SZÉCHENYI EGYETEM
UNIVERSITY OF GYŐR

IV. Közlekedésbiztonsági Konferencia
Győr, 2026

TRANSPORT SAFETY CONFERENCE

Do Smart Crossings Guide Driver Attention?

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Agenda

01

Problem statement

02

Methodology

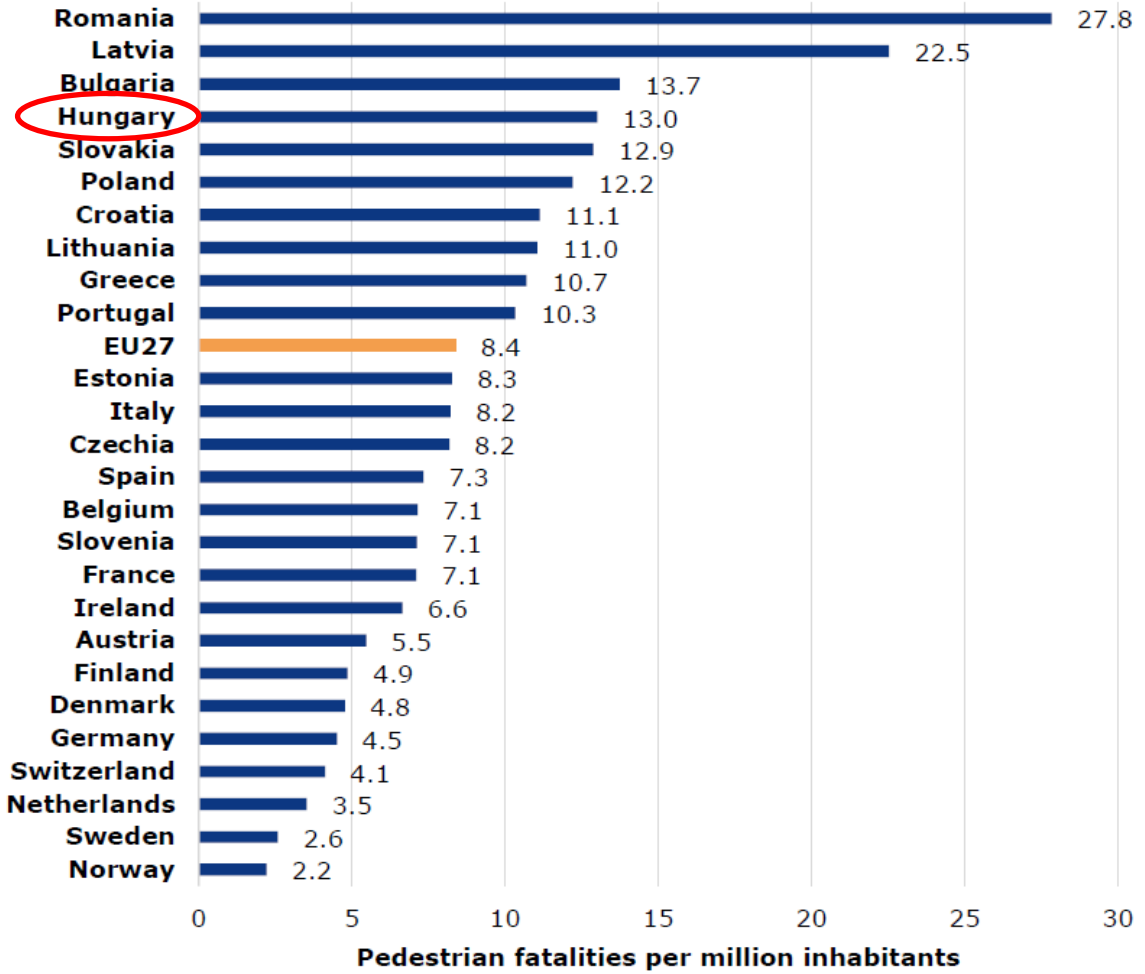
03

Findings

04

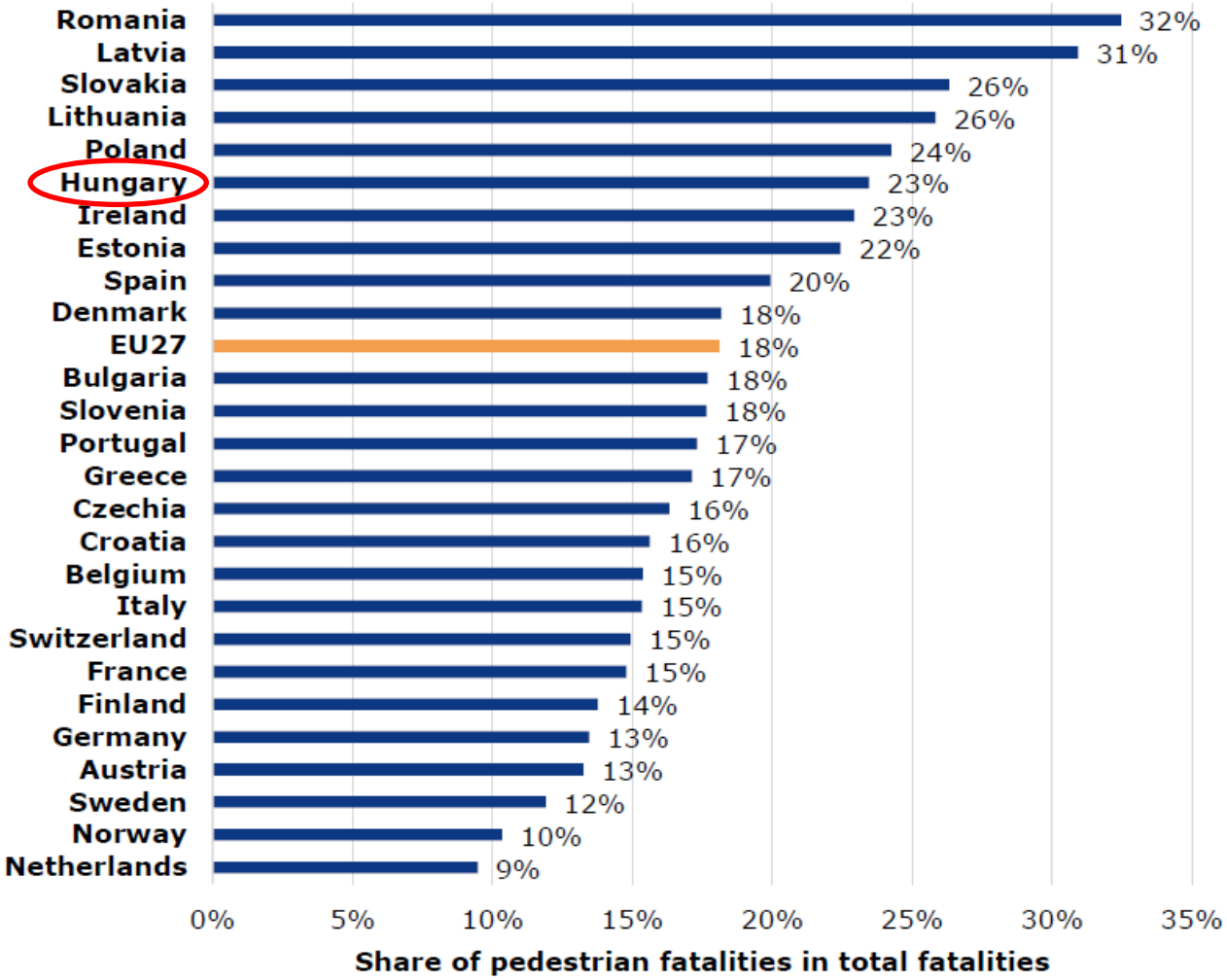
Summary

Európai trendek (meghalt/1 millió lakos) - gyalogos



Forrás: European Road Safety Observatory: Facts and Figures – Pedestrians – 2024, https://road-safety.transport.ec.europa.eu/european-road-safety-observatory/data-and-analysis/facts-and-figures_en

Európai trendek (meghaltak részaránya) - gyalogos



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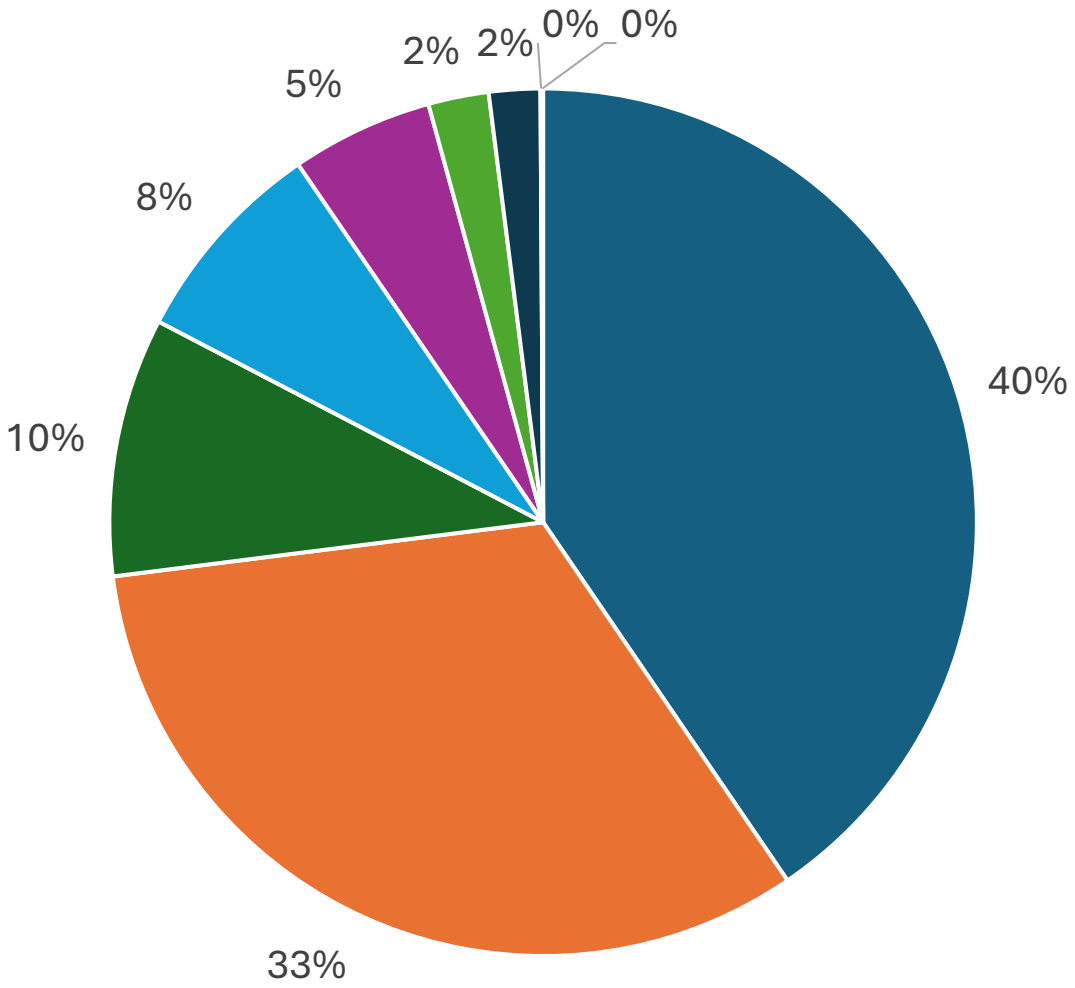
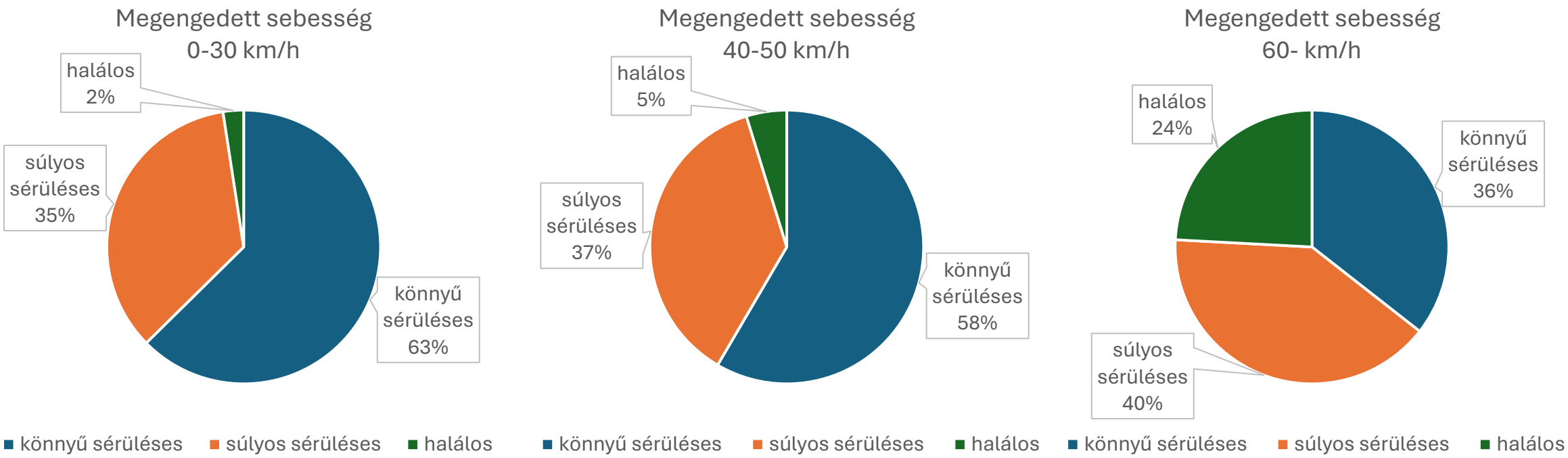
Gyalogos balesetek okai (2022)



