Training working memory in older drivers: The effect on cognitive ability and driving performance

Ariane Cuenen[1], Ellen M. M. Jongen[1],Tom Brijs[1], Kris Brijs[1,2], Katrijn Houben[3] & Geert Wets[1]

[1] Transportation Research Institute (IMOB) - Hasselt University, Belgium
[2] Faculty of Applied Engineering Sciences - Hasselt University, Belgium
[3] Faculty of Psychology and Neuroscience - Maastricht University, the Netherlands

International Convention of Psychological Science (ICPS), 12-14 March 2015, Amsterdam, the Netherlands

AIMS

INVESTIGATION OF OLDER DRIVERS':

1) IMPROVEMENT OF COGNITIVE ABILITY THROUGH A TRAINING OF WORKING MEMORY

2) IMPROVEMENT OF DRIVING PERFORMANCE THROUGH A TRAINING OF WORKING MEMORY

BACKGROUND

With age: decline in cognitive abilities, for example Working Memory (WM)
"The ability to temporarily store or manipulate information" (Baddeley, 1992)

WM is related to driving performance of older drivers
→ Left turn performance among female drivers (Guerrier et al., 1999)
→ On road driving performance (Adrian et al., 2011)

Ageing of society + consequences of driving cessation + costs of road accidents
→ Need for effective interventions to keep older drivers safe drivers for as long as possible

Cognitive training improves cognitive abilities of older people (Ball et al., 2002, 2007; Karbach & Kray, 2009; Rebok et al., 2014; Schmiedek et al., 2010)

Moreover, cognitive training improves driving abilities of older drivers (Ball et al., 2010, 2013; Cassavaugh & Kramer, 2009; Edwards et al., 2009; Roenker et al., 2003)

A cognitive training targeting WM improves cognitive abilities of older people (Borella et al., 2010, 2013; Morrison & Chein, 2011; Richmond et al., 2011)

Positive transfer effects of a cognitive training targeting WM have been shown in different domains of behavior
→ Problematic drinking behavior among adults (Houben et al., 2011)
→ Motor activity among children with ADHD (Klingberg et al., 2002)

To our knowledge, solely one study investigated the effect of a cognitive training targeting visuo-spatial WM on driving performance of older drivers
→ Accelerator response to lead-vehicle braking (Cassavaugh & Kramer, 2009)

METHOD

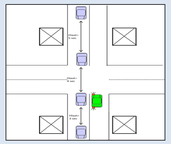
PRE-TEST (N=54)
Cognitive ability
Driving performance

TRAINING
Experimental condition
Control condition

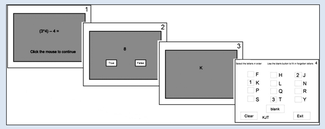
POST-TEST (N=38)
Cognitive ability
Driving performance

PARTICIPANTS
Age = 70.34 (4.49)
Mini-Mental State Examination (MMSE) score = 28.74 (1.27)

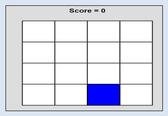
DRIVING PERFORMANCE
° **Specific driving measures:** fixed-based medium-fidelity driving simulator (STISIM 400; Systems Technology Incorporated)
→ Crashes (number)
→ Gap acceptance while turning left (s)
→ Giving right of way (yes or no)
→ Standard Deviation of Lateral Lane Position (m)
→ Speed (km/h)

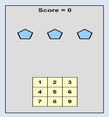


COGNITIVE ABILITY
° **WM:** Automated Operation SPAN (AOSPAN, Unsworth et al., 2005)



WM TRAINING (Klingberg et al., 2002)
Procedure: 25 sessions at home via the internet
Experimental condition: Start = span previous session, Maximum span = 15
Control condition: Start = span 3, Maximum span= 3
3 training tasks: 1 = Visuo-spatial span 2 = Back digit span 3 = Letter span





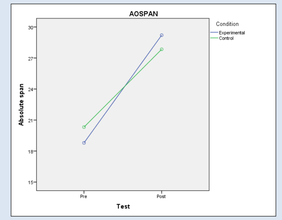
DATA ANALYSIS

1) IMPROVEMENT OF COGNITIVE ABILITY THROUGH A TRAINING OF WM
Repeated measures ANOVA on AOSPAN: WS factor = Test (Pre; Post), BS factor = Condition (Experimental; Control)

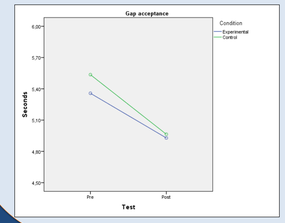
2) IMPROVEMENT OF DRIVING PERFORMANCE THROUGH A TRAINING OF WM
Repeated measures ANOVA on driving measures: WS factor = Test (Pre; Post), BS factor = Condition (Experimental; Control)

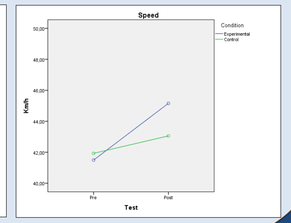
RESULTS

1) IMPROVEMENT OF COGNITIVE ABILITY THROUGH A TRAINING OF WM



2) IMPROVEMENT OF DRIVING PERFORMANCE THROUGH A TRAINING OF WM





CONCLUSIONS AND DISCUSSION

1) IMPROVEMENT OF COGNITIVE ABILITY THROUGH A TRAINING OF WM IN OLDER DRIVERS
WM in older drivers can be improved by training of that specific cognitive function

2) IMPROVEMENT OF DRIVING PERFORMANCE THROUGH A TRAINING OF WM IN OLDER DRIVERS
Driving performance of older drivers can be improved by a training of WM

FUTURE RESEARCH:
Investigate whether effects are due to a training effect or to a learning effect → collection of a passive control condition
→ Even a training with a limited difficulty level can have substantial effects
→ Promising tool to counteract or postpone decreases in cognitive ability and driving performance

LIMITATIONS

→ Relatively low sample size due to simulator sickness
→ Only investigation of immediate effects

Contact information: Ariane Cuenen, Transportation Research Institute (IMOB) – Hasselt University, Wetenschapspark 5 bus 6, 3590 Diepenbeek, Belgium – Tel. +32 11 26 91 08 – email: ariane.cuenen@uhasselt.be