Do 3D zebra crossings improve pedestrian safety?

Stijn Daniels, Vias institute
Brussels, Belgium
stijn.daniels@vias.be

Authors: Tim De Ceunynck, Brecht Pelssers, Stijn Daniels, Kishan Vandael Schreurs, Philip Temmerman & Helke Martensen
3D zebra crossing?

Conventional

3D
Research questions

▸ Do 3D zebra crossings have a measurable impact on crossing VRU’s safety?
  ▸ Is there an effect on the driving speed of passing vehicles?
  ▸ Is there an impact on other forms of road users’ behaviour (yielding, jaywalking,...)?
  ▸ Is there an effect on the occurrence of serious traffic conflicts?
Study set-up

- Before-after analysis of effects of converting a classic zebra crossing into a 3D zebra crossing
- 3 test sites in Flanders - Belgium
- Assessment of behavioural effects:
  - Impact on driving speed
  - Impact on behaviour (e.g. yielding)
  - Impact on occurrence of serious traffic conflicts
Research site 1 - Beersel
Research site 2 - Bilzen
Research site 3 - Antwerp
Data collection

- **Speed measurements using radar**
  - At 300m away from crossing
  - 50m away from crossing
  - At crossing (0m)
  - Measurement in two directions
    - Towards zebra
    - Away from zebra

- **Two video cameras (facing both driving directions)**

- **Data analysed:**
  - Speed data: 4 days (all motor vehicles)
  - Road user behaviour: 1 day (all interactions)
  - Traffic conflict observations: 4 days
Results speed measurements

- 6 measurements points per site (0m, 50m, 300m; both directions)
  - 300m is control site

- Hypothesis: speed closer to 3D zebra crossings lowers compared to control site (position * test)
  - Hypothesis could not be confirmed: changes between before and after are small and non-systematic across locations

<table>
<thead>
<tr>
<th>Effect</th>
<th>df</th>
<th>F</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intercept</td>
<td>1; 5</td>
<td>414.643</td>
<td>.000</td>
</tr>
<tr>
<td>Position</td>
<td>2; 10</td>
<td>2,461</td>
<td>.135</td>
</tr>
<tr>
<td>Test</td>
<td>1; 5,002</td>
<td>.030</td>
<td>.869</td>
</tr>
<tr>
<td>Position * Test</td>
<td>2; 10,002</td>
<td>2,220</td>
<td>.159</td>
</tr>
<tr>
<td>Site</td>
<td>5; 9,851</td>
<td>3,973</td>
<td>.031</td>
</tr>
<tr>
<td>Position * Site</td>
<td>10; 10</td>
<td>60,215</td>
<td>.000</td>
</tr>
<tr>
<td>Test * Site</td>
<td>5; 10</td>
<td>.564</td>
<td>.726</td>
</tr>
<tr>
<td>Position * Test * Site</td>
<td>10, 1035898</td>
<td>277,419</td>
<td>.000</td>
</tr>
</tbody>
</table>
Behavioural observations

- Preselecting crossing VRU using RUBA
- Verification by researcher to remove false positives
- Coding of interactions in predefined codebook
**Behavioural observation**

- **Four categories of yielding behaviour**

<table>
<thead>
<tr>
<th></th>
<th>Defensive behaviour</th>
<th>Assertive behaviour</th>
</tr>
</thead>
<tbody>
<tr>
<td>According to rules (=pedestrian goes first)</td>
<td>Getting</td>
<td>Taking</td>
</tr>
<tr>
<td>Not according to rules (=motor vehicle goes first)</td>
<td>Giving up</td>
<td>Not getting</td>
</tr>
</tbody>
</table>
### Behavioural observation

- Results yielding process – significant difference over all 3 locations combined (Fisher’s Exact Test: p=0.006)

#### Beersel, before (N=128)
- Getting: 48%
- Taking: 26%
- Not getting: 26%
- Giving up: 0%

#### Bilzen, before (N=197)
- Getting: 48%
- Taking: 29%
- Not getting: 21%
- Giving up: 2%

#### Antwerp, before (N=218)
- Getting: 69%
- Taking: 17%
- Not getting: 12%
- Giving up: 2%

#### Beersel, after (N=80)
- Getting: 41%
- Taking: 32%
- Not getting: 21%
- Giving up: 6%

#### Bilzen, after (N=253)
- Getting: 46%
- Taking: 36%
- Not getting: 18%
- Giving up: 0%

#### Antwerp, after (N=155)
- Getting: 61%
- Taking: 25%
- Not getting: 9%
- Giving up: 5%
Traffic conflict analysis

- Serious traffic conflict = ‘near-crash’

- Measurement through T-Analyst

- Conflict indicators:
  - Minimal Time-to-Collision (TTCmin) < 1.5s
  - Post Encroachment Time (PET) < 1.0s
### Traffic conflict analysis

<table>
<thead>
<tr>
<th>Site</th>
<th># serious conflicts</th>
<th># interactions</th>
<th># conflicts per 1000 interactions</th>
<th># serious conflicts</th>
<th># interactions</th>
<th># conflicts per 1000 interactions</th>
<th>Statistical significance (Fisher)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Beersel</td>
<td>9</td>
<td>315</td>
<td>28,6</td>
<td>1</td>
<td>242</td>
<td>4,1</td>
<td>p=0.049</td>
</tr>
<tr>
<td>Bilzen</td>
<td>5</td>
<td>765</td>
<td>6,5</td>
<td>4</td>
<td>930</td>
<td>4,3</td>
<td>p=0.7394</td>
</tr>
<tr>
<td>Antwerp</td>
<td>1</td>
<td>956</td>
<td>1,1</td>
<td>2</td>
<td>1137</td>
<td>1,8</td>
<td>p=1.000</td>
</tr>
</tbody>
</table>

The statistical significance for Beersel is p=0.049, for Bilzen is p=0.7394, and for Antwerp is p=0.0537.
Conclusions

- 3D zebra crossings do not significantly affect driving speed
- Slight improvement in yielding behaviour
- Some indications of reduction in number of serious conflicts
  - But low numbers
Conclusions

- In any case no indications that 3D zebra crossings would have a negative effect on road safety

- But found effects are too small and too uncertain to conclude that 3D zebra crossings have a positive effect on road safety

- No generalisation was recommended
Do 3D zebra crossings improve pedestrian safety?

Questions?