Cartography M.Sc.

Analysis and mapping of the crime perception gap

A quantitative approach of sketch maps

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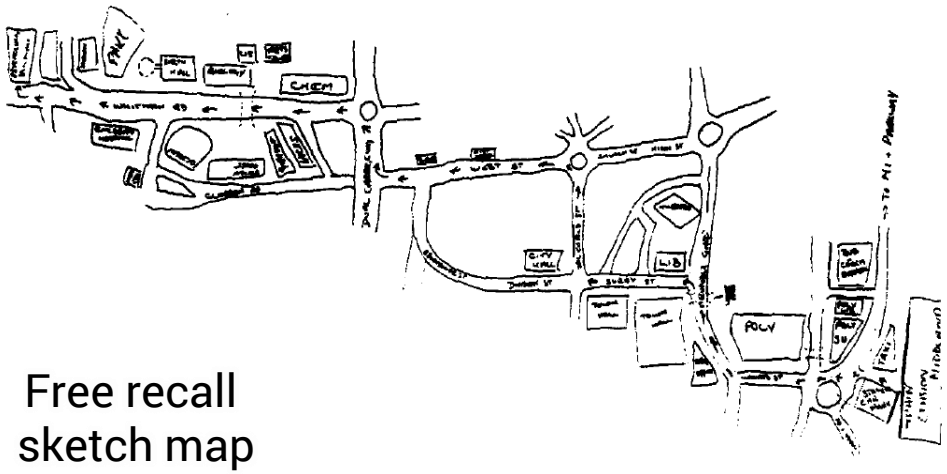
- Sketch maps
  - Spatial attributes
    - Geometry
    - Relative location
  - Non-spatial attributes
    - Believes
    - Impresions

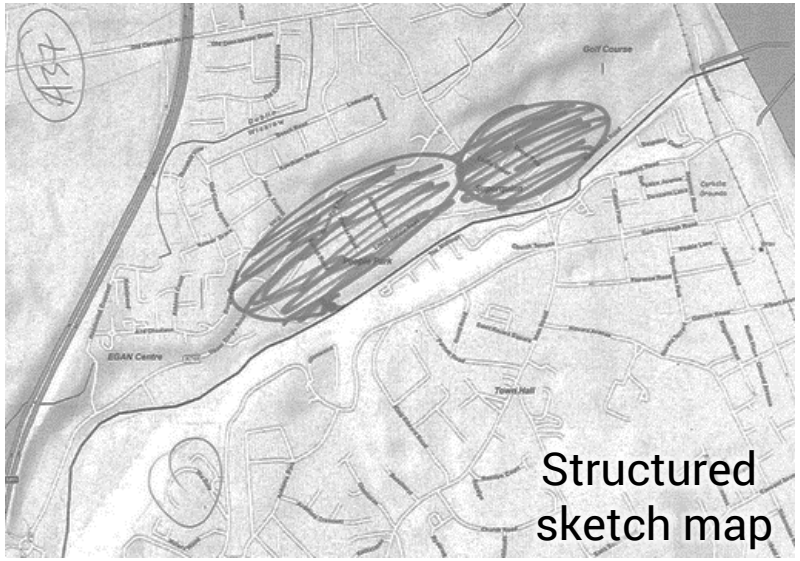
→ **PERCEPTION**

Types of sketch maps



Free recall sketch map

Blades, M. (1990). The reliability of data collected from sketch maps. Journal of Environmental Psychology, 10(4), 327-339.



Structured sketch map

O'Neill, E., Brennan, M., Brereton, F., & Shahumyan, H. (2015). Exploring a spatial statistical approach to quantify flood risk perception using cognitive maps. Natural Hazards, 76(3), 1573-1601.

Perception data ≠ Real/Reference data → Crime perception gap

The misperception of crime can have repercussion on:

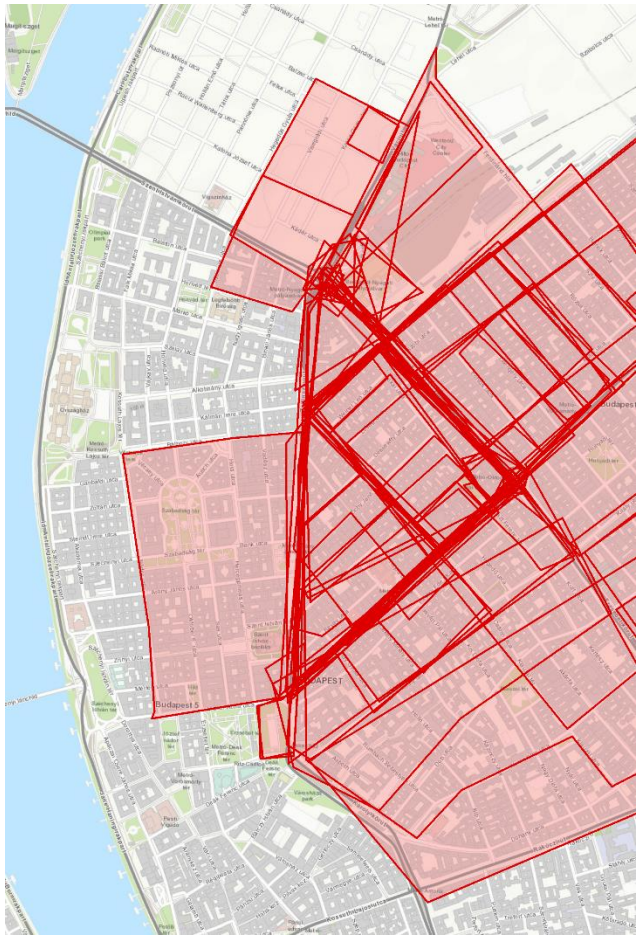
- people's lifestyle
- affect social behaviour
- spatial and economic dynamics

→ It is relevant that police agencies develop strategies directed to narrow the perception gap

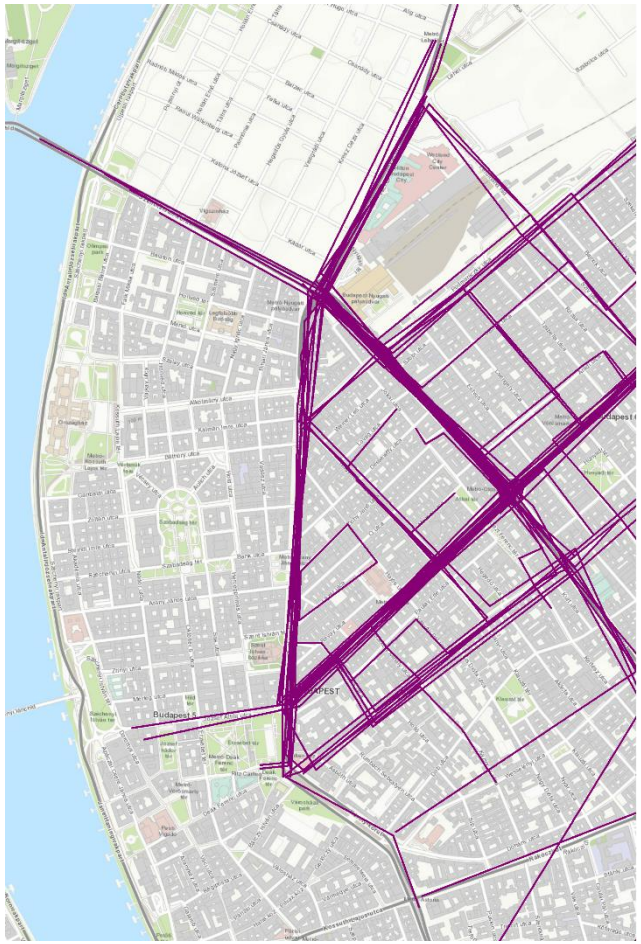
General objective ➡ To quantitatively examine structured sketch maps to analyse and map crime perception. Moreover, to design a GeoVisual Analytics environment that eases the decision-making in the development of strategies to amend the perception of crime

Principles of Geography	Stages of research	Specific objectives
Causality	Exploratory modelling	To analyse the location of perceived unsafe areas in relation to a) the distribution of crime incidents and b) people's activity spaces.
Location	Spatial delineation of the perception accuracy	To determine and explore the accuracy of people's crime perception and to map its spatial distribution.
Relation	Development of a GeoVisual Analytics environment	To conceptually design a GeoVisual Analytic environment for the exploration and reasoning of perceptions of crime.

