Auditory perception and cycling safety (PPT)

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Auditory perception and cycling safety

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Traffic sounds and cycling safety
Use of auditory information by cyclists more challenging

- Portable electronic devices:
  - and
  - deteriorated auditory perception\(^1\)

- Electric cars
  - target: 1 million in 2025 in the Netherlands\(^2\)
  - problem with auditory detection\(^3\)

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\(^1\) De waard et al, 2011
\(^2\) IEA (2012)
\(^3\) JASIC (2009)
What is the impact?

The Silent Killer

Hybrids are so quiet that pedestrians never hear them coming. Now automakers are racing to make the car of the future sound like the gas guzzlers of old.

By Paul Collins

The quiet engine of hybrid and electric cars at low speeds poses a risk to pedestrians

Australian campaign
Main aim

Relationship between limited auditory information: ♫ 📞 🚗 and cycling safety
Focus

Teenagers and the elderly

• Cyclist fatalities by age in EU-19 countries *

![Graph showing cyclist fatalities by age](image1)

* in 2010; data from 2009 was used for the Netherlands, Northern Ireland and Sweden

• Decline in hearing abilities in old age

![Graph showing hearing loss by age](image2)

• Frequent use of devices by youngsters

![Image of teenagers using devices](image3)

• Three age groups
  • 16-18 years old
  • 30-40 years old
  • 65-70 years old
Three studies

Auditory localisation
Study 1

Impact
Study 2

Compensatory behaviour
Study 2 & 3
Study 1: Auditory localisation of conventional and electric cars

- 65 participants (cyclists)

Study 1: Results – car type and speed

- Accuracy of auditory localisation is quite high
- Participants were worse at indicating the location of electric car sounds
- Low car speeds: lower localisation accuracy

<table>
<thead>
<tr>
<th>Car Type</th>
<th>15 km/h</th>
<th>30 km/h</th>
<th>50 km/h</th>
</tr>
</thead>
<tbody>
<tr>
<td>Percent correct: location (in %)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>conventional</td>
<td>96%</td>
<td>98%</td>
<td>100%</td>
</tr>
<tr>
<td>electric</td>
<td>94%</td>
<td>96%</td>
<td>98%</td>
</tr>
</tbody>
</table>

ICTTP, Brisbane, 2-5 August 2016
Study 1: Results - age groups

- Older age: lower localisation accuracy (no interaction effects)
- Small differences – severe (fatal) consequences
Study 2: Impact of ♫ and 📞

- Internet survey among 2249 cyclists
- Compensatory behaviour while ♫ or 📞
- Impact of ♫ or 📞 on cycling safety
  - crashes and noise-related incidents (surprised/startled)

Study 2: Results – frequency of ♫ and 📞

<table>
<thead>
<tr>
<th>Age Group</th>
<th>Music</th>
<th>Phone call</th>
</tr>
</thead>
<tbody>
<tr>
<td>16-18</td>
<td>♫ (%): 50</td>
<td>📞 (%): 0</td>
</tr>
<tr>
<td>30-40</td>
<td>♫ (%): 40</td>
<td>📞 (%): 10</td>
</tr>
<tr>
<td>65-70</td>
<td>♫ (%): 30</td>
<td>📞 (%): 20</td>
</tr>
</tbody>
</table>

Legend:
- **never**: 100%
- **seldom**: 90%
- **on some trips**: 80%
- **on most trips**: 70%
- **on all trips**: 60%
Study 2: Results – self-reported incidents

Incident in the past month?

<table>
<thead>
<tr>
<th>Age Group</th>
<th>Often</th>
<th>More than once</th>
<th>Once</th>
</tr>
</thead>
<tbody>
<tr>
<td>16-18</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>30-40</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>65-70</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Study 2: Results - Compensatory behaviour?

- Compensatory behaviour reported by the majority:
  - most often: increase of visual attention

- Neither ♫ nor ♦ related to incidents reported by teenage cyclists

- Net outcome may still be risky if:
  - no sufficient compensation
  - or suboptimal / less safe (cycling) infrastructure
Study 3: Study in real traffic with cyclists 🎵

- To what extent does 🎵 affect glance behaviour of teenage cyclists?
- Eye-tracker
- 2 trips per cyclist: baseline & music condition
- Ethical considerations

- Uncontrolled intersections
- Intersecting road to the right

Stelling-Konczak, A. et al. (submitted). A study in real traffic examining glance behaviour of teenage cyclists when listening to music: results and ethical considerations.
Study 3: Results cyclists’ visual behaviour whilst 🎶

- 14 cyclists
- No significant differences between baseline & music condition

<table>
<thead>
<tr>
<th>Performance measure</th>
<th>Condition</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Baseline</td>
</tr>
<tr>
<td>Looking to the right *</td>
<td>0.490 (0.328)</td>
</tr>
<tr>
<td>Mean number of glances</td>
<td>4.07 (3.7)</td>
</tr>
<tr>
<td>Mean glance duration (in ms)</td>
<td>500.1 (298.5)</td>
</tr>
</tbody>
</table>

- Effects may exist
Discussion: Should we be concerned about cyclists?

- Accuracy of auditory localisation is quite high, but problematic for electric cars at low speeds
- ♫ popular among teenage cyclists
- Cyclists report compensatory strategies for ♫ (and ☻)
- Compensatory strategies not found in real traffic

- Sufficient compensation?
- Combined effects?
- Mix of vehicles: transition period

ICTTP, Brisbane, 2-5 August 2016
Possible countermeasures

Ban on headphones
Enforcement

Add-on sound
Possible countermeasures: technology

Damson ‘Headbones’

Safe + Sound

BikeMic

Pedestrian/cyclist detection systems

• Suitability?
Thank you

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