LOC\_FAUN | Wild animals (1=strongly disagree; 5 = strongly agree) |

**Response variables: Perceived Restorativeness Scale PRS[[1]](#footnote-1)**

|  |  |
| --- | --- |
| **Acronym** | **Explanation** |
| MEAN | Aggregated mean of all PRS dimensions (1=strongly disagree; 7 = strongly agree) |
| FA | Fascination (1=strongly disagree; 7 = strongly agree) |
| BA | Being away (1=strongly disagree; 7 = strongly agree |
| EC | Extent and coherence (1=strongly disagree; 7 = strongly agree) |
| ES | Scope and compatibility (1=strongly disagree; 7 = strongly agree) |

## 2. Data preparation

We first cleaned the database from records with missing information. We further eliminated records where respondents (1) reported wearing headphones during the outdoor activity, (2) reported activity duration of more than 2 hours, or (3) indicated a restorative place farther away than 33 km from home, as beyond everyday recreation. The thresholds for criteria (2) and (3) equalled to 90th percentile of the given values. Finally, we kept 1494 out of 2206 observations; the number of matches per filter criteria are given in Table S1, whereas one record might include several criteria matches (source("R/data\_prep.R")).

*Table S1 Number of matches per filter criteria*

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Headphone | PRS\_all\_NA | Distance | Activity\_NA | Duration | HM\_Noise\_NA | JourneyTime |
| 303 | 226 | 221 | 102 | 96 | 96 | 20 |

Next we splitted the data into a training and a test set (50/50) before testing the hypothesis to ensure valid inference after feature selection. Missing values were imputed using MissForest (doi:10.1093/bioinformatics/btr597). This method leverages conditional dependencies between variables to predict missing values through an iterative random forest approach. To avoid introducing spurious correlations between different variable sets, we imputed the following data groups separately: PRS variables on the complete dataset; mediators on training data only; geodata on training data only; mediators for prediction analysis; geodata for prediction analysis; PRS variables for prediction analysis.

Mediators and geodata were intentionally not imputed on the test set to maintain valid inference, as MissForest does not provide a mechanism to propagate imputation uncertainty. Missing values in the test set predictors remained untreated, which is justified under the missing completely at random (MCAR) assumption, where missing values occur independently of all other variables.

For the prediction analysis, fewer statistical assumptions were required, so using the MissForest approach did not violate any assumptions. PRS variables could have been imputed separately for training/test sets and prediction analysis, but we prioritized simplicity as these variables serve only as response variables. Additionally, we compared MissForest with simpler imputation methods (variable-wise and observationwise mean imputation) for the PRS variables. Results confirmed that MissForest consistently outperformed these alternatives.

## 3. Prediction analysis of perceived restorativeness (PRS)

We applied multiple machine learning models using the mlr3 framework (doi:10.21105/joss.01903)

* Linear models (Lm; baseline)
* XGBoost (gradinent boosting with tree-based models and hyperparameter tuning for learning rate and tree depth (arxiv: 1603.02754)
* Random Forest (RF; with default parameters) (doi: 10.1023/A:1010933404324)

### 3.1 Benchmark helper function

Ein Bild, das Text, Screenshot, Dokument, Schrift enthält.

KI-generierte Inhalte können fehlerhaft sein.

### 3.2 Results of prediction analysis for PRS

The following tables present the variance of the predicted parameters explained by the different model approaches. As the sensory perceptions (LOC\_variables) strongly added to the model’s predictive power (see Tables S3 and S4), we included them in the analysis described in section 1.4 of this document.

*Table S2 Predicting PRS with geodata only (explained variance)*

|  |  |  |  |
| --- | --- | --- | --- |
|  | Lm | xgboost | RF |
| MEAN | -0.002 | 0.005 | -0.036 |
| FA | -0.002 | 0.013 | 0.002 |
| BA | -0.006 | -0.009 | -0.021 |
| EC | 0.001 | -0.027 | -0.042 |
| ES | 0.048 | 0.041 | 0.026 |

Code:

Ein Bild, das Text, Schrift, Screenshot, Reihe enthält.

KI-generierte Inhalte können fehlerhaft sein.

