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#### Cyclists' eye movements at uncontrolled intersections

#### An eye-tracking study using animated video clips

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# **CYCLISTS' EYE MOVEMENTS AT UNCONTROLLED INTERSECTIONS**

# AN EYE-TRACKING STUDY

## USING ANIMATED VIDEO CLIPS $V \Lambda^{1^*}$ output due de CARDALL<sup>1</sup> ot une contener de L

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# INTRODUCTION

Research indicates that crashes between cyclists and car drivers occur even when the cyclist must have seen the approaching car, suggesting the importance of expectancy and attention allocation issues [1]. Once a relevant stimulus is detected in traffic, cyclist must make a judgement regarding whether the trajectory of their own bicycle and the vehicle of another road user has the potential to case a conflict [2]. To examine the sources of visual information that are involved in the anticipation of bicycle-car collisions at uncontrolled intersections, the cyclists' eye movements were recorded while they were watching various intersection scenarios i.e., cyclist passing the car(s) in front, behind, or colliding while cyclist approached at simulated at three different speeds.

# RESULTS

### DWELL TIME PERCENTAGE ON AOIs (CARS AND ROAD AHEAD) FOR EVERY SCENARIO AND SPEED



# METHOD

- Thirty-seven cyclists
   (*M* age = 21.0 years,
   *SD* age = 1.4 years)
   viewed animated video
   clips.
- Each experimental
   video clip was
   repeated three times.



- O Independent variables of the fixed animations were:
  - Fixed cyclist approach speed: 15 km/h 25 km/h 35 km/h Video clip duration: 22.7 s 4 13.6 s 9.7 s
  - > approaching cars' deceleration:

Scenario Initial speed (km/h)

Deceleration (m/s<sup>2</sup>) Final speed (km/h)

Behind R	54 SD=11	55 SD=12	57 SD=10		19 SD=12	24 SD=12	25 SD=11	40 au
In front R&L	55 SD=11	56 SD=10	54 SD=12	-	17 SD=13	23 SD=14	26 SD=15	Dwell tin 30 05
Mean	59 SD=12	59 SD=12	60 SD=12		16 SD=12	20 SD=12	22 SD=12	10
	15 Spe	25 eed [km	35 /h]		15 Spe	25 eed [km	35 /h]	-0

- Visual behaviour of cyclists approaching uncontrolled intersections differ between situational aspects of collision/non-collision outcomes and location of cars at the intersection.
  - A high dwell time percentage on the right car was found in the collision scenario as compared to the three non-collision scenarios.
  - In the non-collision scenarios participants were more likely to direct their gaze on the road ahead.
- No substantial differences between the three cycling speeds regarding DTPs on the approaching car(s).

### DWELL TIME PERCENTAGE ON AOIs FOR A CYCLING SPEED OF 25 KM/H





The lines are plotted from the moment when Car R became visible for the participants till the video



Sample frames from the animated video clips for cycling speed of 25 km/h from the beginning of the video till the moment when Car R almost disappeared in scenario *Behind R*.

- Eye movements were recorded using the Eyelink 1000 Plus eye tracker (SR Research) and analysed with dynamic areas of interests (AOIs) defined around the road ahead as well as cars approaching from right (Car R) and left (Car L).
- O Visual behaviour was operationalized as the total dwell time percentage (DTP), defined as the composite percentage of all participants' gaze samples within each AOI taken across the sum time of AOI visibility per each condition.

was occluded. The vertical lines indicate the moment in time at which Car R stopped decelerating.

## CONCLUSION

It might be generalizable that cyclists draw their visual focus along lines of perceived hazards and intent (i.e., objects with future collision trajectory potential and priority).

### REFERENCES

[1] Räsänen, M., and Summala, H. (1998). Attention and expectation problems in bicyclecar collisions: An in-depth study. *Accident Analysis & Prevention*, *30*, 657-666.
[2] Wetton, M. A., Horswill, M. S., Hatherly, C., Wood, J. M., Pachana, N. A., & Anstey, K. J. (2010). The development and validation of two complementary measures of drivers' hazard perception ability. *Accident Analysis & Prevention*, *42*, 1232-1239.

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