AutO-Mobility: Driving with a visual impairment in the Netherlands

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The Netherlands

- 16.7 million inhabitants
- 316,000 visually impaired people [1.9%]
- Driving is the main form of transport in NL.
  7.7 million passenger cars.
- Elderly population is growing
- Co-morbidity
Optimization of independent mobility is important for social participation.

Driving itself is not the goal. Independent mobility is!

Safety first.

Rehabilitation programme AutO&Mobility: Individual advice and training programme to optimize independent mobility, if possible in motorised vehicles.
Driving: Skills, Fitness & Behaviour

- **Fitness to Drive**: medical/biological preconditions that allow us to learn and exercise our driving skills.

- **Driving Skills**: steering, braking, handling, manoeuvring, making the right decisions.

- **Driving Behaviour**: how we act in daily traffic.
Some examples of unwanted phenomena in each category

- **Fitness to Drive:**
  -- epileptic insults
  -- visual impairments
  -- cognitive impairments

- **Driving Skills:**
  -- not driving fast enough when joining traffic
  -- not adapting the distance to the car in front of you

- **Driving Behaviour:**
  -- driving 80 km/h in an urban area
  -- overtaking at the wrong side
Stereotype of people with brain injury, visually impairments or elderly drivers

- **Fitness to Drive:**
  -- neuropsychological and medical impairments

- **Driving Skills:**
  -- good in familiar situations,
  -- poor in unfamiliar or complex situations

- **Driving Behaviour:**
  -- avoiding difficult and unfamiliar situations > self restriction
  -- slowing down > compensation in time

- Driving Skills, Adapted Driving Behaviour and Visual Aids allow **compensation** for impaired Medical Fitness to Drive
The hierarchical task structure of driving: three levels (after Michon, 1985)

<table>
<thead>
<tr>
<th>Strategic (long time constant)</th>
<th>Goals, route planning; Do I go by car or take the train?</th>
<th>What time of day? How much time do I need?</th>
<th>Which route shall I take?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tactical (Seconds)</td>
<td>Intersection approach speed</td>
<td>Maintaining safe distance to other vehicles</td>
<td>Changing lanes in time</td>
</tr>
<tr>
<td>Operational (milliseconds)</td>
<td>Maintaining course, steering, braking</td>
<td>Avoiding an obstacle</td>
<td>Braking in time for a crossing cyclist</td>
</tr>
</tbody>
</table>

Driving behaviour

Driving skills

Fitness to drive
fitness to drive: **EU-directive**

**medical**
- visual acuity: 0.5 in best eye [6/12, 20/40]
- visual field: ≥ 120°

**practical**
- the ability to drive safely and smoothly despite one’s visual impairment.
- on road driving test by the Netherlands Bureau of Driving Skills Certificates [CBR].
  Considered as *Golden Standard* in NL
visual acuity 0.5: reading licence plate at 35m

VA = 0.2
Step 1: Coeckelbergh & Kooijman
1998 – 2002

N = 67 participants.
Visual acuity loss and/or visual field defect.
All had insufficient medical fitness to drive.
Practical fitness to drive test [CBR].

[Human Factors, 2004, 46(4): 748-760]
Step 1: Coeckelbergh & Kooijman
1998 – 2002: conclusion

[Human Factors, 2004, 46(4): 748-760]

34% passed practical fitness to drive test [CBR]

The medical fitness to drive (visual acuity and visual field) provides not sufficient information to decide about the practical fitness to drive.
Step 2: build a consortium
2000 - 2004

- Netherlands Bureau of Driving Skills Certificates [CBR]
- Ministry of Transport
- 2 driving schools
- University Medical Center Opthalmology
- University Medical Center Traffic Medicine
- Royal Dutch Visio: clinical physicist
  optometrist
  occupational therapist
  neuro-psychologist
Step 3: development of training
2004 - 2007

- **Impaired visual acuity:**
  Problem: reading signs, anticipate, overtaking
  Bioptic Telescope System [BTS]

- **Visual field defect:** homonymous hemianopia
  Problem: overview
  Scanning Compensatory Therapy [SCT]
Homonymous Hemianopia

- Field defect the same for both eyes
- No visual perception
- Half of the visual field

Due to acquired post-chiasmatic brain damage
normal visual field

left hemianopia, gaze right
normal visual field

left hemianopia, gaze right
normal visual field

left hemianopia, gaze far right
Training protocol (IH-CST)