*Table S3 Predicting PRS with geodata and mediators (explained variance); left: all mediators (FEELNAT, LNOISE, LOC\_variables); right: only FEELNAT & LNOISE*

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | Lm | xgboost | RF |  |  | Lm | xgboost | RF |
| MEAN | 0.225 | 0.234 | 0.223 |  | MEAN | 0.134 | 0.143 | 0.135 |
| FA | 0.236 | 0.260 | 0.248 |  | FA | 0.135 | 0.164 | 0.144 |
| BA | 0.120 | 0.130 | 0.131 |  | BA | 0.072 | 0.069 | 0.064 |
| EC | 0.042 | 0.012 | 0.021 |  | EC | 0.019 | -0.015 | -0.012 |
| ES | 0.150 | 0.168 | 0.158 |  | ES | 0.130 | 0.144 | 0.117 |

Code:

Ein Bild, das Text, Schrift, Screenshot enthält.

KI-generierte Inhalte können fehlerhaft sein.

*Table S4 Predicting PRS with mediators only (explained variance); left: all mediators (FEELNAT, LNOISE, LOC\_variables); right: only FEELNAT & LNOISE*

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | Lm | xgboost | RF |  |  | Lm | xgboost | RF |
| MEAN | 0.224 | 0.235 | 0.191 |  | MEAN | 0.137 | 0.155 | 0.148 |
| FA | 0.227 | 0.254 | 0.225 |  | FA | 0.131 | 0.170 | 0.165 |
| BA | 0.132 | 0.145 | 0.112 |  | BA | 0.085 | 0.086 | 0.077 |
| EC | 0.036 | 0.025 | -0.020 |  | EC | 0.008 | 0.011 | 0.008 |
| ES | 0.130 | 0.137 | 0.085 |  | ES | 0.116 | 0.108 | 0.102 |

Code:

Ein Bild, das Text, Screenshot, Schrift, Reihe enthält.

KI-generierte Inhalte können fehlerhaft sein.

*Table S5 Predicting mediators with GIS variables (explained variance)*

|  |  |  |  |
| --- | --- | --- | --- |
|  | Lm | xgboost | RF |
| FEELNAT | 0.126 | 0.136 | 0.111 |
| LNOISE | 0.096 | 0.070 | 0.080 |
| LOC\_SENS | 0.020 | -0.008 | -0.025 |
| LOC\_SOUN | 0.041 | 0.010 | -0.001 |
| LOC\_SCEN | 0.039 | 0.052 | 0.021 |
| LOC\_VISE | 0.008 | -0.029 | -0.047 |
| LOC\_VEGE | 0.052 | 0.025 | 0.032 |
| LOC\_FAUN | 0.057 | 0.062 | 0.047 |

Code:

Ein Bild, das Text, Schrift, Screenshot enthält.

KI-generierte Inhalte können fehlerhaft sein.

### 3.3 Legacy code

XGBoost Parameter Tuning

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KI-generierte Inhalte können fehlerhaft sein.

Superseded setup with mlr3

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KI-generierte Inhalte können fehlerhaft sein.

First basic setup with mlr3

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KI-generierte Inhalte können fehlerhaft sein.

## 4. Hypothesis testing with linear modelling

Imputing PRS\_orig-vars

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KI-generierte Inhalte können fehlerhaft sein.

### 4.1 Imputation with MissForest on training data

Number of NA in mediators: sapply(D[Mediator\_vars], \(x) sum(is.na(x)))

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| FEELNAT | LNOISE | LOC\_SENS | LOC\_SOUN | LOC\_SCEN | LOC\_VISE | LOC\_VEGE | LOC\_FAUN |
| 16 | 291 | 28 | 30 | 36 | 62 | 69 | 88 |

Number of NA in GIS variables: sapply(D[GIS\_vars], \(x) sum(is.na(x)))

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| LCARTIF\_sqrt | LCFOREST\_sqrt | HETER | OVDIST\_sqrt | VIS5K\_sqrt | RL\_NDVI | RL\_NOISE | DISTKM\_sqrt | JNYTIME\_sqrt | STRIMP123\_sqrt | STRIMP999\_sqrt |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 86 | 0 | 0 |

Impute missing values using MissForest

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KI-generierte Inhalte können fehlerhaft sein.