Sketch maps

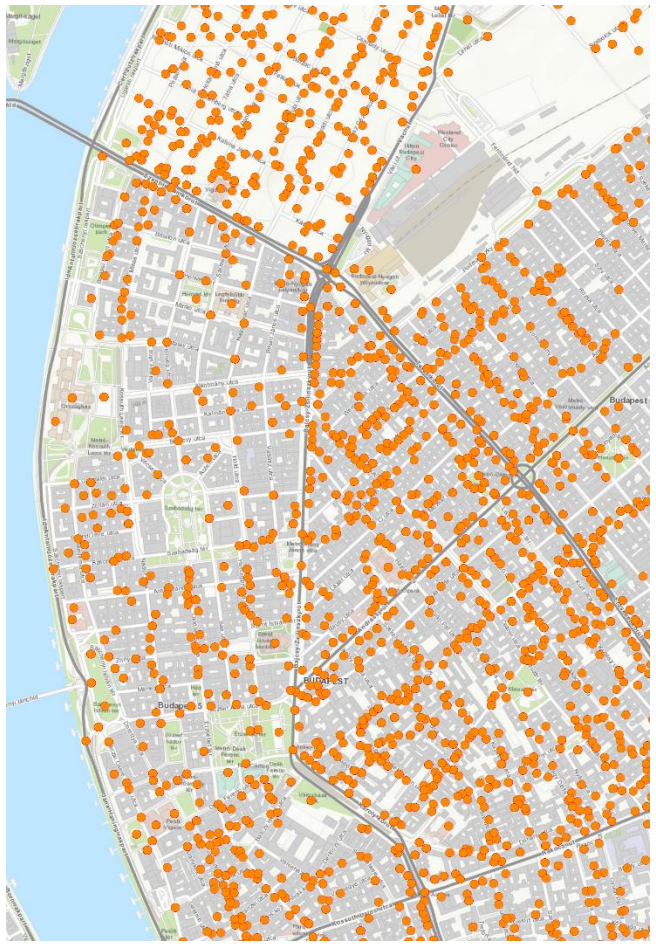


Perceived safe/unsafe areas



Daily routes

Actual incidences



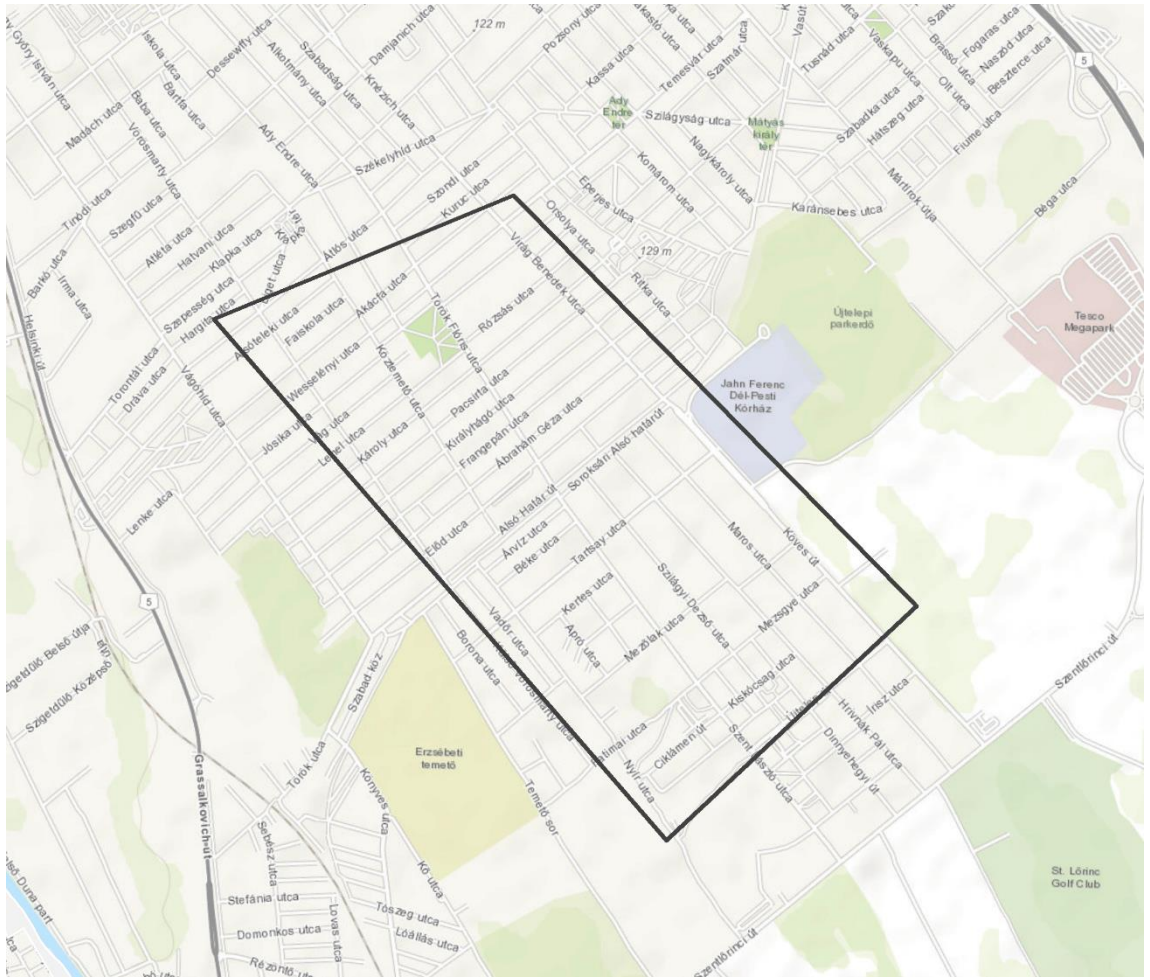
Crime events

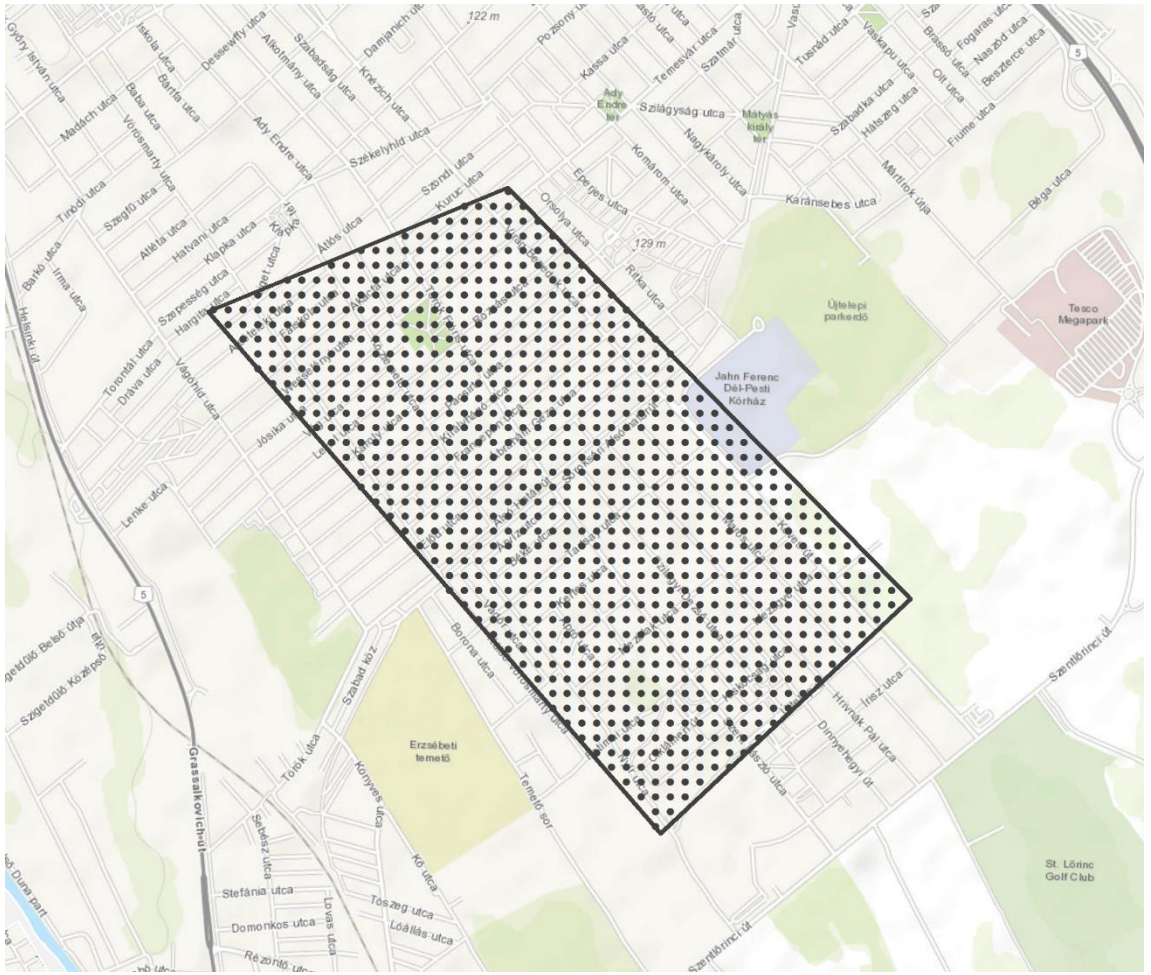
EXPLORATORY MODELING

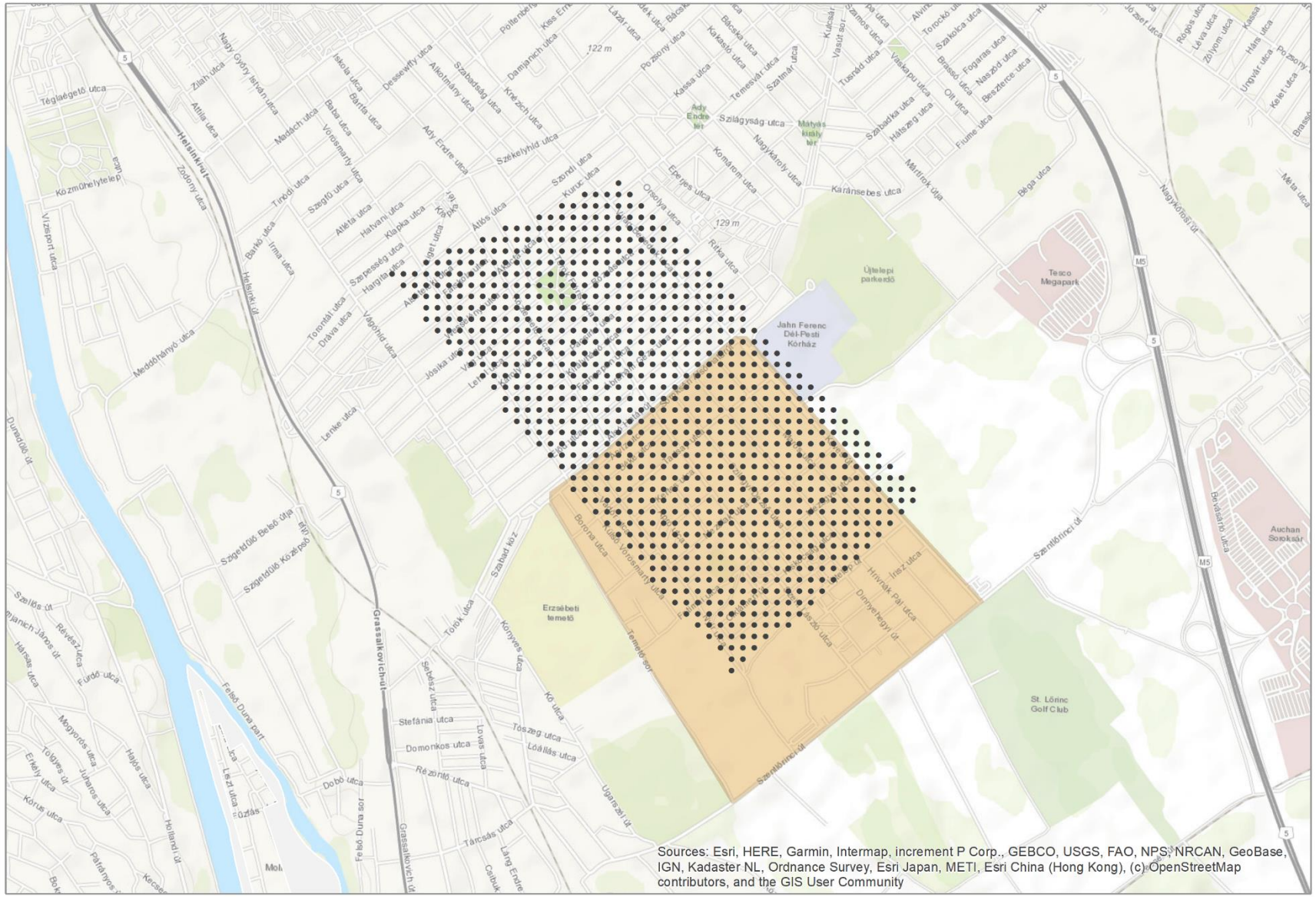
Causality

- What is the relationship between the people's daily **activity spaces** (neighbourhood and daily routes) and the location of the areas they perceive as unsafe?
- What is the relationship between the location of the **crime incidents** and the perceived unsafe areas?