- elsőbbség meg nem adása
- gyalogosok hibája
- irányváltoztatási, haladási, bekanyarodási hiba
- járművezető egyéb hibája
- sebesség nem megfelelő alkalmazása
- megállási kötelezettség elmulasztása
- előzés szabályainak meg nem tartása
- utasok hibája
- egyéb okok

Gyalogos balesetek kimenetele és sebesség (2022)



Commonly used smart crossing in Hungary

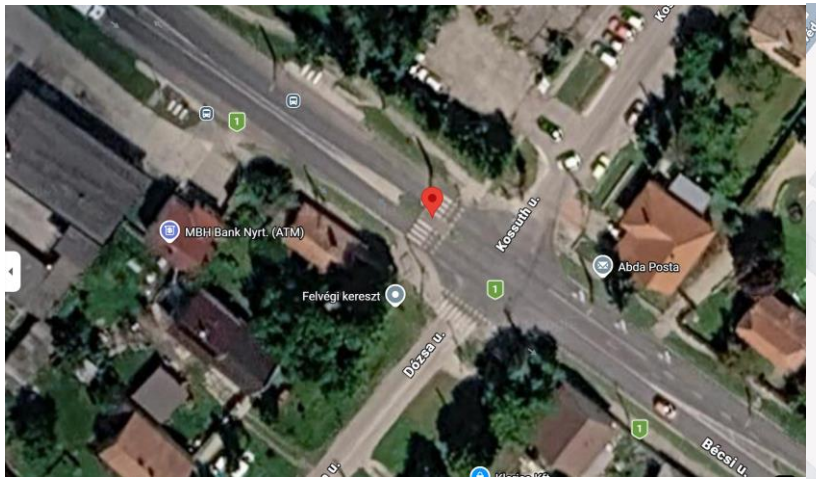
Do smart crossing guide driver attention?

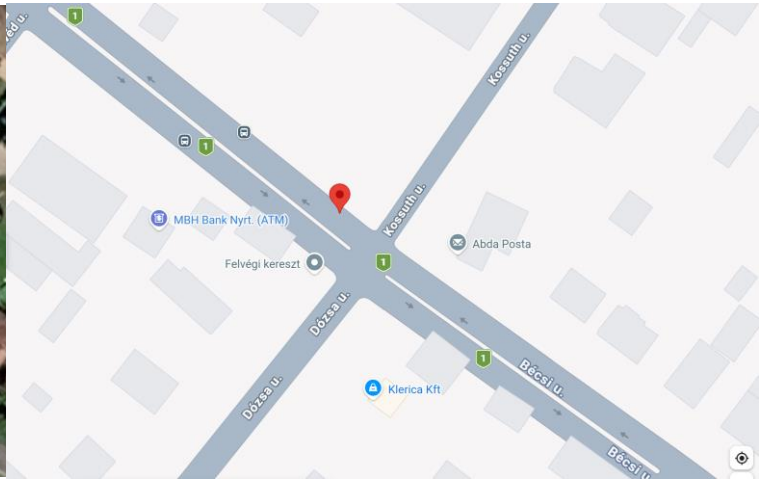
Aim

To identify the impact of SC on drivers' **recognition patterns of pedestrians** and their reliance perceptions on such solutions in various **situational and environmental** conditions.

Case study:

- SafeXone at Abda, Hungary
- 47°41'49.0"N 17°32'35.1"E





Study design

Design	3x3 mixed design, 9 recorded scenarios
Independent variable	3 Lightning conditions: daylight, dusk, and night 3 pedestrian movement conditions (right, left, and no pedestrian)
Scenario	Approaching the SC with 50 km/h One Lighting condition One pedestrian movement
Dependent variable	Gaze / fixation metrics Post-drive questionnaire ratings

Methodology

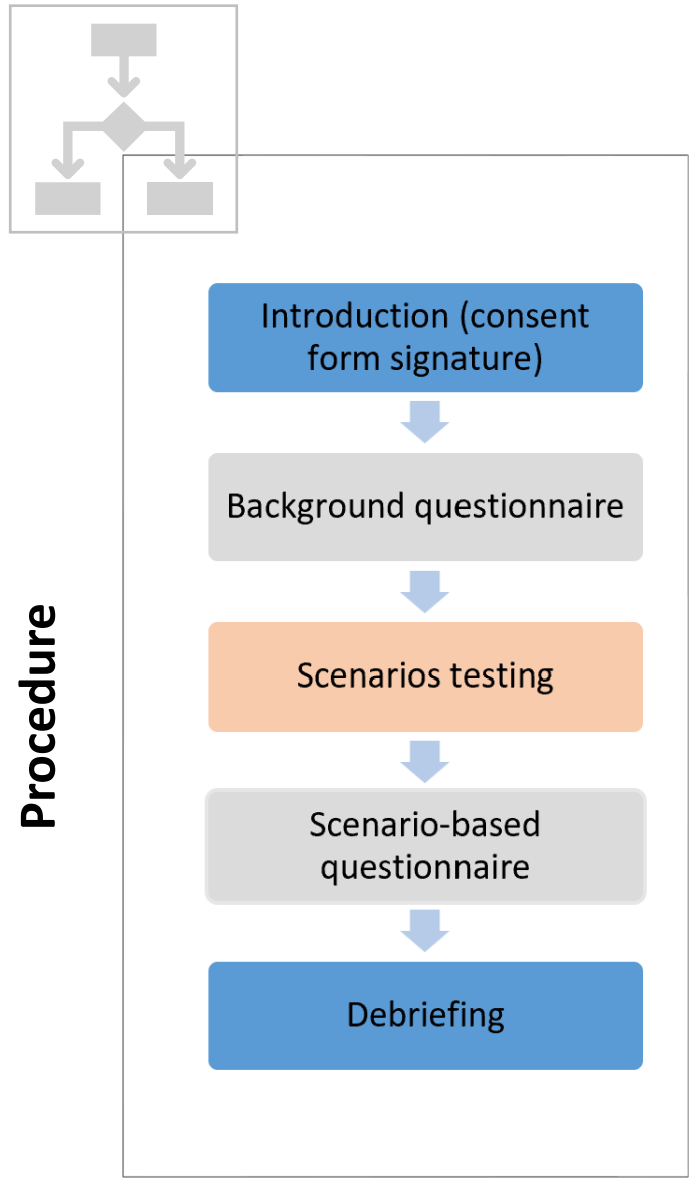
Participants

- 3 groups, each one involves 18 participants
- Each participant experience one light condition and three pedestrian movements
- Volunteer drivers
- At least one year experience
- Good or corrected vision

Apparatus

- GoPro Hero 10 camera (2024 model) for scenarios recordings
- Participants were positioned at a fixed viewing distance of 1.5 m from the screen
- An eye-tracking camera, timestamp-synced to the simulation engine.

Procedure



Data collection

Questionnaire

Subjective, self-reported measures collected:

* Generalities (age, gender, etc.,)

* Helpfulness of the system (5-point Likert scales)