### 4.2 Scaling test data

Scaling variables and show original scale:

Ein Bild, das Text, Schrift, Screenshot enthält.

KI-generierte Inhalte können fehlerhaft sein.

*Table S6 Original scale of variables*

|  |  |  |
| --- | --- | --- |
|  | **Mean** | **sd** |
| FEELNAT | 6.142 | 1.055 |
| LNOISE | 4.210 | 0.747 |
| LOC\_SENS | 4.098 | 1.016 |
| LOC\_SOUN | 4.296 | 0.947 |
| LOC\_SCEN | 3.967 | 1.056 |
| LOC\_VISE | 4.080 | 1.027 |
| LOC\_VEGE | 4.343 | 0.859 |
| LOC\_FAUN | 3.298 | 1.365 |
| LCARTIF\_sqrt | 0.271 | 0.269 |
| LCFOREST\_sqrt | 0.454 | 0.311 |
| HETER | 1.305 | 0.402 |
| OVDIST\_sqrt | 21.797 | 10.144 |
| VIS5K\_sqrt | 3.323 | 1.620 |
| RL\_NDVI | 0.635 | 0.202 |
| RL\_NOISE | 41.615 | 9.261 |
| DISTKM\_sqrt | 1.473 | 1.156 |
| JNYTIME\_sqrt | 3.830 | 2.247 |
| STRIMP123\_sqrt | 6.555 | 10.739 |
| STRIMP999\_sqrt | 47.557 | 13.162 |
| PRS | 4.987 | 0.879 |
| FA | 5.266 | 1.111 |
| BA | 5.140 | 1.156 |
| EC | 4.540 | 1.287 |
| ES | 5.006 | 1.426 |

### 4.3 Testing variance inflation factor (VIF)

VIF: PRS ~ (Mediators + GIS vars)^2 (without interaction)

Ein Bild, das Text, Screenshot, Schrift, Reihe enthält.

KI-generierte Inhalte können fehlerhaft sein.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Min. | 1st Qu. | Median | Mean | 3rd Qu. | Max. |
| 1.21 | 1.46 | 1.94 | 2.03 | 2.24 | 4.99 |

VIF: PRS ~ (Mediators + GIS vars)^2 (with interaction)

Ein Bild, das Text, Screenshot, Schrift, Reihe enthält.

KI-generierte Inhalte können fehlerhaft sein.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Min. | 1st Qu. | Median | Mean | 3rd Qu. | Max. |
| 12 | 81 | 147 | 205 | 269 | 1398 |

### 4.4 All interactions: Mediators ~ (GIS vars)^2

Code

Ein Bild, das Text, Screenshot, Schrift enthält.

KI-generierte Inhalte können fehlerhaft sein.

**Feeling of being in nature (FEELNAT)**

Call: lm(formula = formula(step\_model), data = D\_tst)

*Table S7 Residuals for feeling of being in nature*

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Min | 1Q | Median | 3Q | Max |
| -4.959 | -0.391 | 0.264 | 0.607 | 1.685 |

*Table S8 Coefficients of the regression analysis of feeling of being in nature*

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | Estimate | Std. Error | t value | Pr(>|t|) |
| (Intercept) | 0.0618 | 0.0410 | 1.51 | 0.13260 |
| LCARTIF\_sqrt | -0.1524 | 0.0570 | -2.67 | 0.00770 \*\* |
| RL\_NDVI | 0.1498 | 0.0436 | 3.43 | 0.00063 \*\*\* |
| OVDIST\_sqrt | 0.0270 | 0.0452 | 0.60 | 0.55112 |
| LCARTIF\_sqrt:RL\_NDVI | 0.1146 | 0.0402 | 2.85 | 0.00446 \*\* |

---

Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 0.948 on 733 degrees of freedom (9 observations deleted due to missingness)

Multiple R-squared: 0.106, Adjusted R-squared: 0.101

F-statistic: 21.8 on 4 and 733 DF, p-value: <2e-16

**Overall soundscape quality (LNOISE)**

Call: lm(formula = formula(step\_model), data = D\_tst)

