OBSERVATION STUDY INTO THE INFLUENCE OF VIEW BLOCKING OBSTRUCTION AT AN INTERSECTION ON BICYCLE AND PASSENGER CAR VELOCITY PROFILES

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ICSC2015, Hannover, 16th September 2015

Foto: Tjerja Geerts
INTRODUCTION

- Total road fatalities
- Percentage cyclist fatalities

Year

Total road fatalities (x1000)

Percentage cyclist fatalities


5 10 15 20 25 30

5% 6% 7% 8% 9% 10%

2014 CAR 2 CAR

2016 PEDESTRIAN

EXPECTED IN 2018 CYCLIST

www.euroncap.com

3 | Observation study

16 September 2015
CATS PROJECT

Objective:

- Prepare the introduction of a protocol for consumer tests of Cyclist-AEB systems on board passenger cars.
- Propose a test setup (incl. hardware) and test protocol for Cyclist-AEB systems based on technical/scientific considerations.
- Base the tests on analysis of most relevant cyclist accident scenarios in EU countries.

Timing:

- Start : 2014 Q2
- Finish: 2016 Q1
MOST COMMON CAR-TO-CYCLIST SCENARIOS

Test parameters:
- Car speed
- Bicycle speed
- Bicycle intention/trajectory
- Contact point in case of collision
- Time-To-Collision
- Size & location of view-blocking obstructions

Limited detailed data of these scenarios available → Observation study
OBJECTIVE OBSERVATION STUDY

› **Objective:**
  Determine the influence of the presence of a view-blocking obstruction on the behaviour of cars and bicycles when approaching a crossing.

› **Hypothesis:**
  **Both** bicyclists and car drivers **reduce speed** in case the **view on the crossing is limited** because of an obstruction (e.g. building, fouling, parked car). The more the view is limited, the larger the effect on speed reduction is expected to be.
APPRAOCH

› Measure cyclist and car behaviour
  › Velocity-profile as function of distance (with automotive radar)
  › Visual behaviour (with camera)

› Locations:
  › 2 bicycle crossings in Eindhoven area
  › Reasonable severe permanent view-blocking obstruction
Urban area
Speed limit = 50 km/h (also 20 km/h possible)
Severe obstruction prevents direct view on right hand sight (w.r.t. car)
Permanent obstruction (e.g. hedge, building)
Cyclist have priority, however
• No traffic control lights
• No stop signs (for neither cyclist nor car)
• No or only low speed bumps
Significant traffic flow
No specific requirements w.r.t. road layout

* Values: based on typical TTC and characteristic measures for road-layout
MEASUREMENT EQUIPMENT

› **Speed measurements** by use of road-side-unit
  › 2x Automotive radar (Continental SSR 208)
    *Short-range-radar, update rate 33 Hz*
    *FoV +/-20°, range 50m*

› Data acquisition box
  *filtering*, target tracking, data recorder, wireless communication unit

› **Visual behaviour** by use of camera
  › 2x Action camera’s *(GO PRO)*

* Based on: life time, minimum velocity, ROI
SELECTED LOCATIONS

SON: busy bicycle crossing

- Obstruction: hedge
- Cyclist lane: exclusively for cyclists
- Location: crossing connects living area with busy village center
- Priority:
  - Non-prioritized intersection
  - Cyclist from right have right of way
  - Cyclist give yield to traffic from right

EINDHOVEN: busy 4-armed intersection*

- Obstruction: building
- Cyclist lane: for all traffic
- Location: crossing in city center
- Priority:
  - Non-prioritized intersection
  - Traffic from right has right of way
  - Cyclist give yield to traffic from right

* This is not a round-about!!
MEASUREMENT SETUP: SON

Fully obstructed view

Cyclists
Obstruction (hedge)

D₀₁ = 4.5 m
D₀₂ = 5.0 m

Boslaan
Cars

Radar integrated in garbage bin

Unobstructed view

Cars & cyclists
Boslaan

GoPro camera attached to traffic sign

Observation study
### RESULTS SON: BICYCLE

<table>
<thead>
<tr>
<th>Bicycle manoeuvre</th>
<th>Stopped pedaling</th>
<th></th>
<th>Continued pedaling</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Continued riding</td>
<td>Full stop</td>
<td>Continued riding</td>
</tr>
<tr>
<td>Straight</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>total</td>
<td>20</td>
<td>9</td>
<td>2</td>
</tr>
<tr>
<td>no cars present</td>
<td>9</td>
<td></td>
<td></td>
</tr>
<tr>
<td>car from left</td>
<td>8</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>car from right</td>
<td>3</td>
<td>7</td>
<td></td>
</tr>
<tr>
<td>Turning left</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>total</td>
<td>4</td>
<td>6</td>
<td>2</td>
</tr>
<tr>
<td>no cars present</td>
<td>3</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>car from left</td>
<td></td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>car from right</td>
<td></td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>cars from both sides</td>
<td></td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Turning right</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>total</td>
<td>1</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>cars from both sides</td>
<td></td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Total # bicycles</td>
<td>25</td>
<td>15</td>
<td>4</td>
</tr>
</tbody>
</table>