* Recognition of pedestrian presence

* Recognition of signals presences

* Familiarity with location

Etc.,

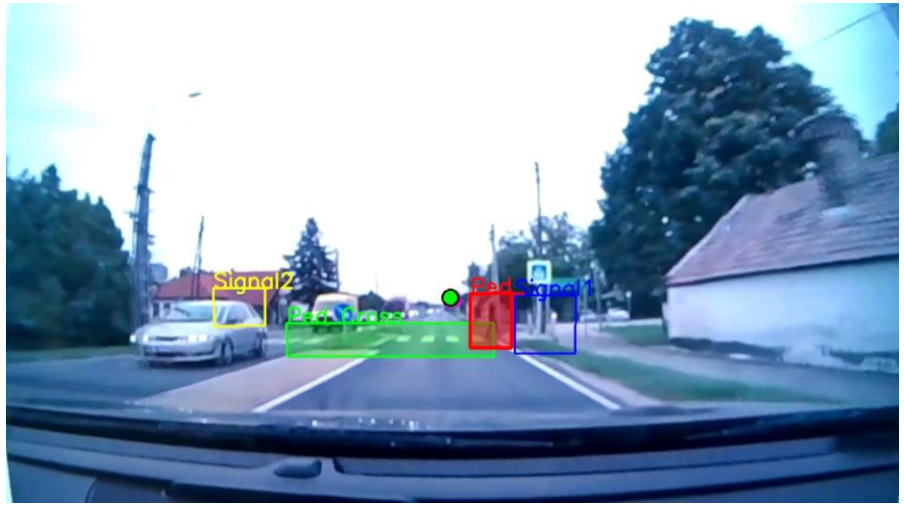
Eye-Tracking Camera

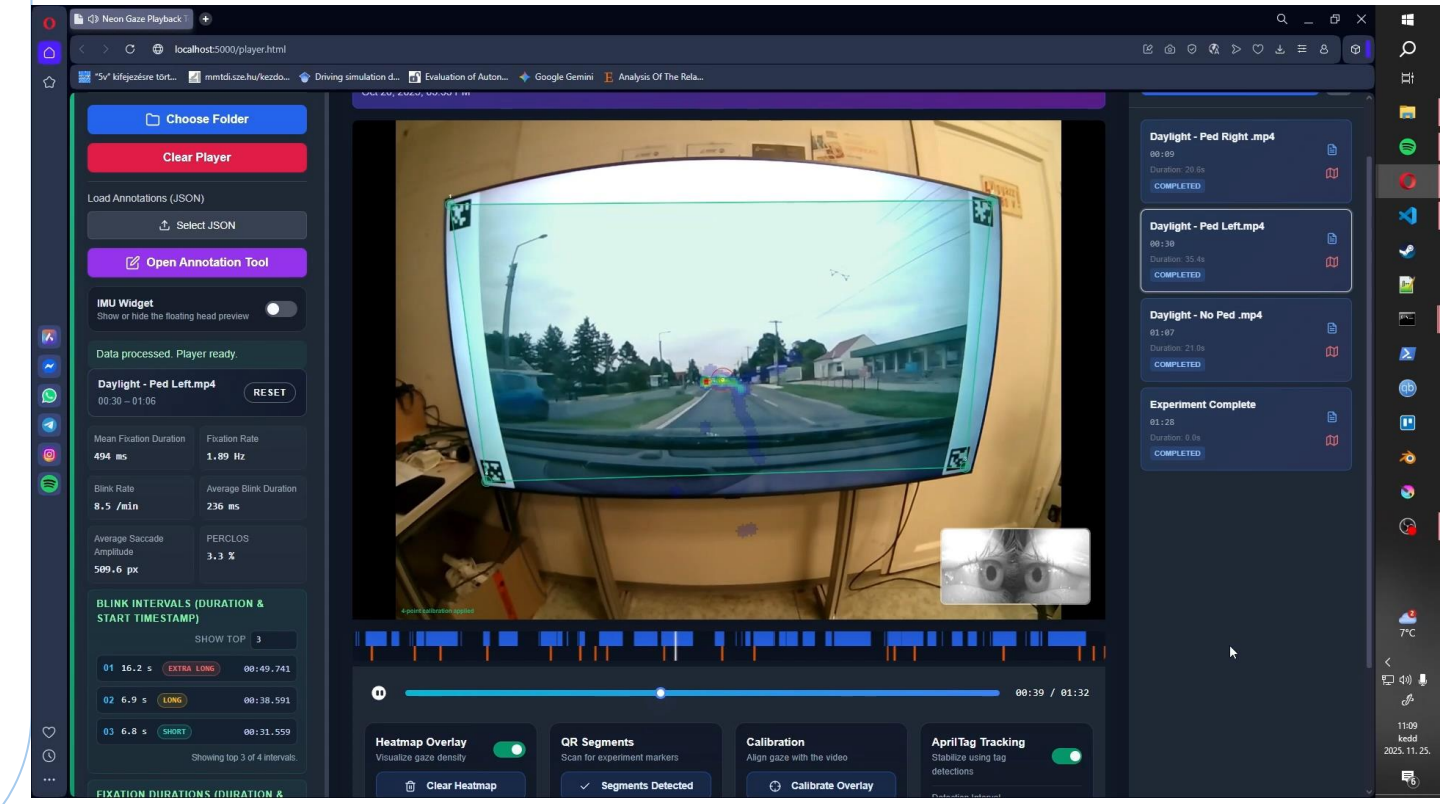
- Fixation count & duration by area of interest
- Gaze heatmaps per crossing condition

Data collection & analysis

- QR code generation for each scenario
- Definition of four areas of interest (AOIs) using YOLO:
  - The pedestrian
  - The pedestrian crossing (the pavement),
  - Signal 1 (on the right side of the pedestrian crossing)
  - Signal 2 (on the left side of the pedestrian crossing).

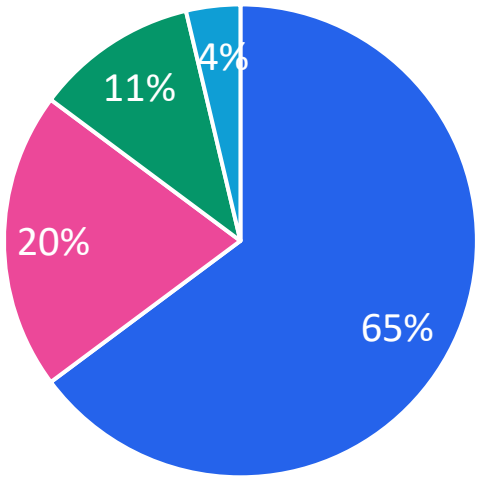
- Digital questionnaire (Google form)
- Statistical test using R





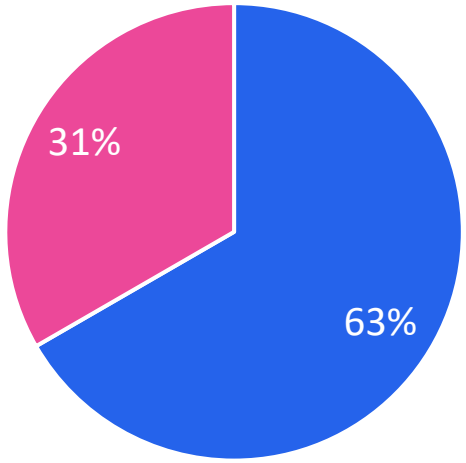
Questionnaire results: Participants' profiles

Age range



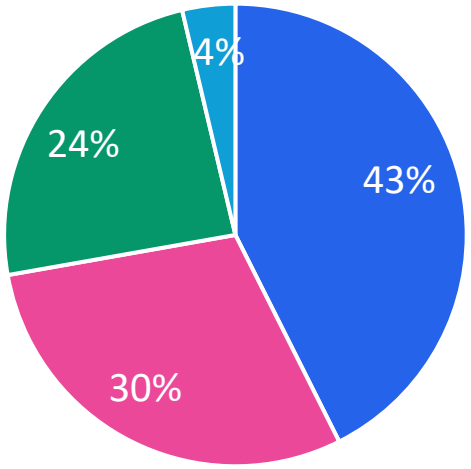
16 – 25 26 – 35 36 – 45 45+

Gender



Male Female

Education level



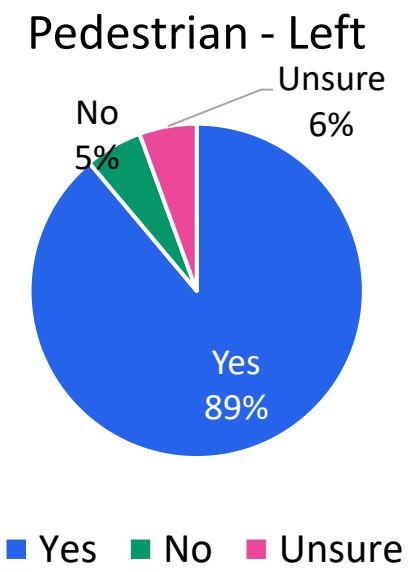
High school Bachelor's Master's Doctorate

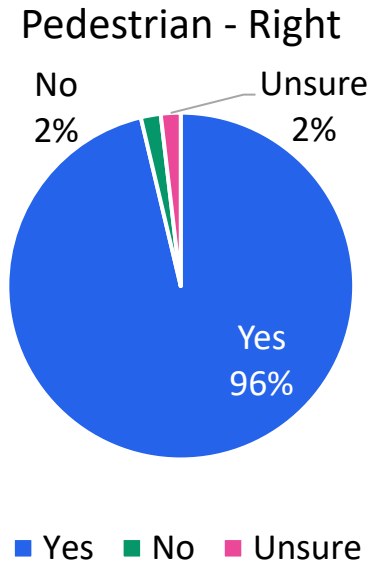
Questionnaire results: Detection accuracy

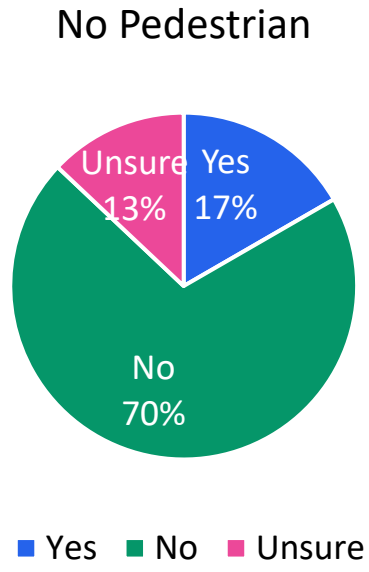
Q: Did you notice a pedestrian at the crossing?

Confusion matrix- participants' detection of pedestrian presence (yes/no), self-reported (total number of trials: 162).

	Responses		
Ground truth	No	Unsure	Yes
Yes (Pedestrian approaching from the left)	3	3	48
No pedestrian	38	7	9
Yes (Pedestrian approaching from the right)	1	1	52







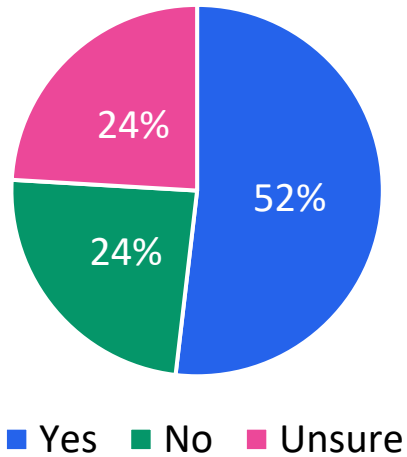
Questionnaire results: Detection accuracy

Q: Did you notice the signals (flashing lights) at the crossing?

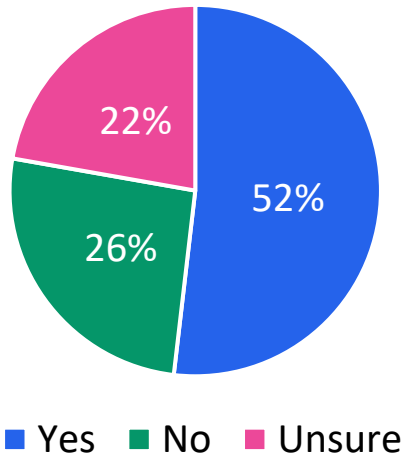
Confusion matrix depicting participants' detection of IPC signals presence (yes/no), self-reported (total number of trials: 162)

	Responses		
Ground truth	No	Unsure	Yes
Yes (Pedestrian approaching from the left)	14	12	28
No pedestrian	32	13	9
Yes (Pedestrian approaching from the right)	13	13	28