*Table S9 Residuals for overall soundscape quality*

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Min | 1Q | Median | 3Q | Max |
| -3.999 | -0.527 | 0.012 | 0.676 | 1.622 |

*Table S10 Coefficients of the regression analysis of overall soundscape quality*

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | Estimate | Std. Error | t value | Pr(>|t|) |
| (Intercept) | -0.00097 | 0.03862 | -0.03 | 0.980 |
| LCARTIF\_sqrt | -0.12357 | 0.04841 | -2.55 | 0.011 \* |
| RL\_NOISE | -0.24203 | 0.04890 | -4.95 | 9.7e-07 \*\*\* |

---

Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 0.945 on 596 degrees of freedom (148 observations deleted due to missingness)

Multiple R-squared: 0.11, Adjusted R-squared: 0.107

F-statistic: 36.6 on 2 and 596 DF, p-value: 9.79e-16

**Sensations (LOC\_SENS)**

Call: lm(formula = formula(step\_model), data = D\_tst)

*Table S11 Residuals for sensations*

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Min | 1Q | Median | 3Q | Max |
| -3.319 | -0.217 | -0.007 | 0.831 | 1.390 |

*Table S12 Coefficients of the regression analysis of sensations*

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | Estimate | Std. Error | t value | Pr(>|t|) |
| (Intercept) | -0.000148 | 0.036675 | 0.00 | 0.99678 |
| HETER | 0.129769 | 0.038233 | 3.39 | 0.00073 \*\*\* |
| STRIMP999\_sqrt | -0.072664 | 0.038328 | -1.90 | 0.05837. |

---

Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 0.993 on 730 degrees of freedom (14 observations deleted due to missingness)

Multiple R-squared: 0.0168, Adjusted R-squared: 0.0141

F-statistic: 6.22 on 2 and 730 DF, p-value: 0.00209

**Sounds (LOC\_SOUN)**

Call: lm(formula = formula(step\_model), data = D\_tst)

*Table S13 Residuals for sounds*

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Min | 1Q | Median | 3Q | Max |
| -3.623 | -0.402 | 0.482 | 0.698 | 1.512 |

*Table S14 Coefficients of the regression analysis of sounds*

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | Estimate | Std. Error | t value | Pr(>|t|) |
| (Intercept) | 0.000403 | 0.036322 | 0.01 | 0.9912 |
| LCARTIF\_sqrt | -0.175213 | 0.037180 | -4.71 | 2.9e-06 \*\*\* |
| HETER | 0.109010 | 0.037186 | 2.93 | 0.0035 \*\* |

---

Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 0.984 on 731 degrees of freedom (13 observations deleted due to missingness)

Multiple R-squared: 0.0344, Adjusted R-squared: 0.0317

F-statistic: 13 on 2 and 731 DF, p-value: 2.82e-06

**Scents and odours (LOC\_SCEN)**

Call: lm(formula = formula(step\_model), data = D\_tst)

*Table S15 Residuals for scents and odours*

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Min | 1Q | Median | 3Q | Max |
| -3.0383 | -0.2135 | 0.0669 | 0.8101 | 1.8029 |

*Table S16 Coefficients of the regression analysis of scents and odours*

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | Estimate | Std. Error | t value | Pr(>|t|) |
| (Intercept) | -0.00114 | 0.03618 | -0.03 | 0.97 |
| RL\_NDVI | 0.21701 | 0.03629 | 5.98 | 3.5e-09 \*\*\* |

---

Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 0.977 on 727 degrees of freedom (18 observations deleted due to missingness)

Multiple R-squared: 0.0469, Adjusted R-squared: 0.0456

F-statistic: 35.8 on 1 and 727 DF, p-value: 3.48e-09

**Visual elements (LOC\_VISE)**

Call: lm(formula = formula(step\_model), data = D\_tst)

*Table S17 Residuals for visual elements*

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Min | 1Q | Median | 3Q | Max |
| -3.0692 | -0.1488 | -0.0235 | 0.8511 | 1.0861 |

*Table S18 Coefficients of the regression analysis of visual elements*

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | Estimate | Std. Error | t value | Pr(>|t|) |
| (Intercept) | -0.000356 | 0.037305 | -0.01 | 0.992 |
| LCARTIF\_sqrt | -0.071106 | 0.037580 | -1.89 | 0.059 . |