Segmentation of the sketch polygons



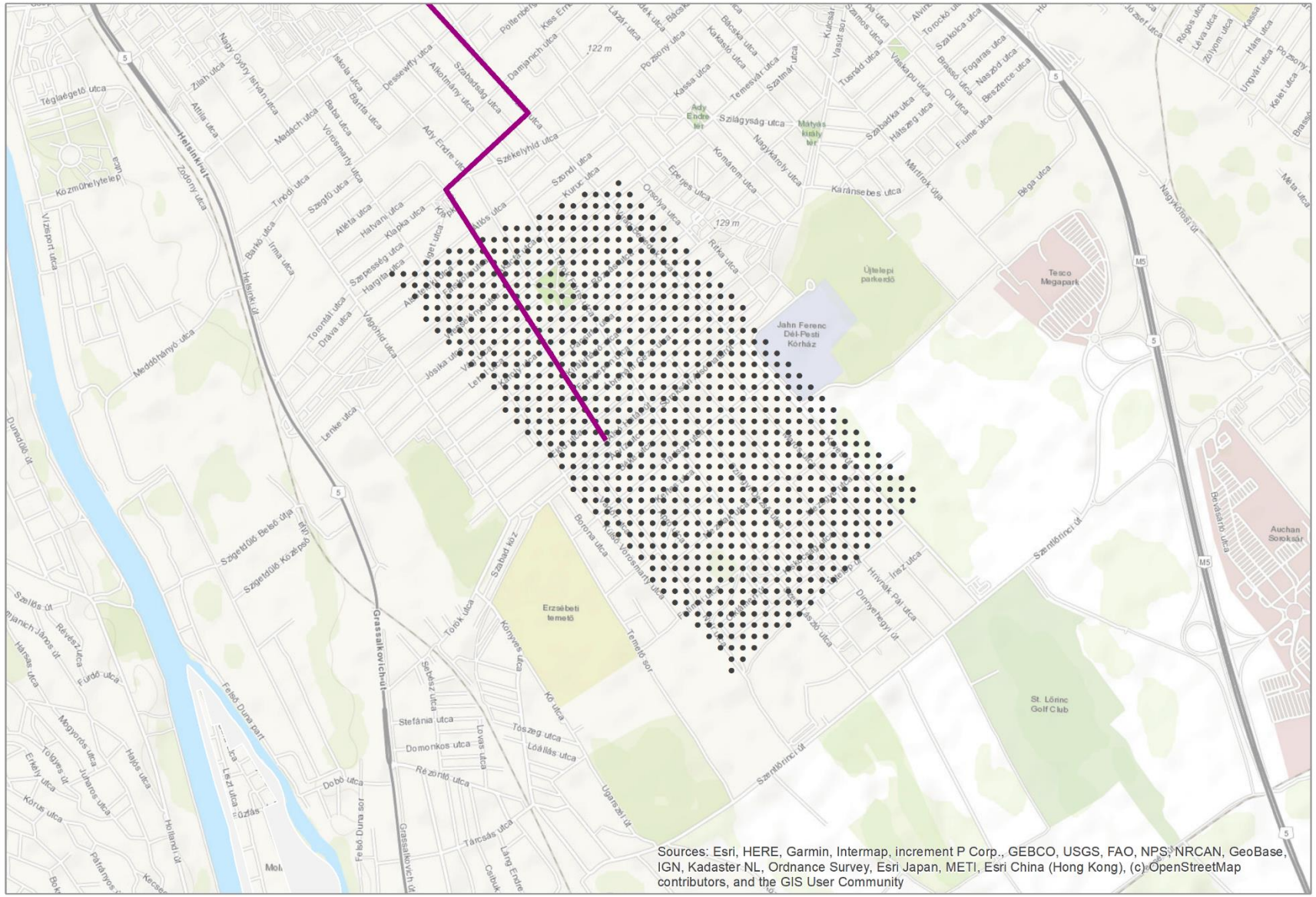




Exploratory variables

Distance from the cells' centroid within a sketched polygon to:

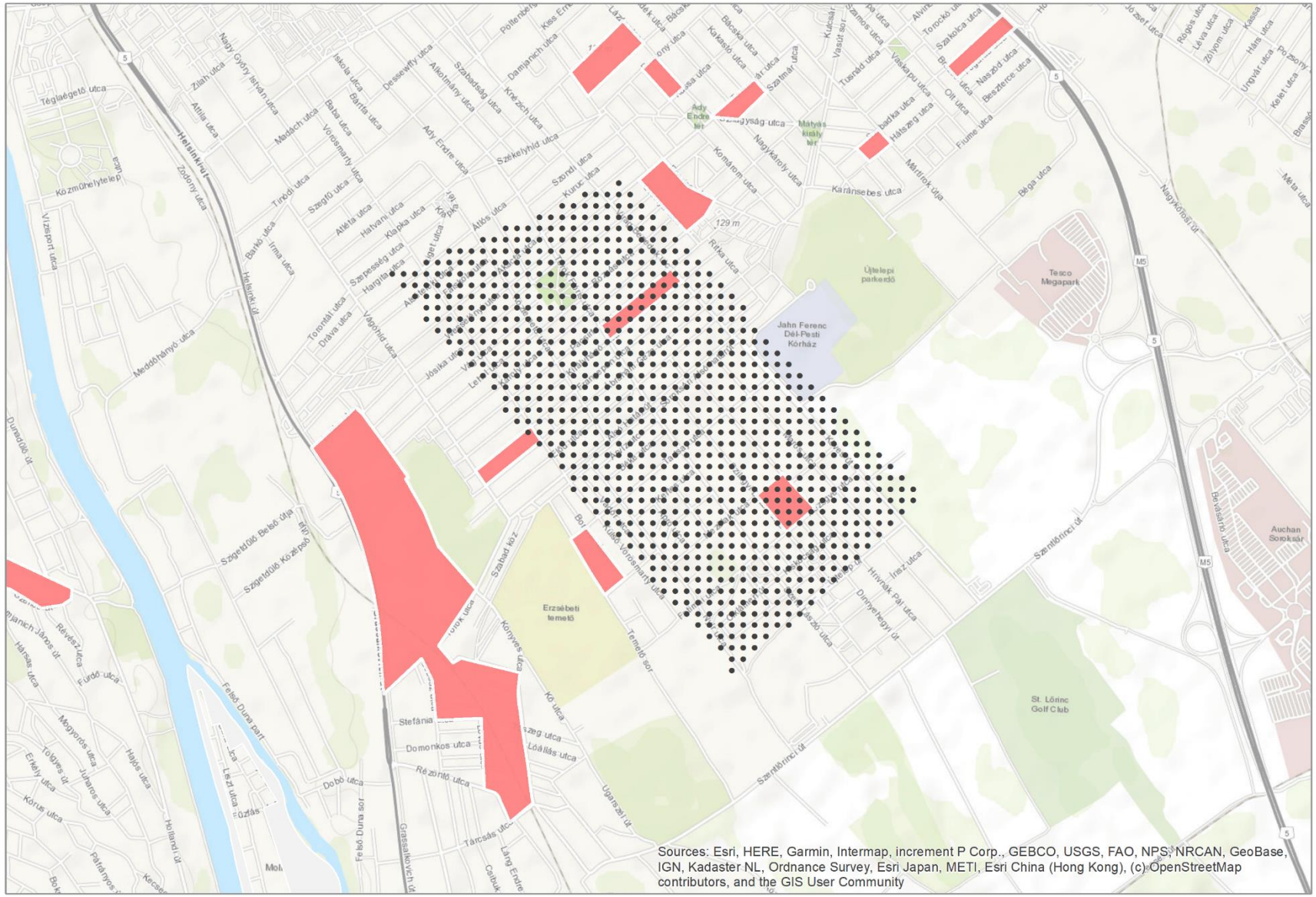
- Participant's neighbourhood



Exploratory variables

Distance from the cells' centroid within a sketched polygon to:

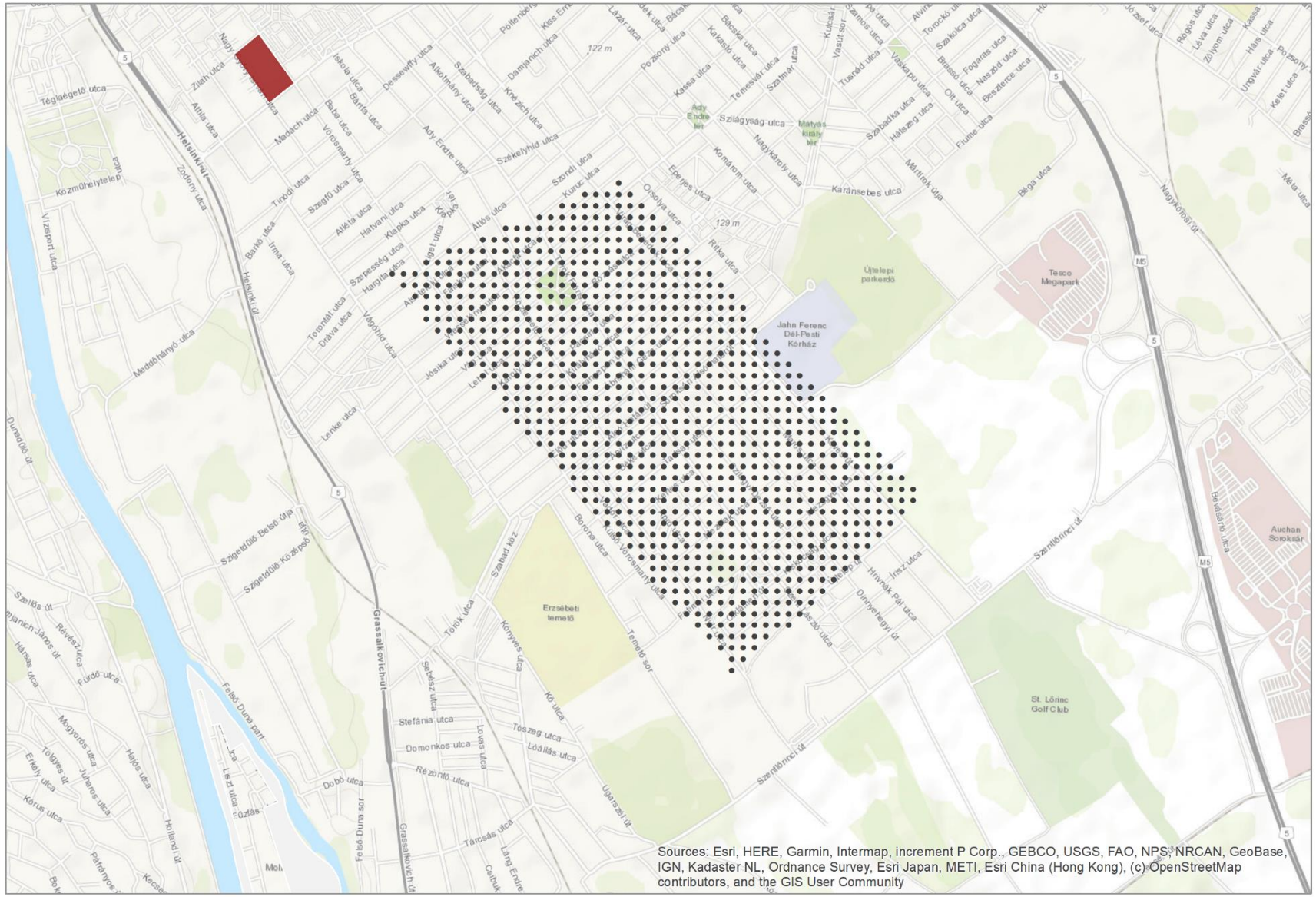
- Participant's neighbourhood
- Participant's daily route



Exploratory variables

Distance from the cells' centroid within a sketched polygon to:

- Participant's neighbourhood
- Participant's daily route
- Crime hotspots



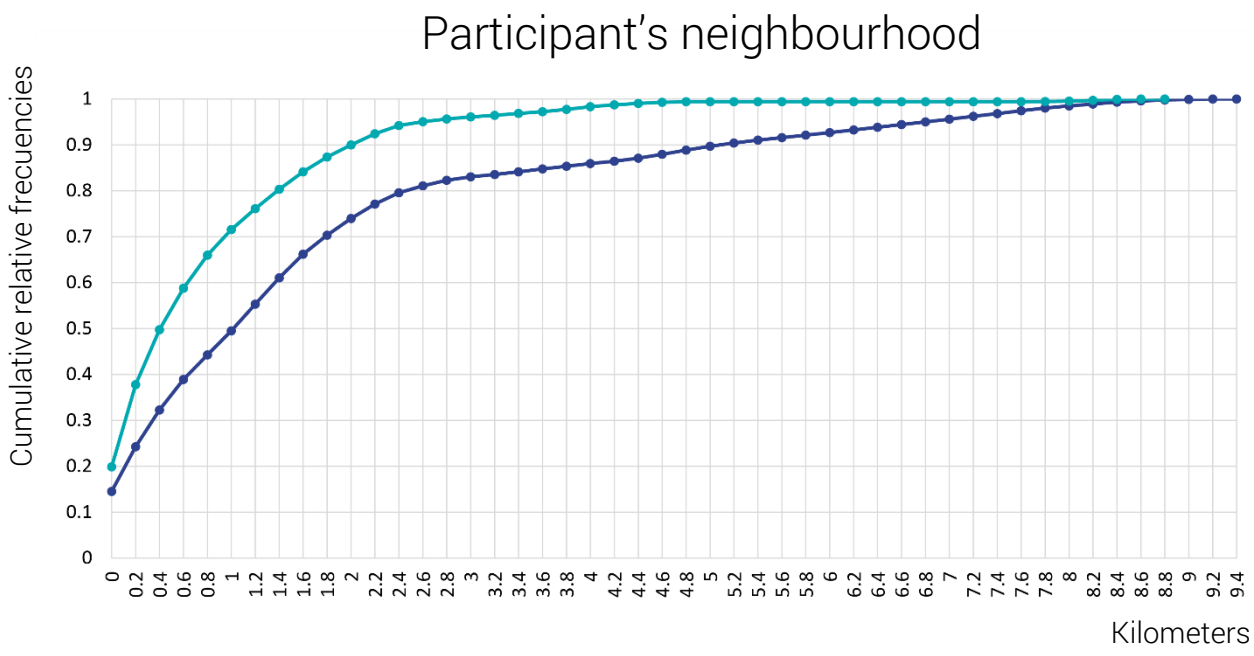
Exploratory variables

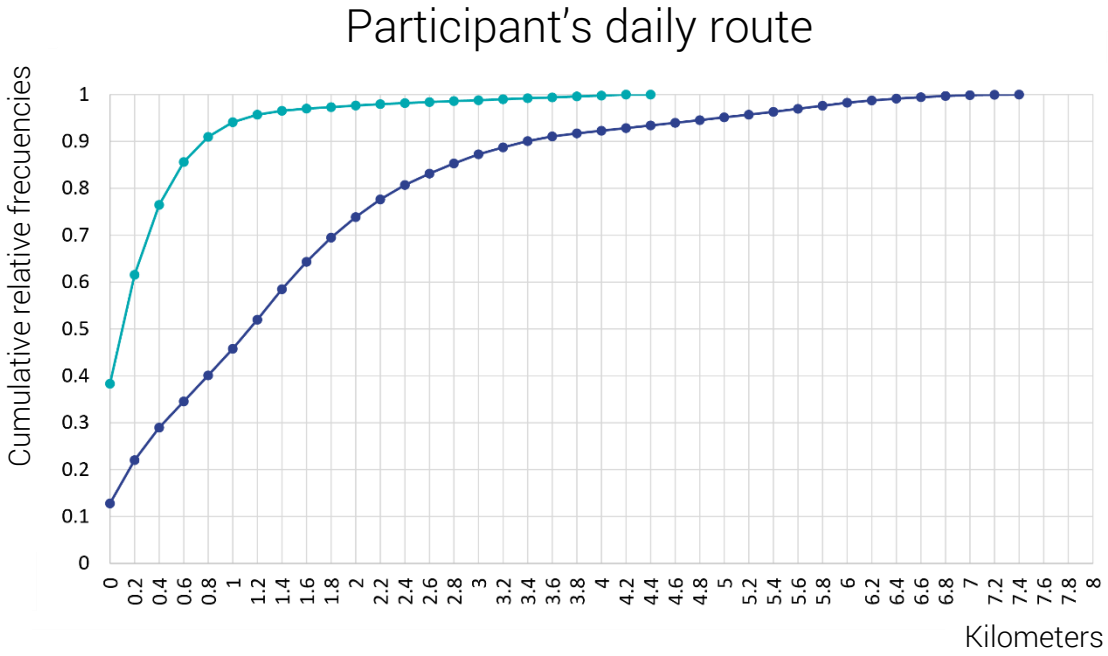
Distance from the cells' centroid within a sketched polygon to:

- Participant's neighbourhood
- Participant's daily route
- Crime hotspots
- High crime intesity areas

Exploratory variables

Distance from the cells' centroid within a sketched polygon to:





To perceived unsafe areas

To perceived safe areas

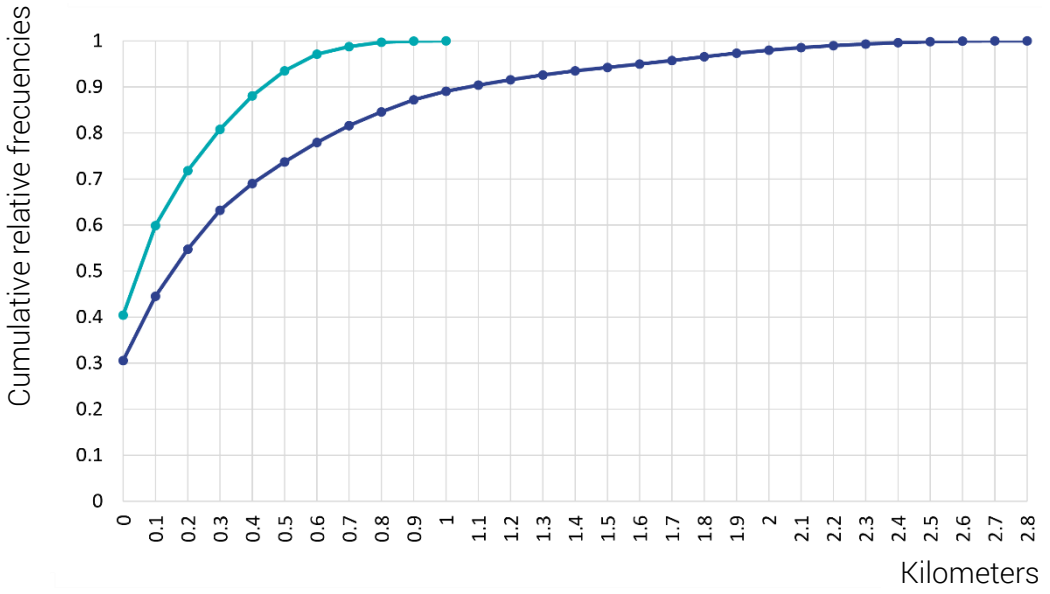
The participants identified safe areas near to their neighbourhood

The participants identified unsafe areas further away from their daily routes

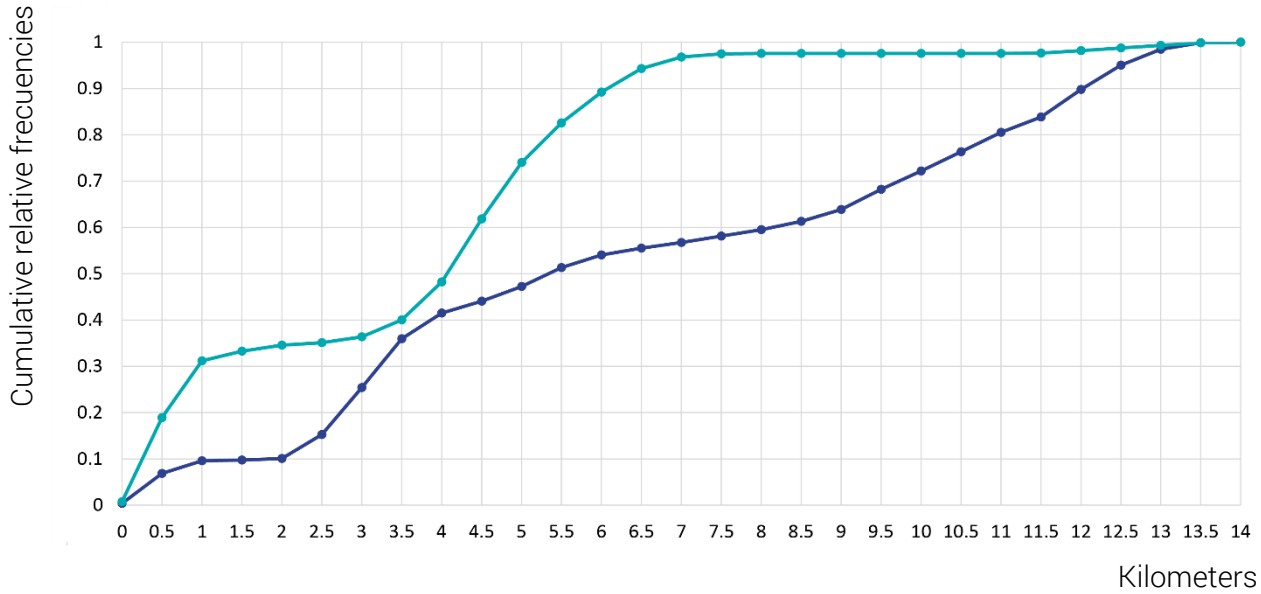
Exploratory variables

Distance from the cells' centroid within a sketched polygon to:

Crime hotspot



High crime intesity areas



To perceived unsafe areas

To perceived safe areas

Participants perceived safe areas near to the hotspots

More participants identified safe areas closer to the HCIAs than unsafe areas

Hypothesis 1: *the likelihood of people perceiving an area as unsafe increases when the target area is far away from their neighbourhood and their daily routes*.

Hypothesis 2: *People's misconception of crime reality involves both the overestimation of safe areas (inaccurate perception of safe areas- IS) and the underestimation of unsafe areas (inaccurate perception of safe areas- IU).*

Resultant logistic regression model

$$Xb = -3.1573 + 0.0002X_1 + 0.001X_2 + 0.0007X_3 + 0.0009X_4 + 0.0002X_5$$

Coefficients' odds ratio

Explanatory variable	Coefficient	e^b
Distance to:		
Neighbourhood	0.0002	1.0002
Daily route	0.0010	1.0010
Cluster hotspot	0.0007	1.0007
Outlier hotspot	0.0009	1.0009
High crime intensity areas (HCIA)	0.0001	1.0001

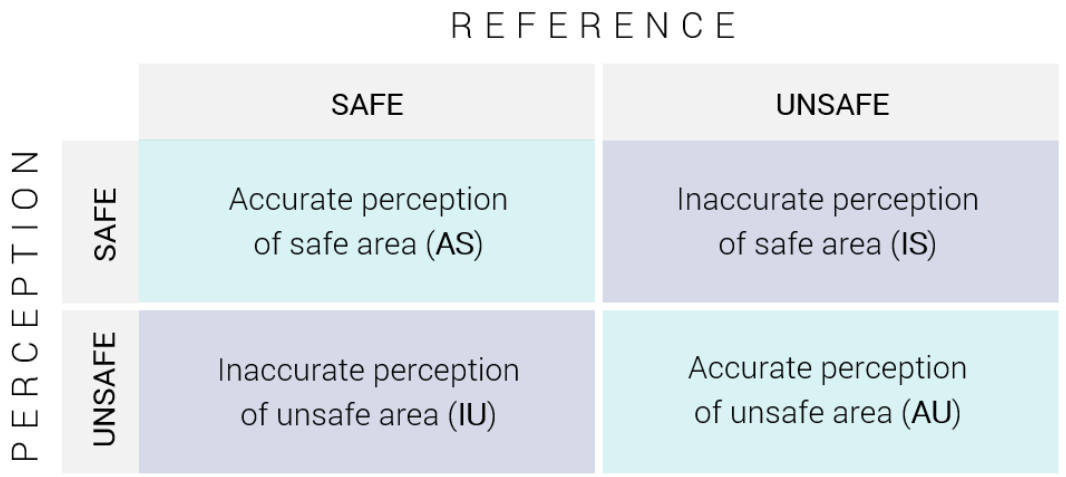
	1 block (230 m)	2 blocks (460 m)	3 blocks (690 m)	4 blocks (920 m)	5 blocks (1150 m)
Neighbourhood	1.05	1.10	1.15	1.20	1.26
Daily route	1.26	1.58	1.99	2.51	3.16
Cluster hotspot	1.17	1.38	1.62	1.90	2.24
Outlier hotspot	1.23	1.51	1.86	2.29	2.82
High crime intensity areas	1.02	1.05	1.07	1.10	1.12

✓ Hypothesis 1: *the likelihood of people perceiving an area as unsafe increases when the target area is far away from their neighbourhood and their daily routes*

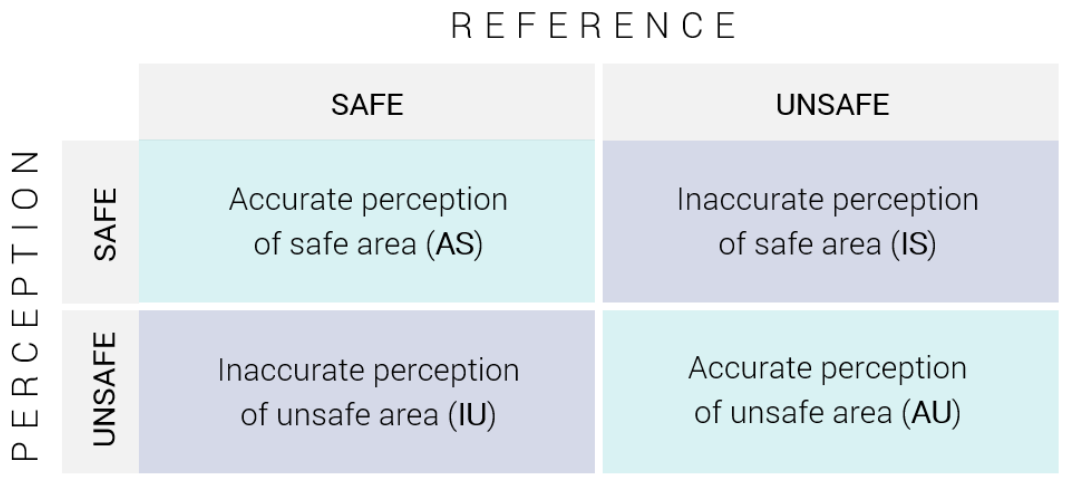
CRIME PERCEPTION ACCURACY: SPATIAL DELINEATION

Location

- How to measure the accuracy of people's crime perception?
- How can the location of inaccurately perceived unsafe areas be explained by the spatial distribution of another explanatory variable?



Block ID	Hotspot	Participants who classified the block by type		Total	% of participants who classified the block by type		Classification of the block		Accuracy type	Level of accuracy
		Safe	Unsafe		Safe	Unsafe	Reference	Perceived		
1	yes	4	7	11	36.4	63.6	unsafe	unsafe	AU	Low
2	no	7	1	8	87.5	12.5	safe	safe	AS	High
3	yes	13	4	17	76.5	23.5	unsafe	safe	IS	Medium
4	no	3	19	7	13.6	86.4	safe	unsafe	IU	High



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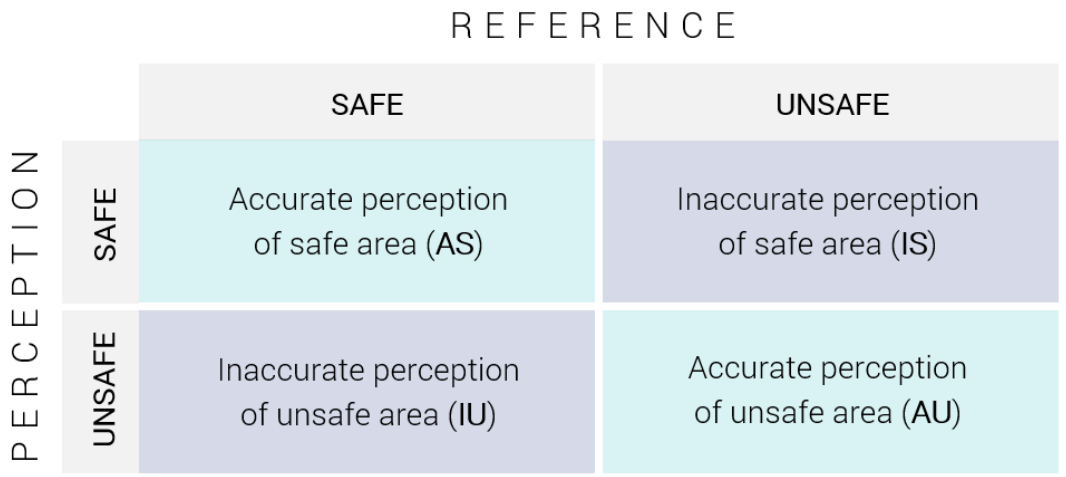

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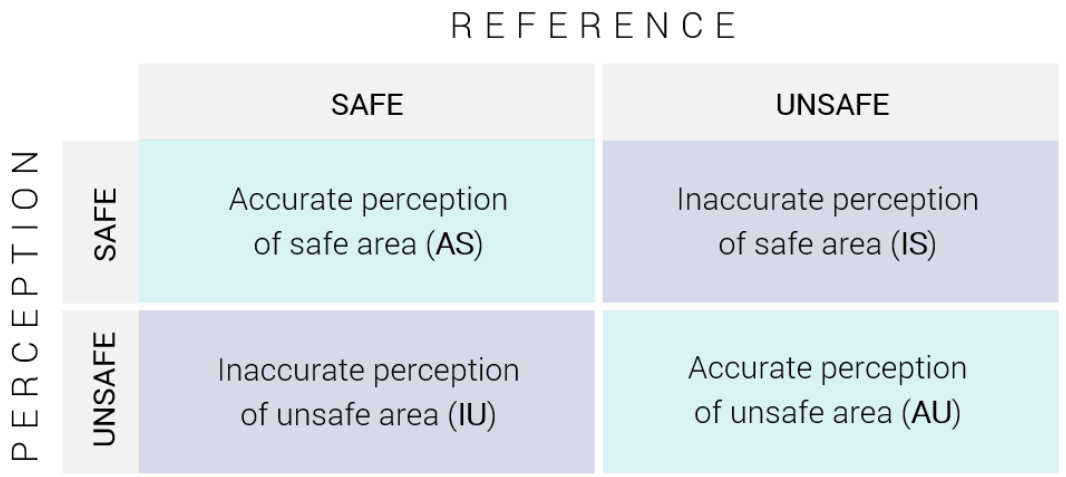

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Percentage of participants	Level of accuracy
> 50% - 65%	Low
> 65% - 85%	Medium
> 85% - 100%	High

Block ID	Hotspot	Participants who classified the block by type		Total	% of participants who classified the block by type		Classification of the block		Accuracy type	Level of accuracy
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Percentage of participants	Level of accuracy
> 50% - 65%	Low
> 65% - 85%	Medium
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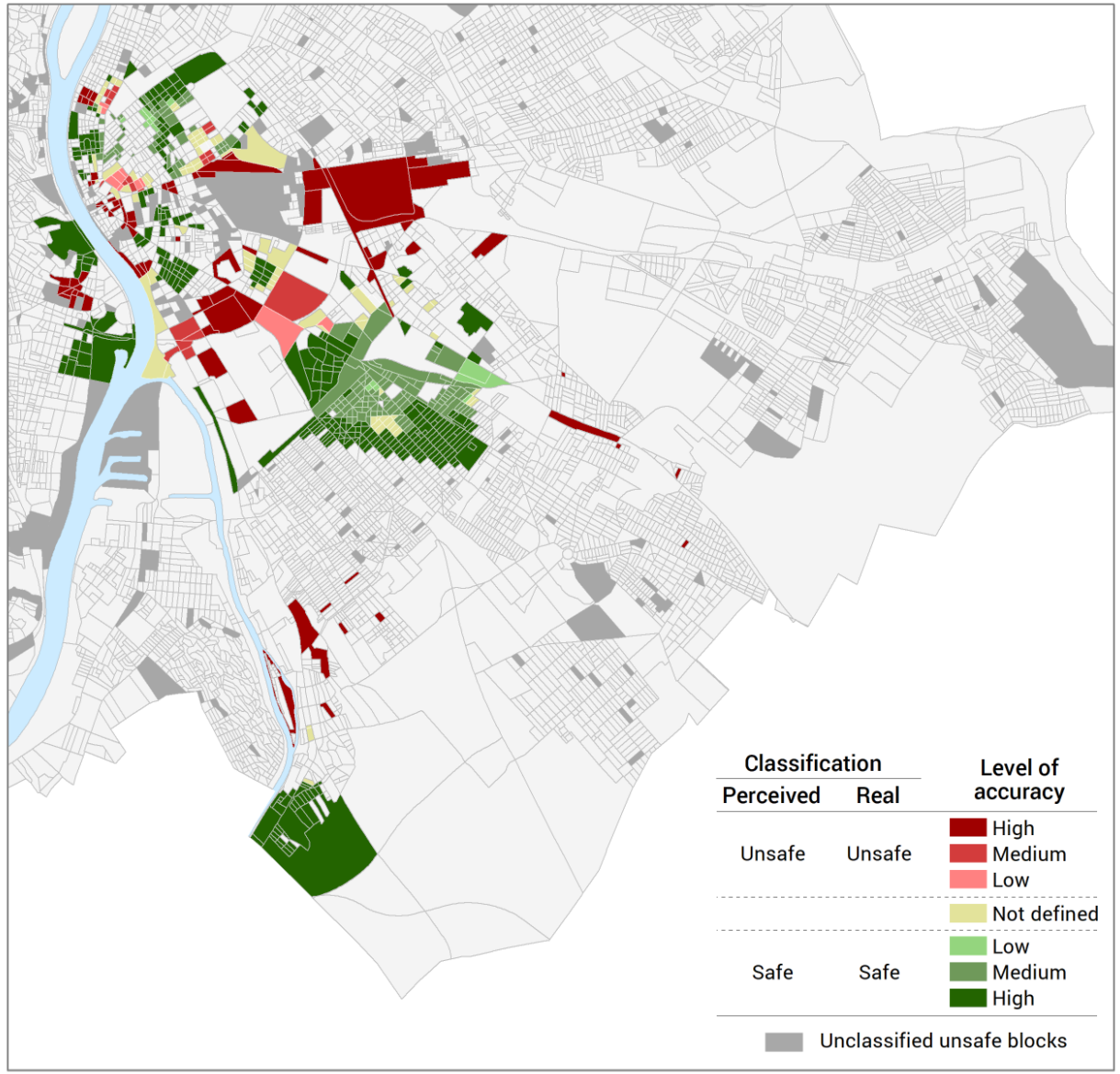
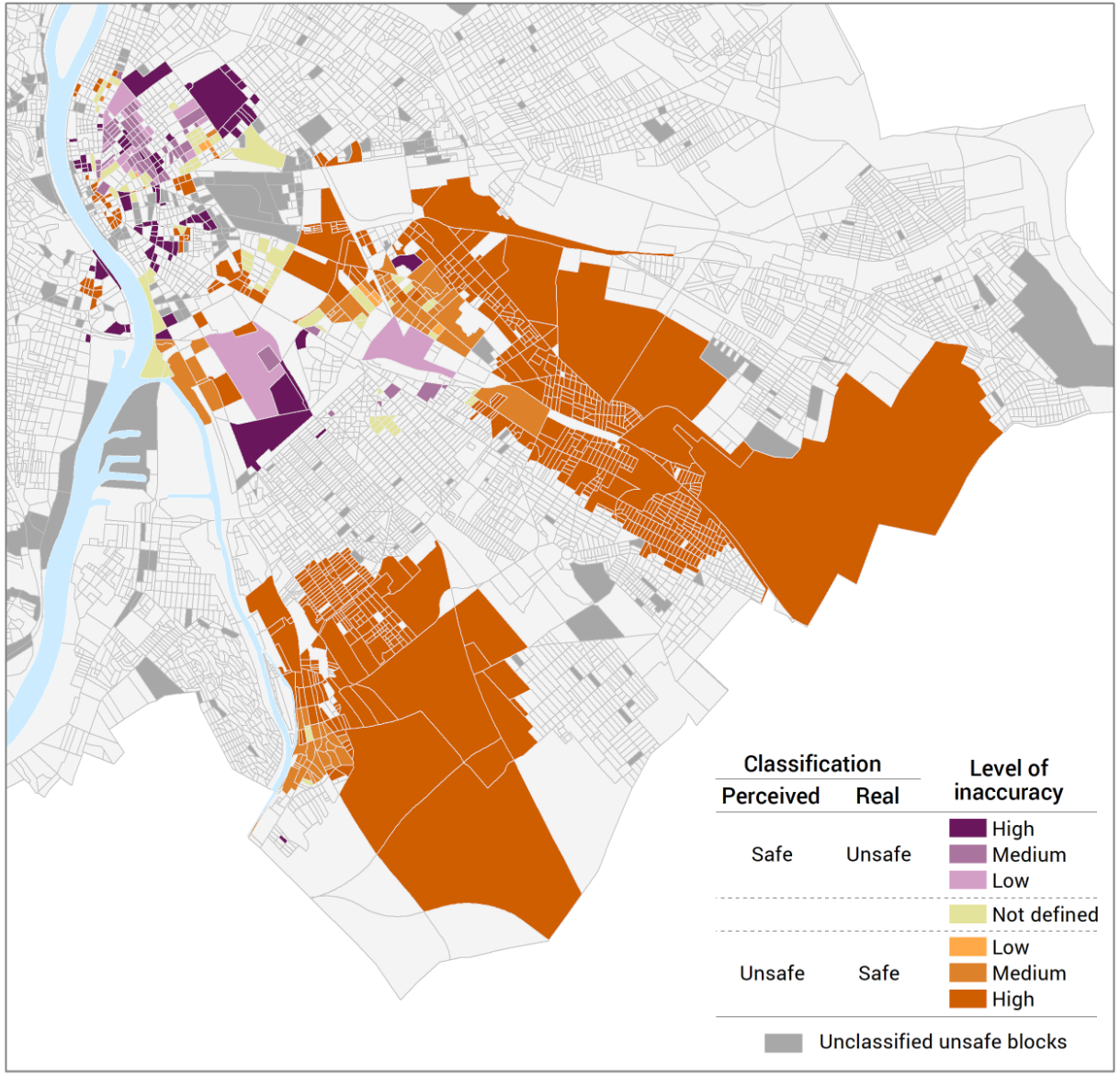
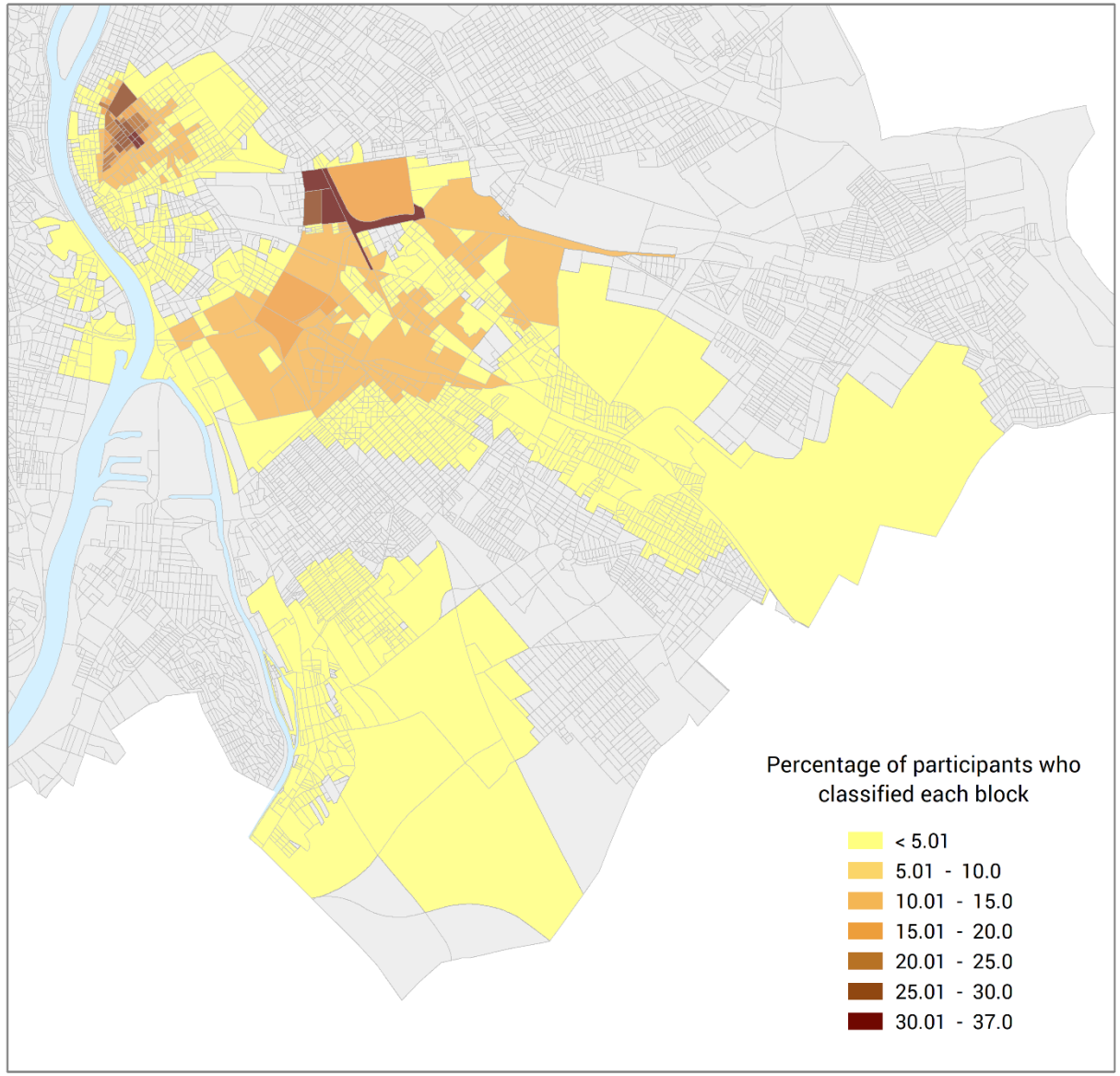
ACCURATE PERCEPTION



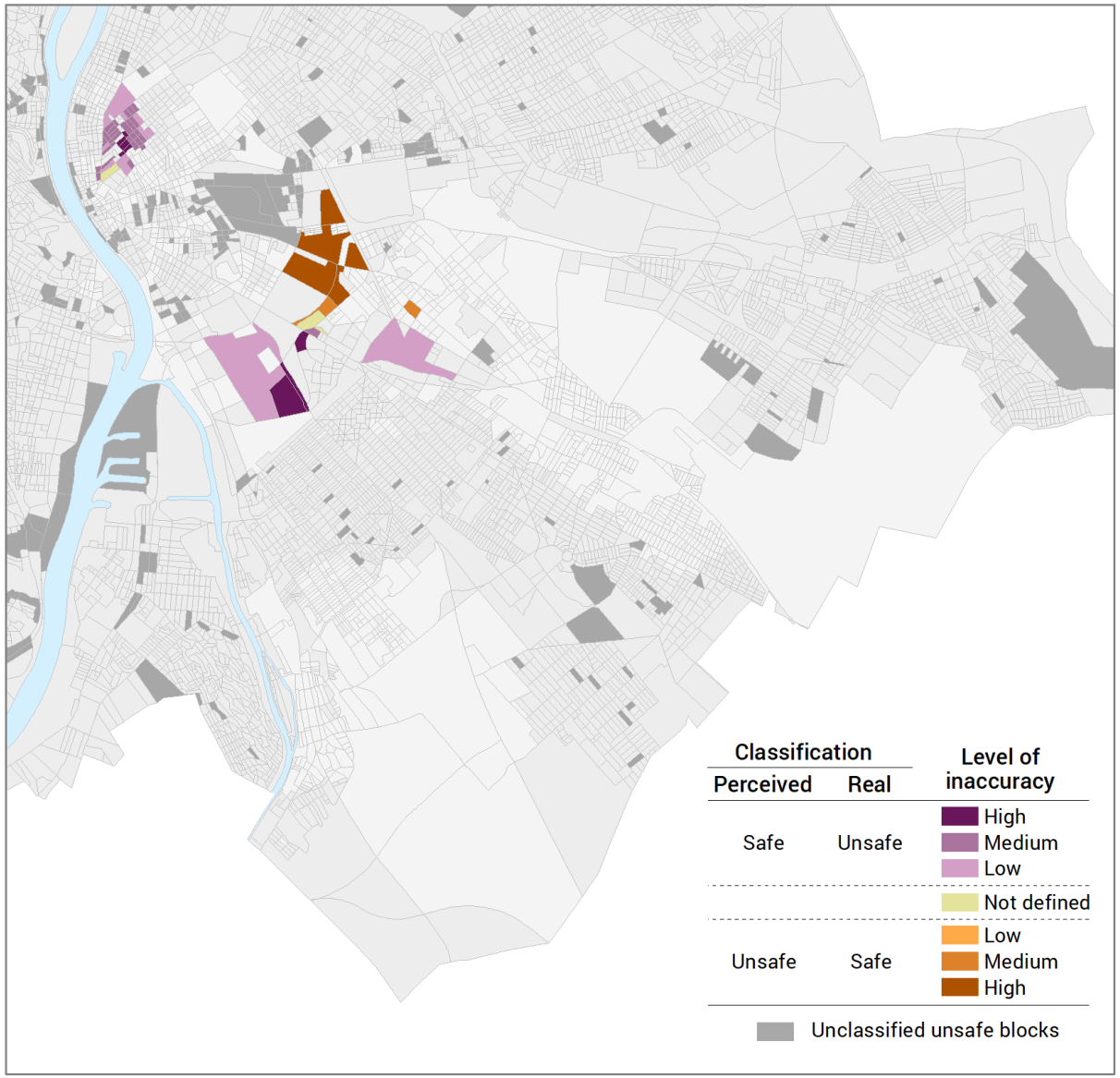
INACCURATE PERCEPTION



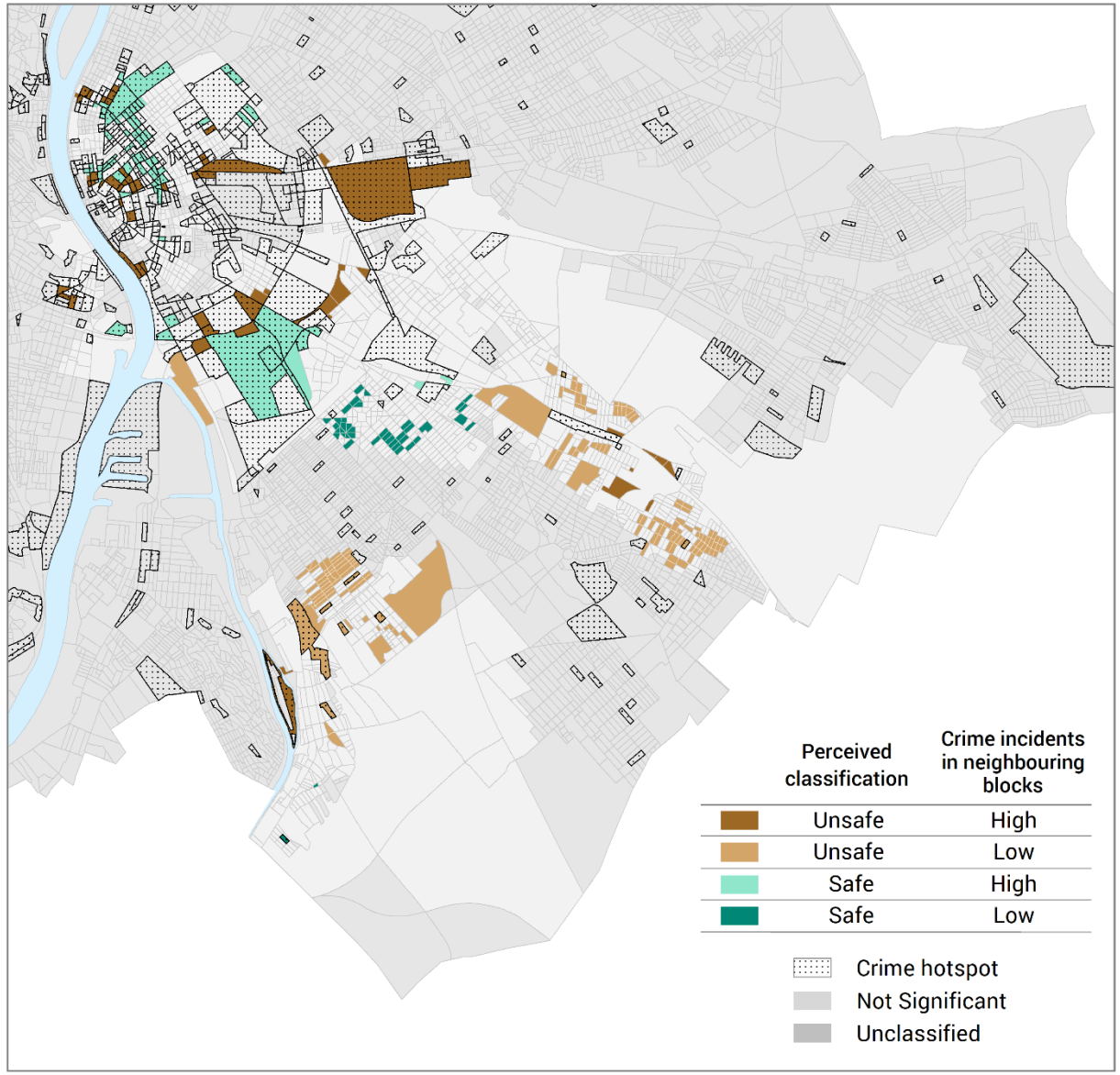
PERCENTAGE OF PARTICIPANTS WHO CLASSIFIED EACH BLOCK

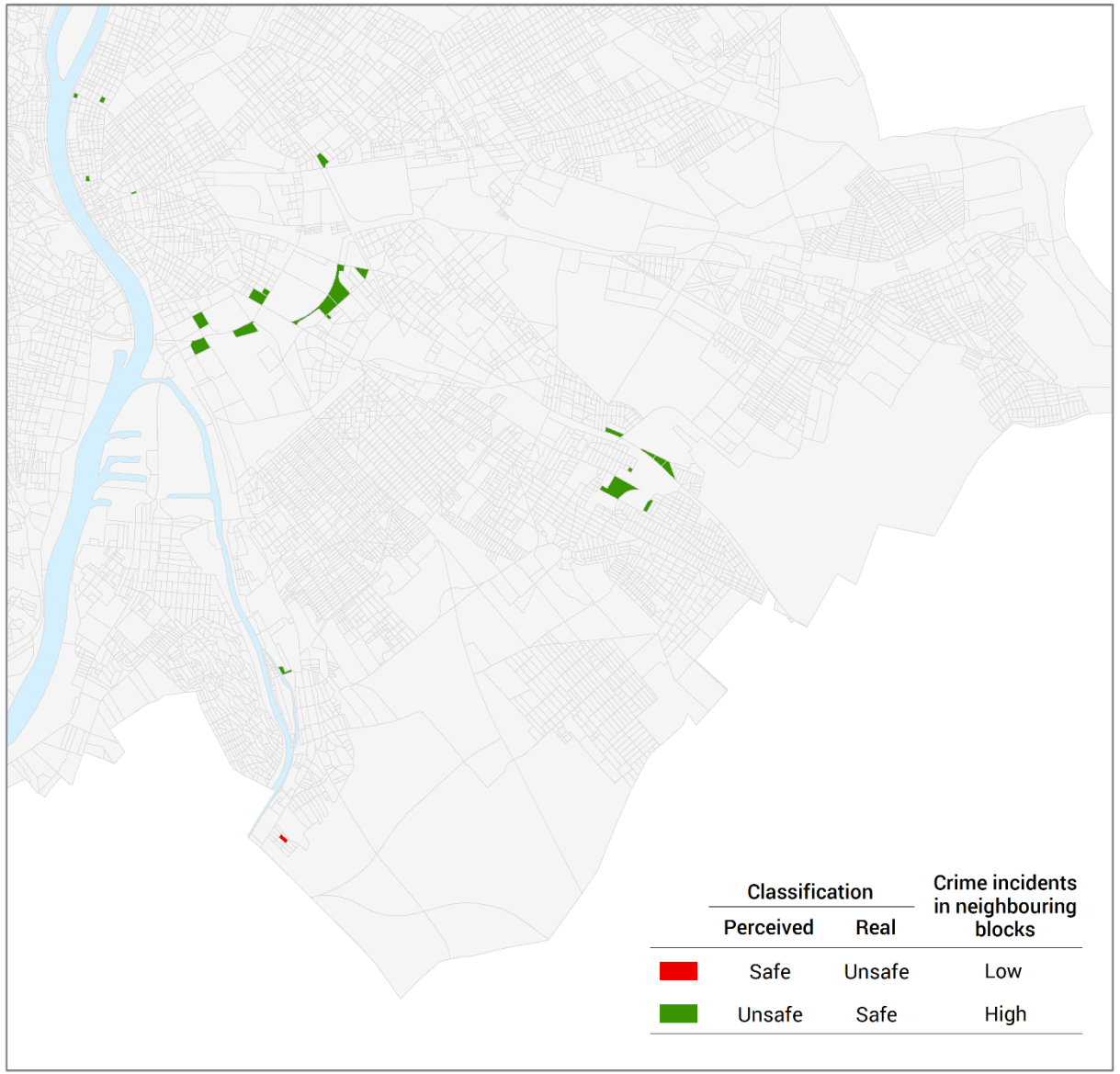


INACCURATE PERCEPTION – MORE THAN 10 PARTICIPANTS



BIVARIATE ANALYSIS

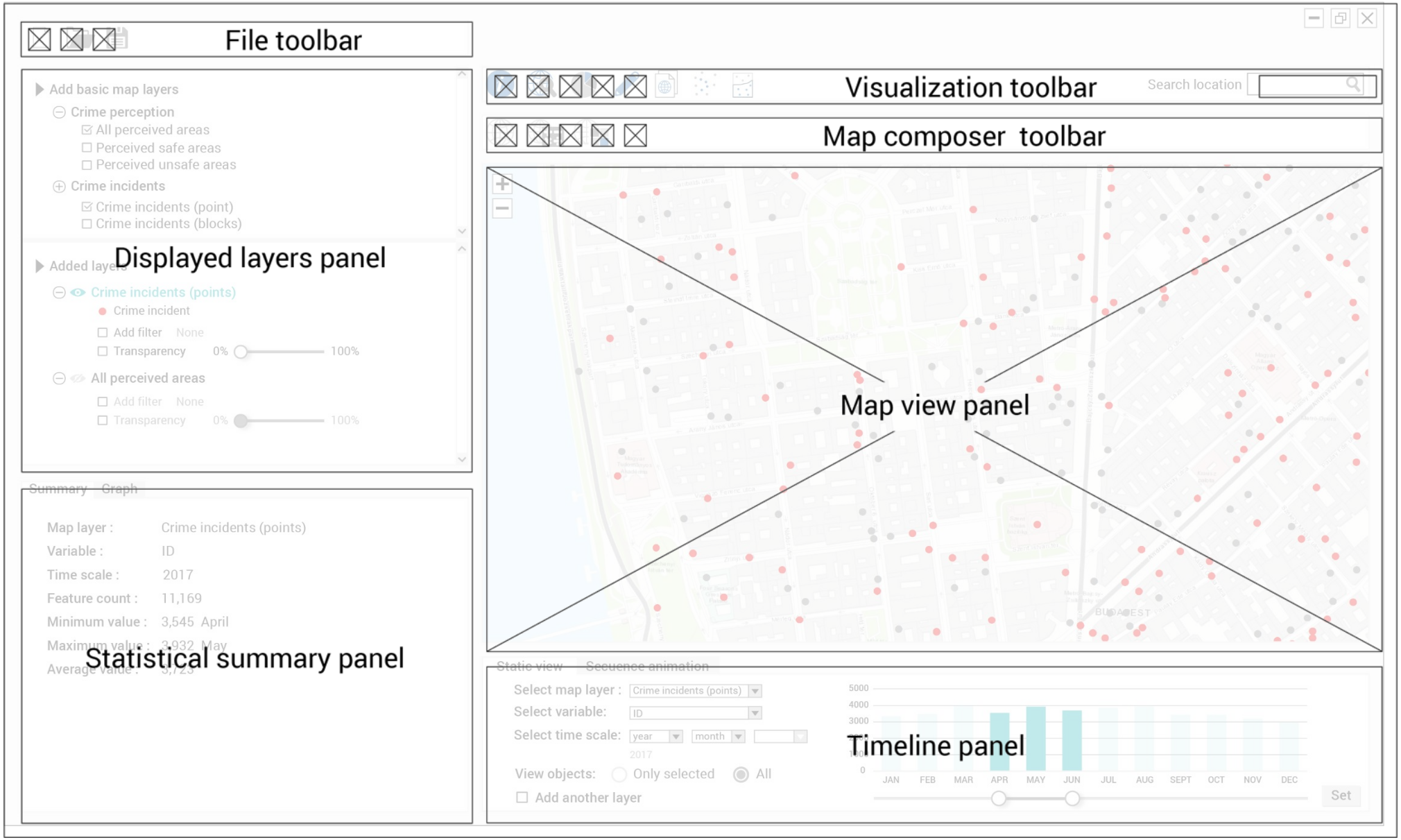


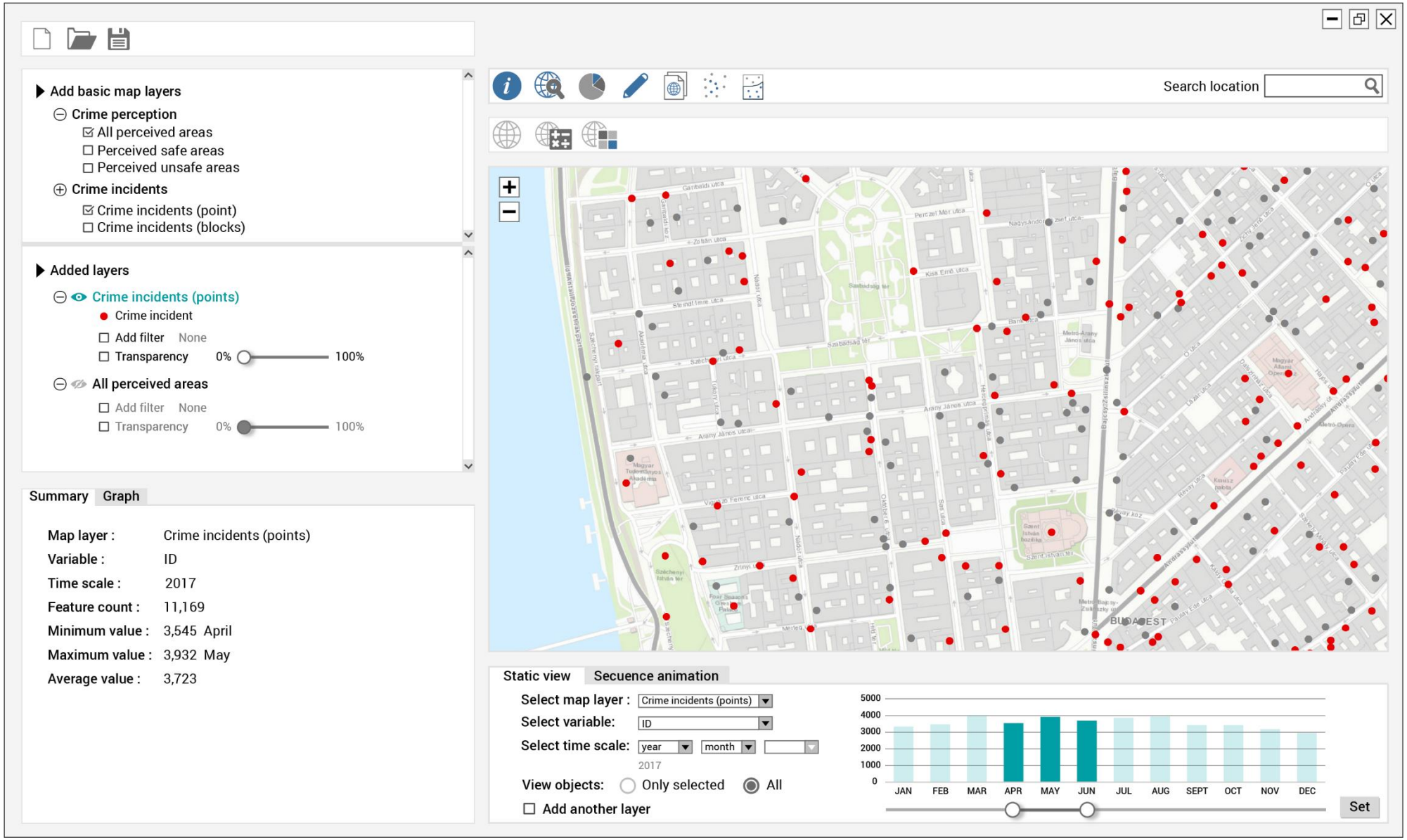


DEVELOPMENT OF A GEOVISUAL ANALYTICS ENVIRONMENT

Relation

- Which tools and representations could be integrated in a GeoVisual Analytic interface to explore and analyse crime perception?


File toolbar
Add basic map layers
Crime perception
All perceived areas
Perceived safe areas
Perceived unsafe areas
Crime incidents
Crime incidents (point)
Crime incidents (blocks)
Displayed layers panel
Added layers
Crime incidents (points)
Crime incident
Add filter None
Transparency 0% 100%
All perceived areas
Add filter None
Transparency 0% 100%
Summary Graph
Map layer : Crime incidents (points)
Variable : ID
Time scale : 2017
Feature count : 11,169
Minimum value : 3,545 April
Maximum value : 3,932 May
Statistical summary panel
Visualization toolbar
Search location
Map composer toolbar
Map view panel
Static view Sequence animation
Select map layer : Crime incidents (points)
Select variable: ID
Select time scale: year month
2017
View objects: Only selected All
Add another layer
5000
4000
3000
0
JAN FEB MAR APR MAY JUN JUL AUG SEPT OCT NOV DEC
Timeline panel
Set


Add basic map layers
Crime perception
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Crime incidents (point)
Crime incidents (blocks)
Added layers
Crime incidents (points)
Crime incident
Add filter None
Transparency 0% 100%
All perceived areas
Add filter None
Transparency 0% 100%
Summary Graph
Map layer : Crime incidents (points)
Variable : ID
Time scale : 2017
Feature count : 11,169
Minimum value : 3,545 April
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Search location
BUDAPEST
Static view
Secuence animation
Select map layer : Crime incidents (points)
Select variable: ID
Select time scale: year month
2017
View objects: Only selected All
Add another layer
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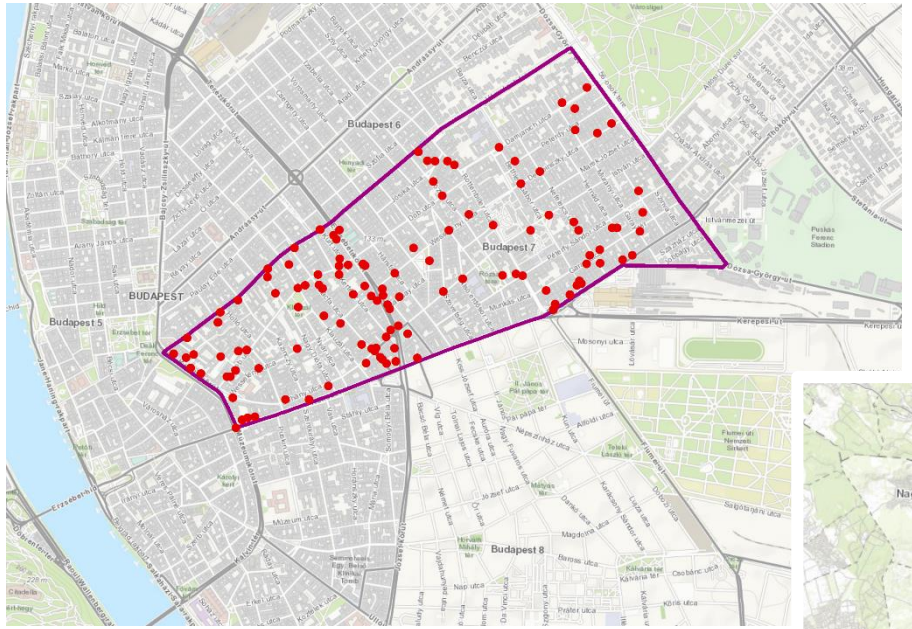
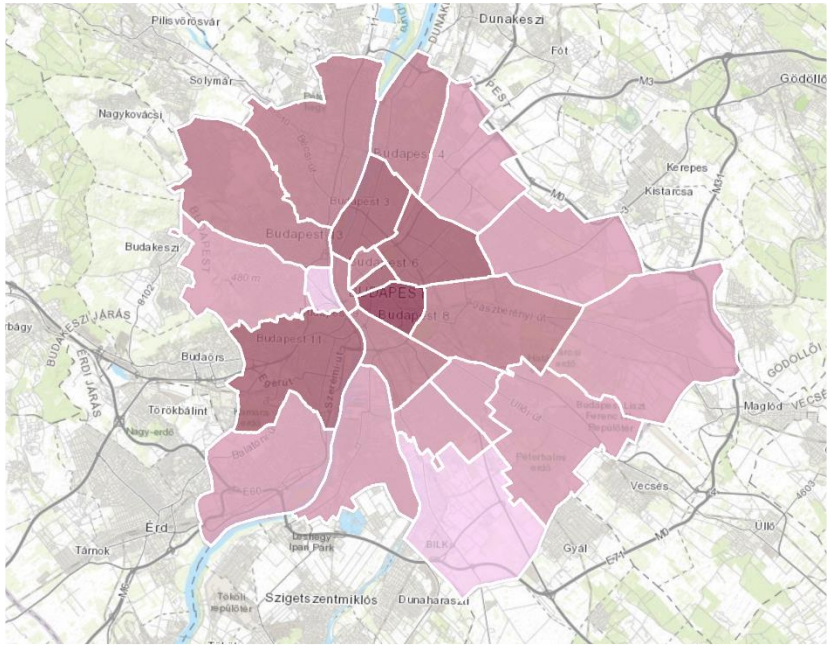
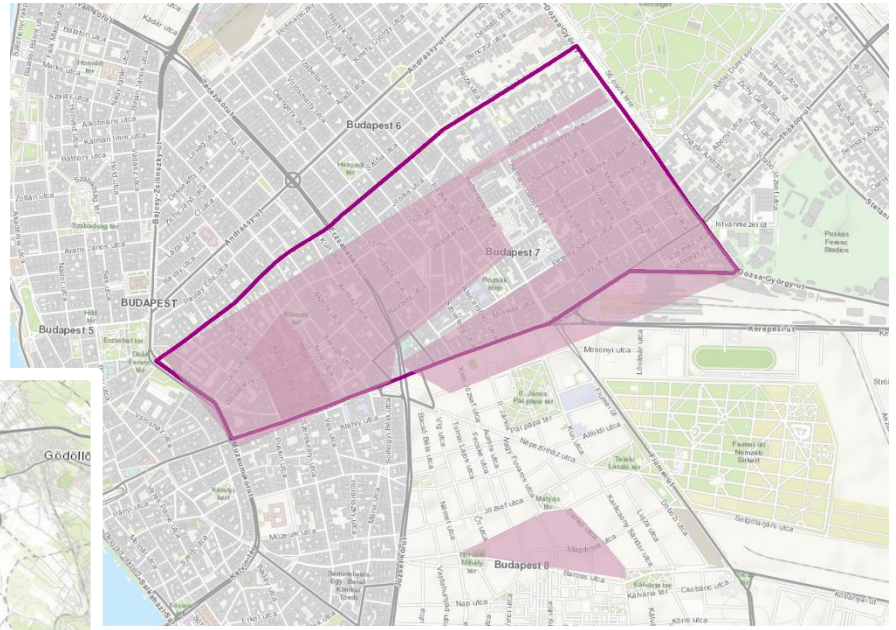


selection by intersection



univariate map



linked selection

Conclusions and final remarks

Conclusions

- This thesis intended to contribute to the spatial studies of perception by the data extraction and analysis of sketch maps.
- An integral interpretation of sketch maps can be done by incorporating the use of GIS, spatial analysis, and statistics.
- This research gave a general idea of how incorporating quantitative and spatial analysis methods for the study of spatial perception from structured sketch maps can result in a more complete and objective interpretation.

Recommendations

- The perception data collection by sketch maps must include a questionnaire or a think-aloud process that can provide more information to the interpretation of the map.
- The logistic regression model can be improved by exploring additional contextual variables to get a more precise overview of the context.
- The requirement analysis should be improved to enhance the GVA prototype presented, which could be used as a reference to develop a high-fidelity prototype that can go through interaction and usability studies.

Cartography M.Sc.

THANK YOU FOR YOUR ATTENTION

Analysis and mapping of the crime perception gap

A quantitative approach of sketch maps