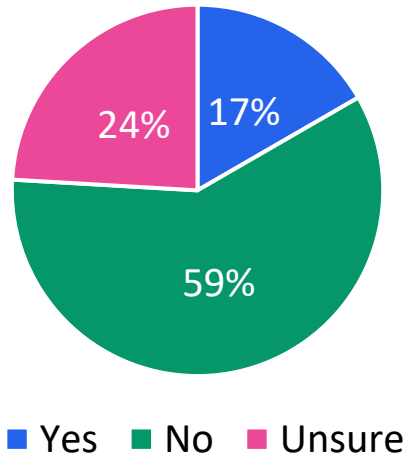
Pedestrian -Right



Pedestrian -Left

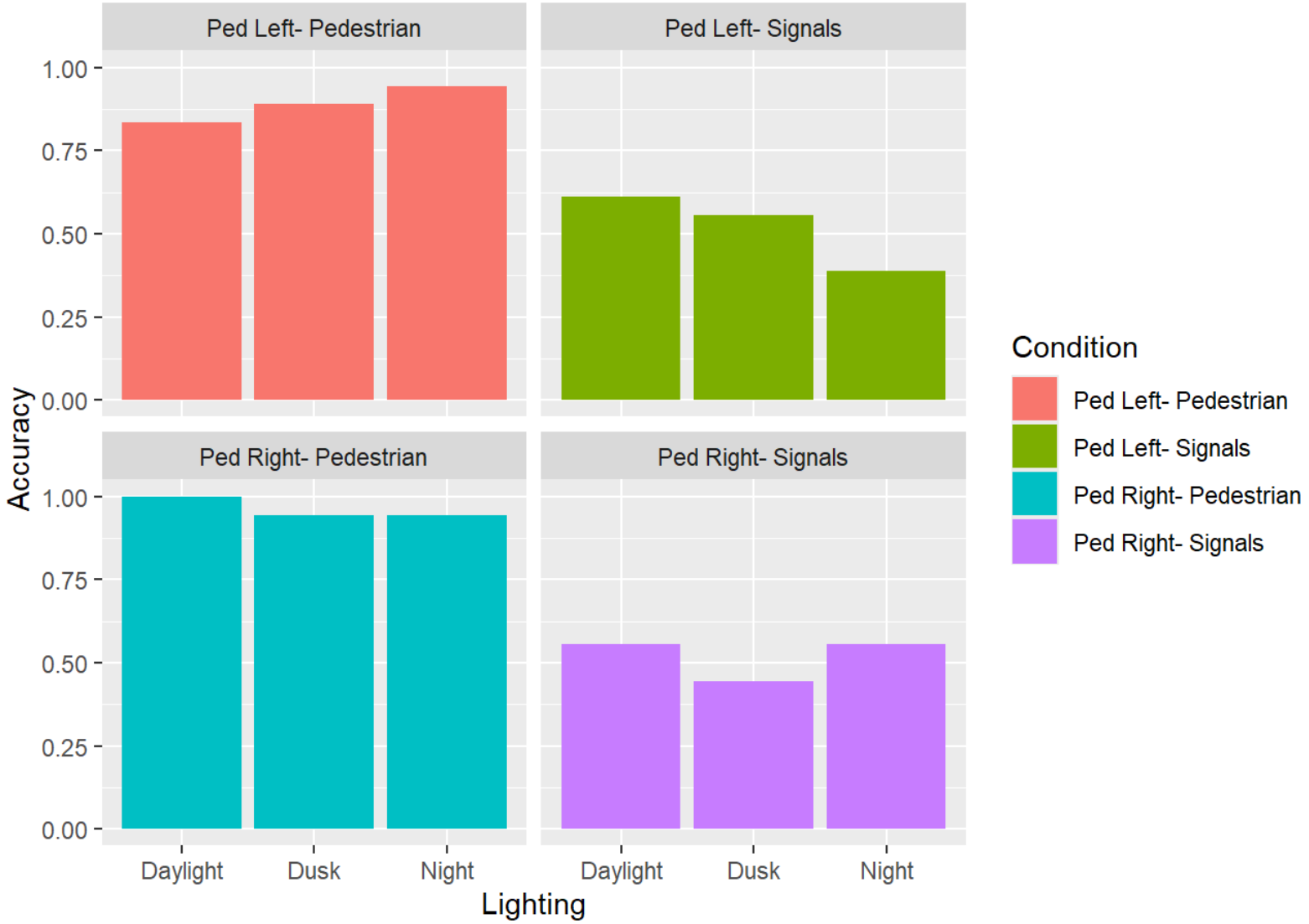


No Pedestrian



Questionnaire results: Detection accuracy

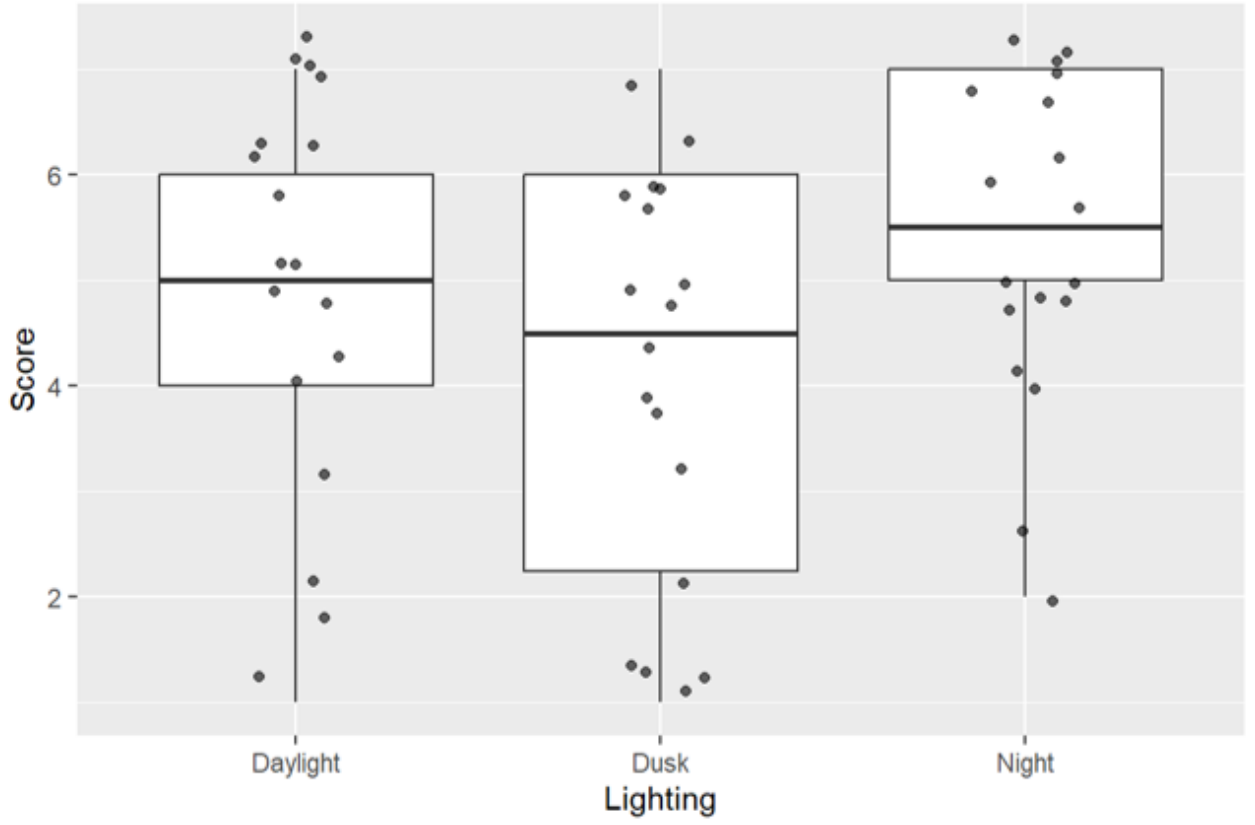
Pedestrian and IPC signals perceived detection accuracy per lighting conditions and pedestrian movement



Questionnaire results: Smart crossing helpfulness

Q: To what extent the IPC signals were helpful in recognizing the crossing pedestrian?

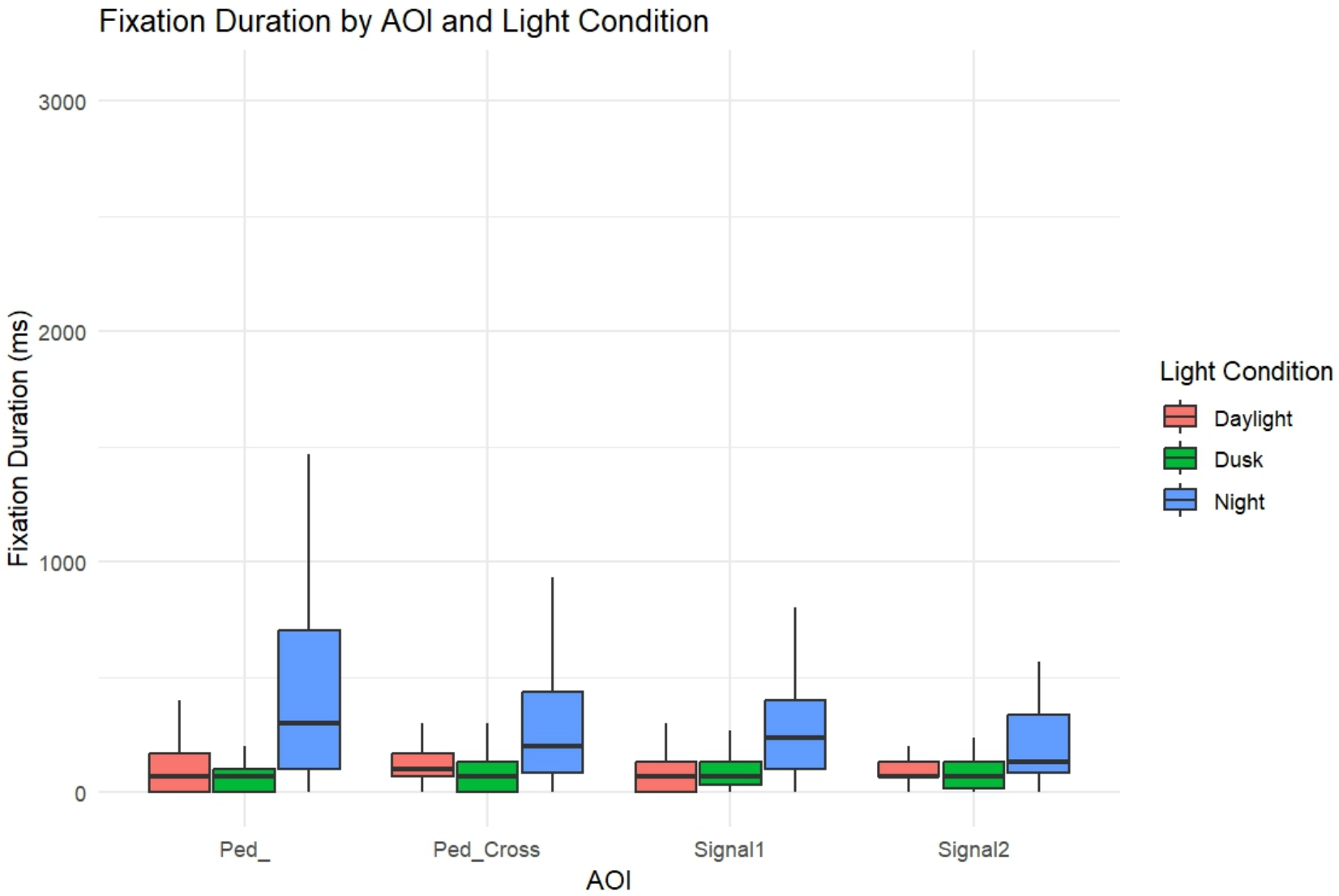
- 7-point Likert-type scale (1 = not at all helpful to 7 = extremely helpful)
- The helpfulness average score = 4.8/7
- **No significant difference** in the score among the lighting conditions Kruskal-Wallis test (chi-squared = 4.394, p-value = 0.111).
- Weak positive correlation (**Non-significant**) between the helpfulness score and the self-reported cautiousness level (Spearman's ρ = 0.134, p-value = 0.334).



Eye-tracking results:

Fixation duration

- Fixation duration is higher at night compared to the other lighting conditions
- Fixation duration on **pedestrian** is higher than SC signals at night
- Fixation durations during dusk are the lowest



Conclusion

The SafeXOne IPC signal system **was positively rated by drivers, particularly at night (avg. 4.8/7). Detection accuracy** for the signals is **50~60%.**

Fixation durations are much longer at night, both for pedestrians and the signals.

Limitations

Procedural

- Drivers are just passive, with no real driving performance (braking or speeding)
- Modest female participation (17/54)
- Young age group dominates (35/54)
- Etc.,

Analytical

- Overlapping between the AOI definition may increase the values (case of the pedestrian crossing pavement and the pedestrian)
- Dwell time, and further gaze metrics were not analysed.
- Etc.,

https://kep.sze.hu/

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Thank you

Questions?