- Most bicycles stopped pedalling but continued riding

*Based on video-observation*
RESULTS SON: BICYCLE

Decay of speed by bicyclists in approaching intersection
(in case view is blocked on approaching cars, even if bicyclists have priority)

Initial speed
Maximum reduced speed
Speed reduction

- Initial speed of bicyclists
- Maximum reduced speed
- Speed reduction

Graph showing the change in bicycle speed profile over distance to collision point.
RESULTS SON: BICYCLE

cyclist low speed
- $V_{\text{ini}} = 10 \text{ km/h}$
- $V_{\text{min}} = 6 \text{ km/h}$

cyclist average speed
- $V_{\text{ini}} = 14 \text{ km/h}$
- $V_{\text{min}} = 8 \text{ km/h}$

cyclist high speed
- $V_{\text{ini}} = 19 \text{ km/h}$
- $V_{\text{min}} = 6 \text{ km/h}$
RESULTS SON: CARS

- In both situations cars reduce speed when approaching crossing.
- In obstructed case, some cars seem to overlook cyclists might appear from behind obstruction and do not reduce speed (only slightly).
RESULTS SON: CARS

Cars high speed

\[ V_{\text{ini}} = 70 \text{ km/h} \]
\[ V_{\text{min}} = 40 \text{ km/h} \]

\[ V_{\text{ini}} = 60 \text{ km/h} \]
\[ V_{\text{min}} = 50 \text{ km/h} \]
MEASUREMENT SETUP: EINDHOVEN

Fully obstructed view

Cyclists
Obstruction (house)
Cars

Radar integrated in garbage bin

GoPro camera attached to traffic sign

$D_{01} = 4.3 \, m$
$D_{02} = 4.9 \, m$
### RESULTS EINDHOVEN: BICYCLE

More than 85% stopped pedalling

Even with no cross-traffic vast majority stops pedalling during approach

More cyclists stop pedalling than continue pedalling

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</tr>
<tr>
<td><strong>Straight</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>total</td>
<td>68</td>
<td>38</td>
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<td>25</td>
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<tr>
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<td>17</td>
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<tr>
<td>car from right</td>
<td>14</td>
<td>13</td>
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<tr>
<td>cars from both sides</td>
<td>12</td>
<td>11</td>
</tr>
<tr>
<td><strong>Turning left</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>total</td>
<td>16</td>
<td>6</td>
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<tr>
<td>no cars present</td>
<td>5</td>
<td>0</td>
</tr>
<tr>
<td>car from left</td>
<td>7</td>
<td>0</td>
</tr>
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</tbody>
</table>

| Total # bicycles  | 93              | 46                 | 36                |

Speed profile analysis of location Eindhoven has not been concluded yet, as it is hard to make distinction between cars and bicycles in same lane

Prelim results: speed reduction cyclists is 4 km/h
CONCLUSIONS

Method and measurement device developed has served its purpose
- Possible to measure velocity-profiles for bicycles and cars on 2 intersections
- It is difficult to distinguish bicycles and cars automatically

In case of approaching an intersection with severely blocked-view

- **Bicyclists**
  - Appear to reduce their speed: Approximately 6 km/h (Son) ~4 km/h (Eindhoven)
  - Speed reduction coincides with stopping pedalling
  - More than 80% of the observed bicyclists stopped pedalling
  - Obstacle prevents early anticipation on cross-traffic

- **Cars**
  - Generally reduce speed
  - It is very difficult to distinguish between geometrical layout and interaction with other traffic participants
  - Obstacle cause drivers to overlook the traffic from the behind obstruction
  - No general conclusions can be drawn regarding the speed reduction and the presence of a view-blocking obstruction
RECOMMENDATIONS

› Finish analysis of the observations in Eindhoven

› Perform similar study at typical intersections in Germany, to be able to generalize conclusions, by taken into account
  › More than 2 locations
  › Differences in culture (especially traffic rules)
ACKNOWLEDGEMENT: