

VRU safety at signalized versus unsignalized crossings: an empirical analysis of crossing behaviour and conflict indicators

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VRU safety at intersections?

- Flanders, Belgium:
 - VRU crash frequency not longer decreasing.
 - Eight in ten of KSI victims inside built-up areas are VRU.
 - One in three of all injury crashes at intersections include VRU

Objectives

Compare VRU road safety performance
...of signalized intersections with non-
signalized crossings (priority crossings)
...by using observational, non-crash data.

Data

- 2 matched pairs of intersections



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Methodology

- Semi-automated traffic conflict observation
 - T-Analyst:
 - Software-assisted estimation of road user trajectories
 - Calculation of traffic conflict indicators

Project Data Record Display Help

Detections

ID 22 Video

Time 2014-11-04 10:00:35

Status not checked

Type not known

Comment

<< < 00061 > >> x1 show graphs

2014-11-04 10:00:30.000

TTC = 2,05s

2014-11-04 10:00:37.000

TTC = 2,05s

Trajectories

Road user 1	Type	Length, m	Width, m	Height, m	Weight, kg
Road user 2	car	4,80	1,80	1,40	1300

User-defined fields

VRUcategory	bicyclist	Mvcategory	car
WhoEvasive	MV	VconfMV	11,4
TA MV	23	VconfVRU	1,3
TA VRU			
SeverityLevel	24		
T2min	2,00	TTcmin	2,00
FET	2,04	DeltaV8	
LocationConflict	before interse	MVPosition	left lane
MVMaoeuvre	straight throu	VRUOrigin	right side of l
RedLightVRU	not applicabl	RedLightMV	not applicabl

