

Step 1: Analytical scope and data entry point

The reproducible analysis begins with street-level sampling records that combine geographic coordinates, street-segment identifiers, and links to street-view scenes. These tabular datasets constitute the analytical entry point and support all reported quantitative results and spatial analyses.

Step 2: Street-level sampling records and coordinate information

Street-level sampling points were generated along walkable street segments at fixed 20-metre intervals. Sampling records are provided as Excel tables containing unique identifiers, latitude and longitude coordinates, and associated street-segment references. These coordinates allow independent visualisation or reanalysis in GIS software if required.

Three Excel files are shared, corresponding to the three study areas:

oxfo_index.xlsx (Oxford)

camd_index.xlsx (Camden)

lboro_index.xlsx (Loughborough)

The spatial distribution of sampling points shown in Figure 4 is directly generated from the latitude and longitude fields contained in the Excel index tables described above.

Step 3: Access to street-level visual information

For each sampling record, a Google Street View URL is included in the Excel tables, linking to pedestrian-eye-level street scenes used in the visual analysis. All visual inspection and automated detection procedures reference these URLs directly. No street-view images are stored or redistributed.

Step 4: Coordinate preparation and spatial filtering of duplicated detections (Reproduces Table 1; Section 3.4)

Street-view sampling at fixed intervals results in repeated appearances of static objects across consecutive scenes. To avoid duplicated counting, a two-stage coordinate-based filtering procedure was applied.

Geographic coordinates were first standardised using `lat_lon.py`. Spatial filtering was then performed using `geo_filter.py`, which computes pairwise distances using the Haversine formula and applies a 15-metre threshold. When two consecutive sampling points fall within this threshold, only the first occurrence of a detected visual obstacle is retained.

Filtered outputs were exported as updated Excel tables and form the basis for the retained image counts reported in Table 1.

Step 5: Aggregation of visual obstructions and segment-level index preparation
(Reproduces Figure 6 and Table 2; Section 4.2)

After spatial filtering, detected visual obstructions were aggregated at the 20-metre street-segment level in QGIS. Counts of dense vegetation, parked vehicles, and high walls or fences were calculated for each segment and normalised by segment length.

The resulting segment-level metrics were exported as Excel attribute tables and stored in the following files, as introduced in Step 2:

oxfo_index.xlsx
camd_index.xlsx
lboro_index.xlsx

Detection proportions reported in Table 2 and spatial patterns shown in Figure 6 are derived directly from these tables.

Step 6: Incorporation of perception-based weights from questionnaire responses
(Reproduces Table 3; Sections 3.5.1 and 3.5.2)

Perception-based weights were derived from questionnaire responses collected from 184 participants, as reported in the manuscript. The questionnaire response data are provided in the Excel file:

184_response_IJGIS.xlsx

Final normalised coefficients derived from this dataset are:

dense vegetation ($\alpha = 0.220$)
parked vehicles ($\beta = 0.376$)
high walls and fences ($\gamma = 0.404$)

These final coefficients, as reported in Table 3, were manually incorporated into the street-segment attribute tables in QGIS and applied uniformly across all segments in subsequent analysis. Reproduction of the reported results therefore relies on the application of these fixed weights rather than re-estimation of perceptual parameters.

Step 7: Construction of the Perceived Walkability Index (PWI)
(Reproduces Table 4; Sections 3.5.1 and 4.2)

Segment-level PWI values were calculated in QGIS using the perception-weighted formulation described in the manuscript. For each 20-metre street segment, normalised obstruction densities were multiplied by their corresponding perceptual weights and summed

to obtain the PWI score.

Descriptive statistics derived from the resulting PWI field reproduce the values reported in Table 4.

Step 8: Spatial visualisation and clustering analysis
(Reproduces Figures 7 and 8; Section 4.3)

PWI values were joined to street segments in QGIS for visualisation, producing the segment-level maps shown in Figure 7. Local spatial clustering was assessed using the Getis–Ord G_i^* statistic with a 200-metre spatial threshold via the QGIS Hotspot Analysis tool, reproducing the Z-score patterns shown in Figure 8.

All Python scripts operate on the shared Excel files using relative file paths and can be executed without code modification. QGIS operations rely on standard tools (Field Calculator and Hotspot Analysis) with parameters explicitly reported in the manuscript; screenshots are therefore not required for reproduction.