- Designed by Royal Dutch Visio
- 18 hours (15 sessions) of face-to-face training
- 10-15 weeks daily exercise
- Goal: improving “slow mobility” (walking, cycling)
- Three phases:
  1. Increase insight in visual deficit
  2. Systematic scanning strategy
  3. Step-by-step transfer to mobility in daily life
Increase insight

- Awareness of impairment
- Exclusion neglect
- No co-morbidities: cognitive / visual
- Discriminate tasks: Mobility vs. reading
- Awareness of own responsibility / possibilities
Systematic scanning strategy

- Based on training Pizzamiglio (1992) and Tant (2002)
- Scanning strategy:
  - Fixate straight forward
  - Large saccade towards blind hemifield
  - Saccade back to seeing hemifield
- Frequency depending on situation

Right hemianopia:
Scanning strategy: large screen
Scanning strategy while walking
Standardized search tasks
Obstacle course (dual task)
Step 3: scanning compensatory therapy
2007 - 2011

- inclusion: homonymous hemianopia
- SCT-programme:
  - assessment day
  - optimizing optics [optometrist]
  - SCT-training 10 x 1.5 hours [O&M-trainer]
  - driving lessons [driving instructor]
  - practical fitness to drive test [CBR]
Walking time (sec)

<table>
<thead>
<tr>
<th></th>
<th>pre</th>
<th>post</th>
</tr>
</thead>
<tbody>
<tr>
<td>no dual task</td>
<td></td>
<td></td>
</tr>
<tr>
<td>free course</td>
<td></td>
<td></td>
</tr>
<tr>
<td>dual task</td>
<td></td>
<td></td>
</tr>
<tr>
<td>obstacle course</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- **pre** and **post** denote before and after conditions, respectively.
- The graph compares walking times under different conditions (no dual task vs. dual task) for free and obstacle courses.
Tracking task
RT (ms) on blind and seeing side

<table>
<thead>
<tr>
<th>Side</th>
<th>pre</th>
<th>post</th>
</tr>
</thead>
<tbody>
<tr>
<td>blind</td>
<td>1540</td>
<td>1306</td>
</tr>
<tr>
<td>seeing</td>
<td>990</td>
<td>866</td>
</tr>
</tbody>
</table>

Total omissions on blind and seeing side

<table>
<thead>
<tr>
<th>Side</th>
<th>pre</th>
<th>post</th>
</tr>
</thead>
<tbody>
<tr>
<td>blind</td>
<td>7</td>
<td>1</td>
</tr>
<tr>
<td>seeing</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>
Hazard perception
Vlakveld-test
With eye movement recording
Driving simulator

- slightly winding road
- slightly winding road
- slightly winding road
- rural, 2-lane road + crossings
- rural, 2-lane road + crossings
- fixed speed (50 km/h)
- free speed
- instruction: in a hurry
- fixed speed
- free speed
Fitness to drive: TRIP

TRIP-factors improve after training

[Bar chart showing improvements in different factors after training]
Step 4: lobby to change regulations
2007 - 2010

- report to the minister of Transport
- decisions: May 2009 and February 2010

**visual acuity impairment:**
- VA >= 0.50 : unrestricted driving license
- 0.40 <= VA < 0.50 : CBR-test without BTS
- 0.16 <= VA < 0.40 : CBR-test with BTS

**visual field defect:**
- HVF >= 120° : unrestricted driving license
- 90° <= HVF < 120° : CBR-test
Step 5: extending consortium 2009 - 2010

- 4 regions: 12 locations
- education of:
  - 9 information officers
  - 31 optometrists
  - 32 O&M trainers
  - 6 clinical physicists
  - 5 neuro-psychologists
  - 23 driving instructors
  - 8 CBR experts on practical fitness to drive
  - 12 CBR driving examiners

- September 2010: AutO-Mobility nationally available
Current situation
April 2014

- applied for AutO-Mobility: 1027 -- BTS: 879
  -- SCT: 148

- included in AM-diagnostics: 641 -- BTS: 510
  -- SCT: 131

- driving licenses issued: >150 -- normal: >20
  -- BTS: 79
  -- SCT: >50

- Self reported accidents 1 -- parking

**REMEMBER**: AutO&Mobility is about mobility, not about driving!
Step 6: future developments
2014 - 2016

New programmes for:
- mobility scooter [16 km/h = 10 miles/h]
- microcars [45 km/h = 30 miles/h]
- patients with combined acuity and field impairment
- patients with visual and neurological impairment
- driving simulator
Please contact

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