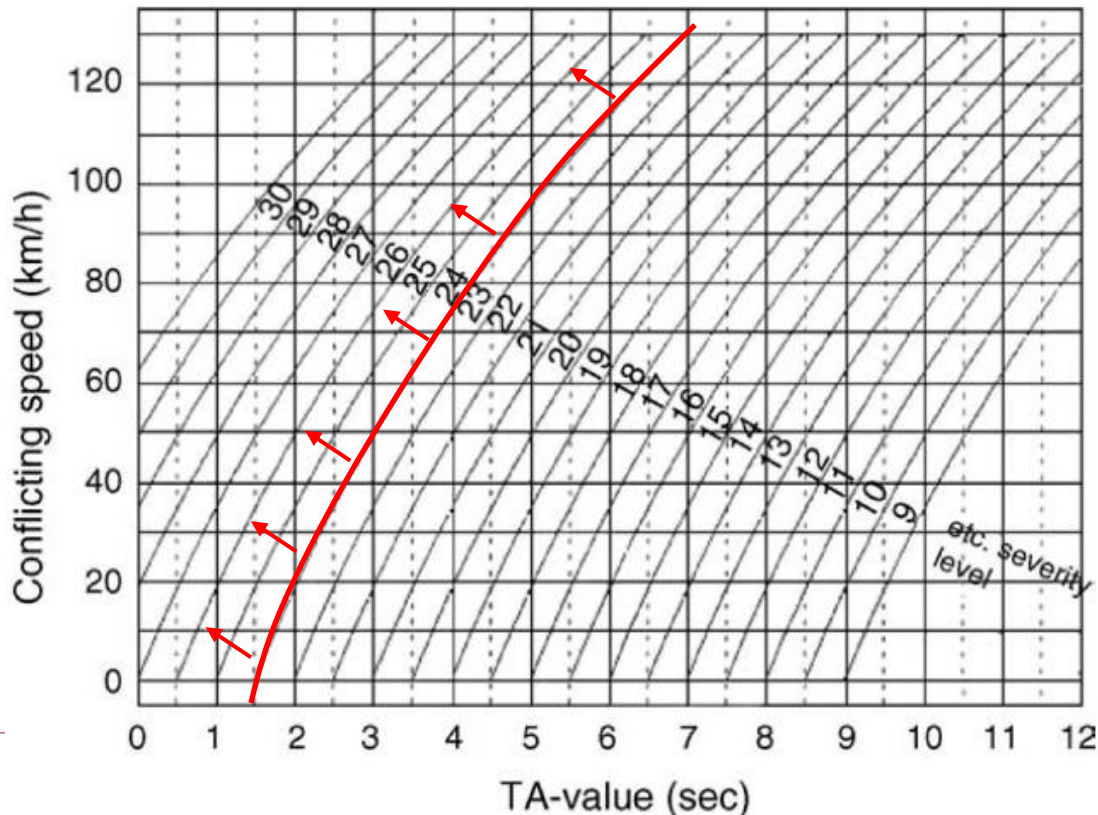
SightObstructed

0:00:04 0:00:1

X: 0,8 m, Y: 2,3 m | X: 339 pxl, Y: 560 pxl | 1 pixel = 0,04 m

Methodology

- Traffic conflict indicators:
 - Swedish Traffic Conflict Technique:
 - Severity level based on speed and Time-to-Accident at the start of the evasive manoeuvre (Svensson, 1998)
 - VRU conflicts with severity level ≥ 24 included



- Supplementary systematic behavioural observations of VRU-MV interactions
 - 3h of video analysed per intersection
 - Data collected about
 - Gender + age VRU
 - Looking behaviour VRU
 - Interaction process (e.g. approaching behaviour, who goes first)

Results – conflict observation

		Antwerp		Hasselt	
		unsignalized	signalized	unsignalized	signalized
Total # serious conflicts		33	22	114	9
Hourly MV volume	Average	1055	1536	775	743
	Minimum	36	60	24	12
	Maximum	2484	3384	1596	1596
Hourly VRU volume	Average	37	127	225	350
	Minimum	0	0	0	0
	Maximum	124	444	1052	1904

Results – conflict observation

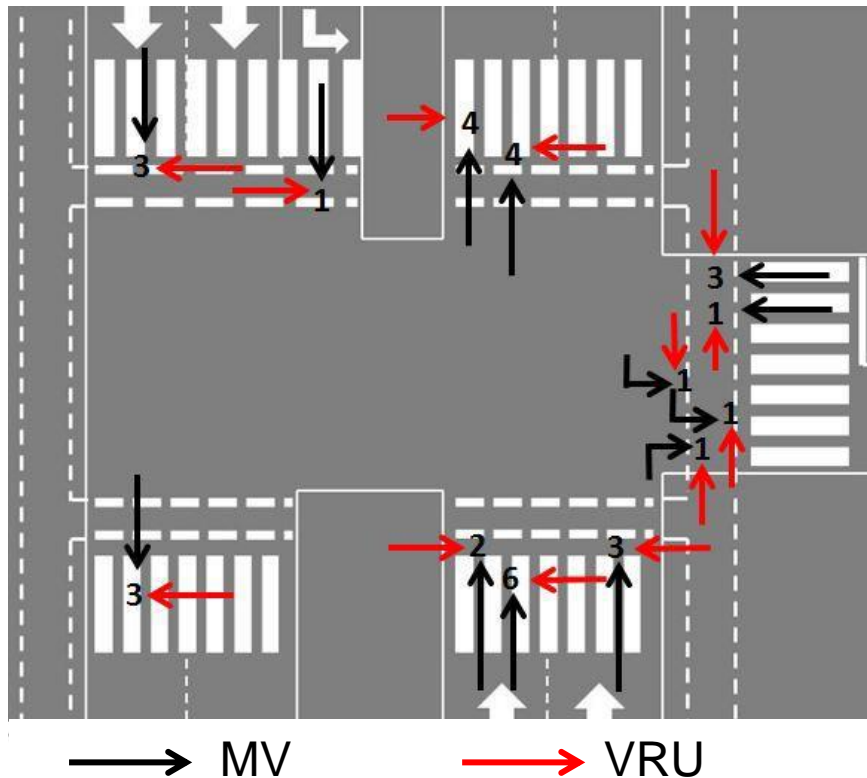
Correlation traffic volumes/h – #traffic conflicts/h