---

Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 0.998 on 714 degrees of freedom (31 observations deleted due to missingness)

Multiple R-squared: 0.00499, Adjusted R-squared: 0.0036

F-statistic: 3.58 on 1 and 714 DF, p-value: 0.0589

**Vegetation and its changes (LOC\_VEGE)**

Call: lm(formula = formula(step\_model), data = D\_tst)

*Table S19 Residuals for vegetation and its changes*

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Min | 1Q | Median | 3Q | Max |
| -3.971 | -0.492 | 0.443 | 0.706 | 1.599 |

*Table S20 Coefficients of the regression analysis of vegetation and its changes*

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | Estimate | Std. Error | t value | Pr(>|t|) |
| (Intercept) | -0.0192 | 0.0378 | -0.51 | 0.6111 |
| RL\_NDVI | 0.2195 | 0.0382 | 5.75 | 1.4e-08 \*\*\* |
| JNYTIME\_sqrt | -0.1139 | 0.0379 | -3.01 | 0.0027 \*\* |

---

Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 0.98 on 671 degrees of freedom (73 observations deleted due to missingness)

Multiple R-squared: 0.0549, Adjusted R-squared: 0.052

F-statistic: 19.5 on 2 and 671 DF, p-value: 6.03e-09

**Wild animals (LOC\_FAUN)**

Call: lm(formula = formula(step\_model), data = D\_tst)

*Table S21 Residuals for wild animals*

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Min | 1Q | Median | 3Q | Max |
| -1.898 | -0.914 | 0.300 | 0.796 | 1.744 |

*Table S22 Coefficients of the regression analysis of wild animals*

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | Estimate | Std. Error | t value | Pr(>|t|) |
| (Intercept) | -0.00127 | 0.03685 | -0.03 | 0.97 |
| LCARTIF\_sqrt | -0.21409 | 0.03697 | -5.79 | 1.1e-08 \*\*\* |

---

Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 0.978 on 702 degrees of freedom (43 observations deleted due to missingness)

Multiple R-squared: 0.0456, Adjusted R-squared: 0.0442

F-statistic: 33.5 on 1 and 702 DF, p-value: 1.05e-08

### 4.5 All interactions: PRS ~ (Mediators + GIS)^2

Code

Ein Bild, das Text, Screenshot, Schrift enthält.

KI-generierte Inhalte können fehlerhaft sein.

**PRS mean value (MEAN)**

Call: lm(formula = formula(step\_model), data = D\_tst)

*Table S23 Residuals for PRS mean*

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Min | 1Q | Median | 3Q | Max |
| -2.869 | -0.564 | -0.040 | 0.601 | 2.773 |

*Table S24 Coefficients of the regression analysis of PRS mean*

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | Estimate | Std. Error | t value | Pr(>|t|) |
| (Intercept) | -0.00667 | 0.03797 | -0.18 | 0.861 |
| LOC\_VISE | 0.17340 | 0.04211 | 4.12 | 4.4e-05 \*\*\* |
| FEELNAT | 0.20269 | 0.04304 | 4.71 | 3.1e-06 \*\*\* |
| LOC\_SENS | 0.10545 | 0.04245 | 2.48 | 0.013 \* |
| LNOISE | 0.17705 | 0.04059 | 4.36 | 1.5e-05 \*\*\* |
| FEELNAT:LOC\_SENS | 0.05447 | 0.02800 | 1.95 | 0.052 . |

---

Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 0.895 on 567 degrees of freedom (174 observations deleted due to missingness)

Multiple R-squared: 0.192, Adjusted R-squared: 0.185

F-statistic: 26.9 on 5 and 567 DF, p-value: <2e-16

**Fascination (FA)**

Call: lm(formula = formula(step\_model), data = D\_tst)

*Table S25 Residuals for fascination*

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Min | 1Q | Median | 3Q | Max |
| -3.391 | -0.518 | 0.093 | 0.592 | 2.567 |

*Table S26 Coefficients of the regression analysis of fascination*

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | Estimate | Std. Error | t value | Pr(>|t|) |
| (Intercept) | -0.00247 | 0.03796 | -0.06 | 0.94823 |
| LOC\_SCEN | 0.16395 | 0.04567 | 3.59 | 0.00036 \*\*\* |
| LOC\_VISE | 0.12820 | 0.04125 | 3.11 | 0.00198 \*\* |
| FEELNAT | 0.16832 | 0.04528 | 3.72 | 0.00022 \*\*\* |
| RL\_NDVI | -0.13269 | 0.03906 | -3.40 | 0.00073 \*\*\* |
| LOC\_FAUN | 0.17630 | 0.04167 | 4.23 | 2.7e-05 \*\*\* |
| LNOISE | 0.13320 | 0.04017 | 3.32 | 0.00097 \*\*\* |
| LOC\_SCEN:FEELNAT | -0.00175 | 0.03148 | -0.06 | 0.95556 |
| LOC\_SCEN:RL\_NDVI | 0.02406 | 0.03405 | 0.71 | 0.48007 |

---

Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 0.865 on 556 degrees of freedom (182 observations deleted due to missingness)

Multiple R-squared: 0.256, Adjusted R-squared: 0.245

F-statistic: 23.9 on 8 and 556 DF, p-value: <2e-16

**Being away (BA)**

Call: lm(formula = formula(step\_model), data = D\_tst)

*Table S27 Residuals for being away*

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Min | 1Q | Median | 3Q | Max |
| -3.965 | -0.508 | 0.071 | 0.649 | 2.406 |

*Table S28 Coefficients of the regression analysis of being away*

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | Estimate | Std. Error | t value | Pr(>|t|) |
| (Intercept) | -0.00762 | 0.03574 | -0.21 | 0.83115 |
| LOC\_VISE | 0.11948 | 0.04048 | 2.95 | 0.00326 \*\* |
| FEELNAT | 0.18740 | 0.03686 | 5.08 | 4.7e-07 \*\*\* |
| LOC\_SENS | 0.14894 | 0.04057 | 3.67 | 0.00026 \*\*\* |

---

Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 0.948 on 700 degrees of freedom (43 observations deleted due to missingness)

Multiple R-squared: 0.114, Adjusted R-squared: 0.11

F-statistic: 30 on 3 and 700 DF, p-value: <2e-16

**Extent coherence (EC)**

Call: lm(formula = formula(step\_model), data = D\_tst)

*Table S29 Residuals for extent and coherence*

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Min | 1Q | Median | 3Q | Max |
| -2.9263 | -0.5456 | -0.0452 | 0.6817 | 2.3709 |

*Table S30 Coefficients of the regression analysis of extent and coherence*

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | Estimate | Std. Error | t value | Pr(>|t|) |
| (Intercept) | -0.00850 | 0.03665 | -0.23 | 0.81665 |
| LOC\_SENS | 0.14389 | 0.04084 | 3.52 | 0.00045 \*\*\* |
| LCFOREST\_sqrt | -0.08886 | 0.03750 | -2.37 | 0.01808 \* |
| LOC\_SCEN | 0.00289 | 0.04120 | 0.07 | 0.94407 |

---

Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 0.985 on 719 degrees of freedom (24 observations deleted due to missingness)

Multiple R-squared: 0.03, Adjusted R-squared: 0.0259

F-statistic: 7.4 on 3 and 719 DF, p-value: 6.88e-05

**Extent Scope (ES)**

Call: lm(formula = formula(step\_model), data = D\_tst)

*Table S31 Residuals for scope and compatibility*

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Min | 1Q | Median | 3Q | Max |
| -3.511 | -0.539 | 0.144 | 0.685 | 2.301 |

*Table S32 Coefficients of the regression analysis of scope and compatibility*

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | Estimate | Std. Error | t value | Pr(>|t|) |
| (Intercept) | 0.03175 | 0.04168 | 0.76 | 0.4464 |
| LNOISE | 0.13367 | 0.04325 | 3.09 | 0.0021 \*\* |
| LOC\_SENS | 0.09971 | 0.04094 | 2.44 | 0.0152 \* |
| DISTKM\_sqrt | 0.08231 | 0.04048 | 2.03 | 0.0425 \* |
| FEELNAT | 0.25862 | 0.04649 | 5.56 | 4.1e-08 \*\*\* |
| LNOISE:FEELNAT | -0.00557 | 0.03433 | -0.16 | 0.8711 |

---

Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 0.952 on 576 degrees of freedom (165 observations deleted due to missingness)

Multiple R-squared: 0.142, Adjusted R-squared: 0.134

F-statistic: 19 on 5 and 576 DF, p-value: <2e-16

## 5. Prediction of greenness and noise exposure at the restorative locations

**Procedure:** Stepwise feature selection using BIC on training data and subsequent model fitting on test data. Performed separately for RL\_NDVI and RL\_NOISE.

**Predictors:** HM\_NDVI + HM\_NOISE + LANG + SPEED\_log + JNYTIME\_sqrt with all two-way interactions.

### 5.1 Predicting greenness at RL (RL\_NDVI)

Call:

lm(formula = formula(step\_ndvi), data = D\_tst)

*Table S33 Residuals for RL\_NDVI*

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Min | 1Q | Median | 3Q | Max |
| -3.371 | -0.430 | 0.182 | 0.698 | 1.989 |

*Table S34 Coefficients of the regression analysis for RL\_NDVI*

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | Estimate | Std. Error | t value | Pr(>|t|) |
| (Intercept) | -0.1690 | 0.0946 | -1.79 | 0.07452 . |
| HM\_NDVI | 0.1581 | 0.0413 | 3.83 | 0.00015 \*\*\* |
| LANGGerman | 0.2232 | 0.1064 | 2.10 | 0.03633 \* |
| LANGItalian | 0.0028 | 0.1965 | 0.01 | 0.98866 |
| SPEED\_log | -0.0720 | 0.0414 | -1.74 | 0.08277 . |
| JNYTIME\_sqrt | 0.1272 | 0.0415 | 3.07 | 0.00226 \*\* |
| HM\_NDVI:SPEED\_log | -0.1848 | 0.0422 | -4.38 | 1.4e-05 \*\*\* |

---  
Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 0.958 on 536 degrees of freedom

Multiple R-squared: 0.0917, Adjusted R-squared: 0.0815

F-statistic: 9.02 on 6 and 536 DF, p-value: 2.09e-09

## 5.2 Predicting noise exposure at RL (RL\_NOISE)

Call:

lm(formula = formula(step\_noise), data = D\_tst)

*Table S35 Residuals for RL\_NOISE*

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Min | 1Q | Median | 3Q | Max |
| -2.5097 | -0.7495 | -0.0467 | 0.6473 | 2.8683 |

*Table S36 Coefficients of the regression analysis for RL\_NOISE*

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | Estimate | Std. Error | t value | Pr(>|t|) |
| (Intercept) | -0.03379 | 0.08896 | -0.38 | 0.70426 |
| HM\_NOISE | 0.23846 | 0.03916 | 6.09 | 2.2e-09 \*\*\* |
| LANGGerman | -0.00494 | 0.09968 | -0.05 | 0.96047 |
| LANGItalian | 0.62198 | 0.18667 | 3.33 | 0.00092 \*\*\* |
| SPEED\_log | -0.06326 | 0.03902 | -1.62 | 0.10552 |
| JNYTIME\_sqrt | -0.31956 | 0.03936 | -8.12 | 3.2e-15 \*\*\* |
| HM\_NOISE:JNYTIME\_sqrt | -0.03423 | 0.04070 | -0.84 | 0.40061 |

---  
Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 0.904 on 536 degrees of freedom

Multiple R-squared: 0.193, Adjusted R-squared: 0.184

F-statistic: 21.3 on 6 and 536 DF, p-value: <2e-16

Ein Bild, das Screenshot, Farbigkeit, Text enthält.

KI-generierte Inhalte können fehlerhaft sein.

*Figure S1 Visualisation of the effect of HM\_NOISE and JNYTIME\_sqrt on RL\_NOISE*

1. Pasini, M., Berto, R., Brondino, M., Hall, R., Ortner, C. 2014. How to measure the restorative quality of environments: the PRS-11. *Procedia Social and Behavioral Sciences* 159, 293–297. DOI: 10.1016/j.sbspro.2014.12.375 [↑](#footnote-ref-1)