Location(s)	Volume	Simple linear regression	R ²
Unsignalized intersections (both)	# MV	#confl = 0.0010MV	0.137
	# VRU	#confl = 0.0067VRU	0.509
Unsignalized intersection Hasselt	# MV	#confl = 0.0022MV	0.360
	# VRU	#confl = 0.0065VRU	0.480
Unsignalized intersection Antwerp	# MV	#confl = 0.0005MV	0.353
	# VRU	#confl = 0.0124MV	0.343
Signalized intersections (both)	# MV	#confl = 0.0002MV	0.188
	# VRU	#confl = 0.0006VRU	0.029
Signalized intersection Hasselt	# MV	#confl = 0.0002MV	0.064
	# VRU	#confl = 0.0004VRU	0.118
Signalized intersection Antwerp	# MV	#confl = 0.0002MV	0.249
	# VRU	#confl = 0.0022VRU	0.193

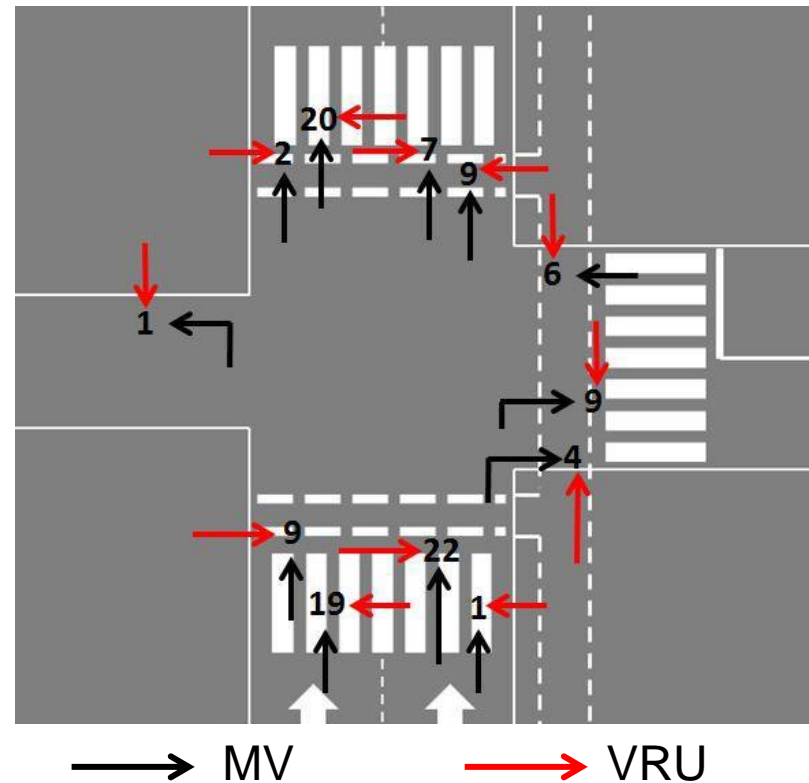
Results – conflict observation

- Conflict patterns at unsignalized intersections

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Results – conflict observation

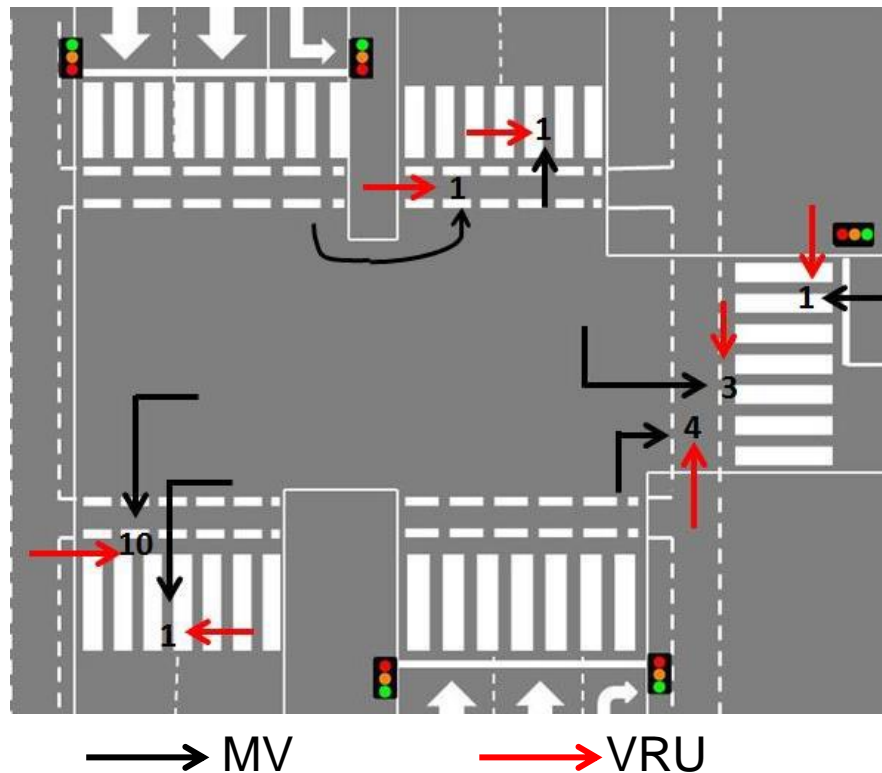
Example of conflict with VRU coming from the far side of the road

Results – conflict observation

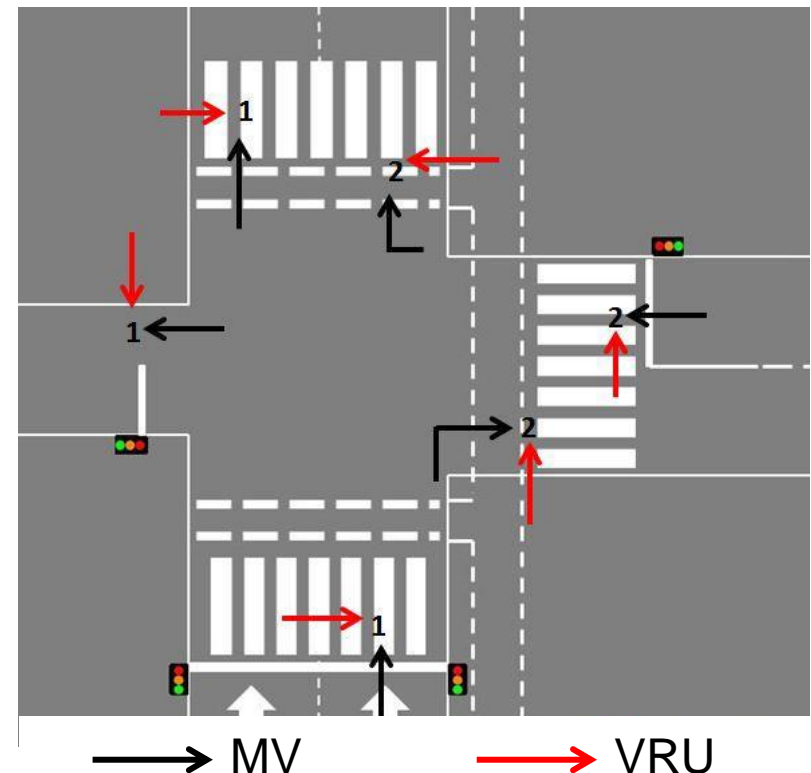
Results – conflict observation

- Conflict patterns at signalized intersections

Antwerp

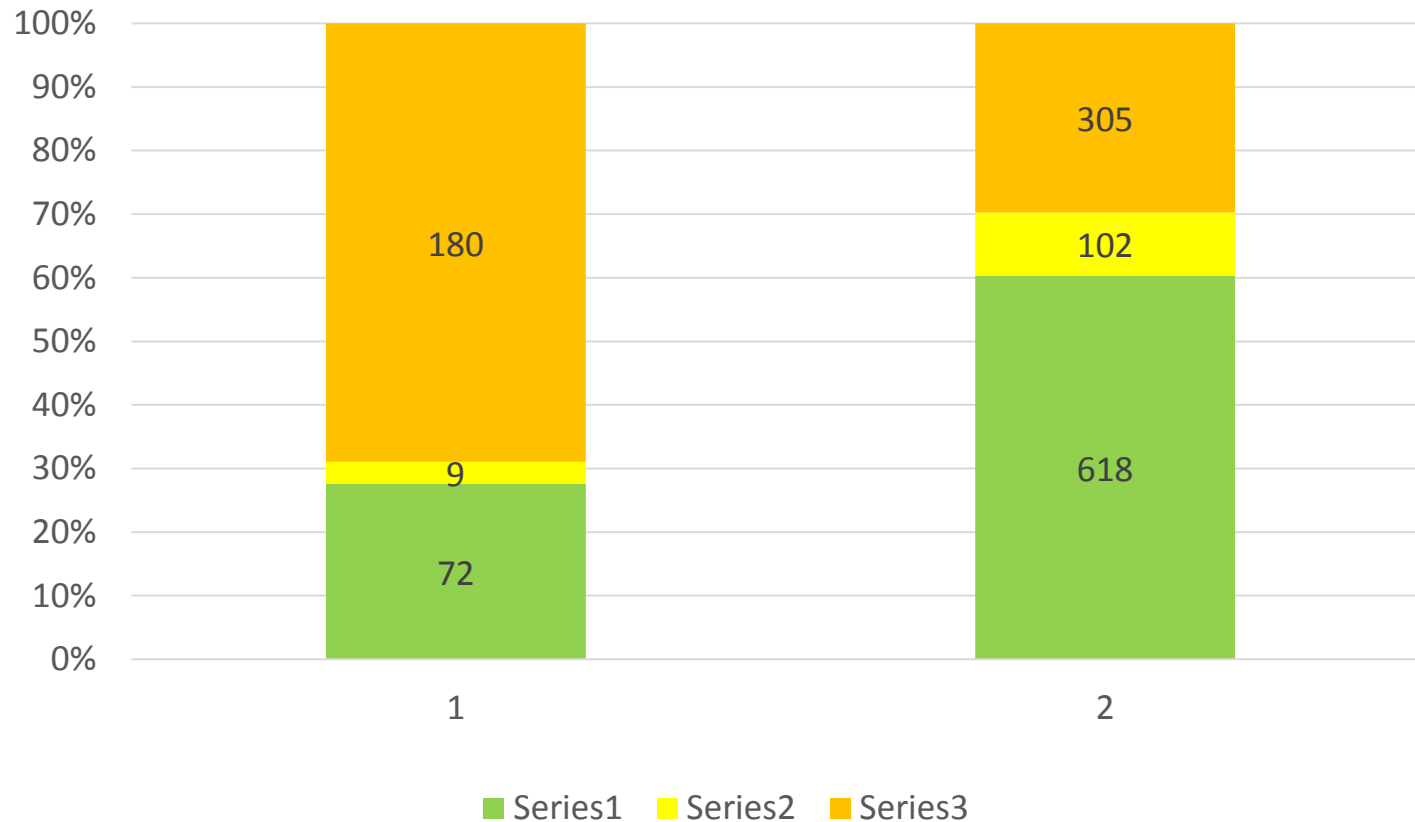


Hasselt



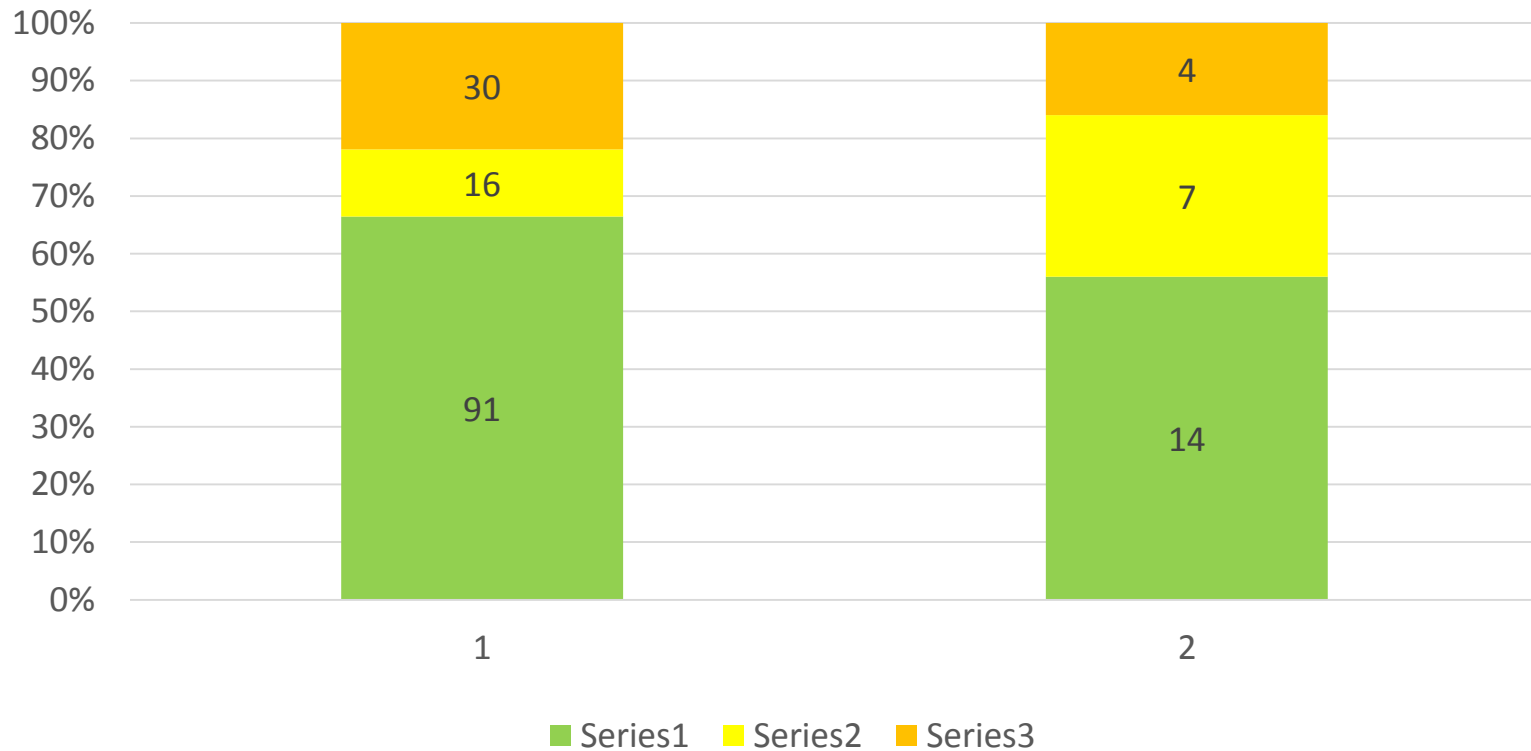
Results – behavioural observations

Yielding behaviour motor vehicle driver - unsignalized intersections



Results – behavioural observations

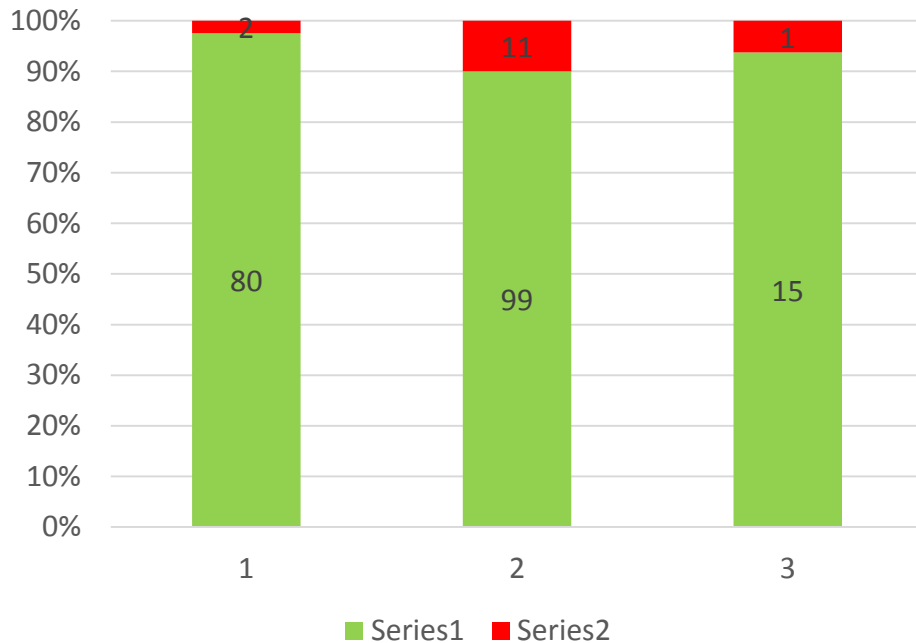
Yielding behaviour motor vehicle driver -
signalized intersections



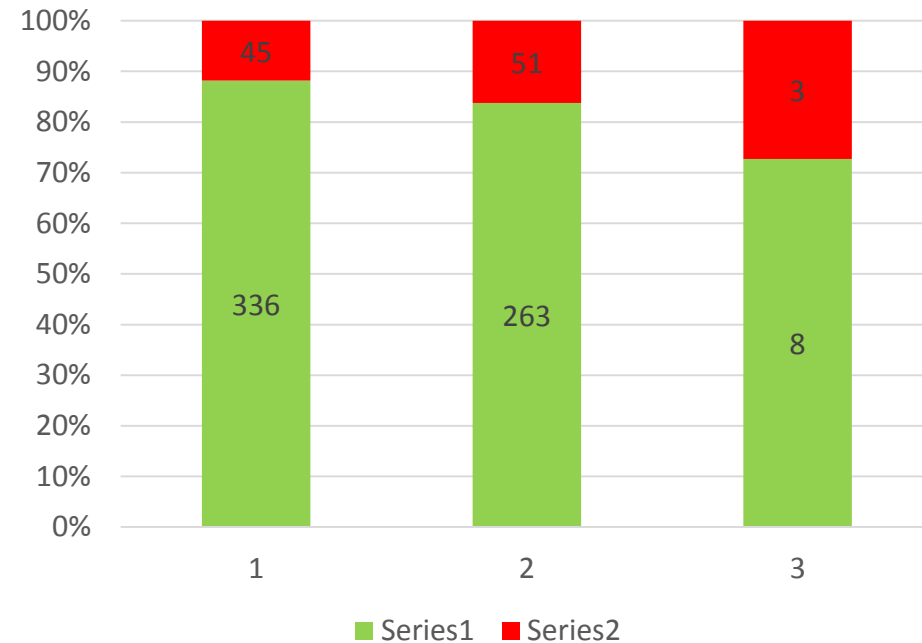
Results – behavioural observation

VRU looking behaviour unsignalized intersections

Antwerp - unsignalized

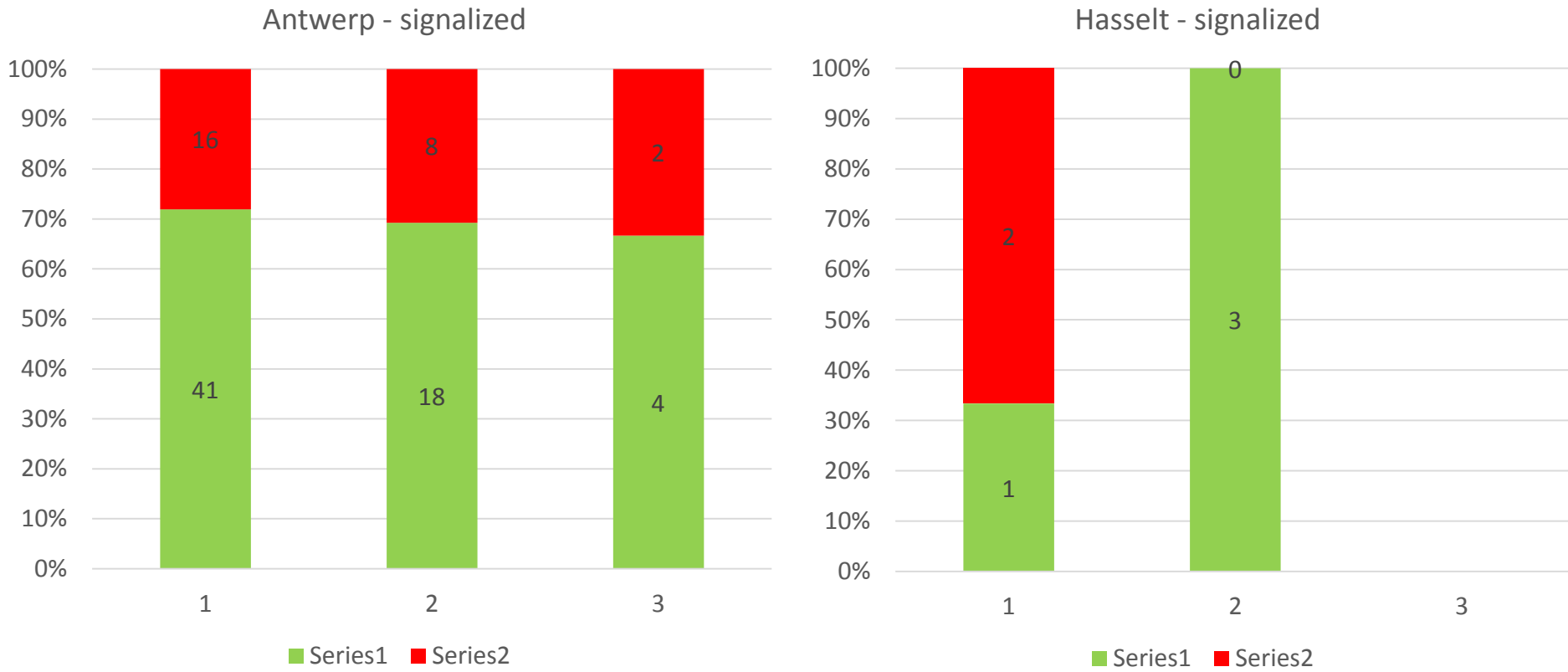


Hasselt - unsignalized



Results – behavioural observation

VRU looking behaviour signalized intersections



Summary

- Frequency of conflicts with VRU higher at unsignalized intersections
- Contributing factor: sight obstruction due to vehicle on other lane
- Correlation between (VRU) traffic volumes and hourly number of conflicts at unsignalized intersections
- Conflicts with cyclists in counterflow at side road of unsignalized intersections
- 'Inherent' conflicts at signalized intersections: VRU do not always look, while MV do not always yield

Further research

- Extend data
 - But how much?
- Check additional conflict indicators for safety critical events
- Compare with crash data

