



ECTRI – FEHRL – FERSI
Young Researchers Seminar 2015

Effectiveness of two cognitive training programs on the performance of older drivers with a cognitive self-assessment bias

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Population ageing

In 2050, $\frac{1}{4}$ of OECD member countries aged $>65+$

OECD, 2012



Anstey et al., 2005



Driving self-regulation

Meng & Siren, 2012

Driving self-regulation

- Behavioral adaptation aims at maintaining a safe driving despite age-related declines

Donorfio et al., 2008



e.g. Ball et al., 1998, Baldock et al., 2006; Charlton et al., 2006, Molnar & Eby, 2008

e.g. Donorfio et al., 2008; Molnar et al., 2009

- Some drivers use these self-regulation strategies but not all

Baldock et al., 2006

- Awareness of cognitive difficulties
 - Essential for a successful adaptation *Anstey et al., 2005*
 - Key factor in the self-regulation of driving *Meng & Siren, 2012*
- Cognitive performances
 - Low cognitive performances are related to incorrect driving self-regulation *Baldock et al., 2008; Wong et al., 2012*

➔ Important to help older drivers who are less inclined to adapt their driving behavior

- Theoretical programs: some limits
 - No improvement of on-road driving performance *Bédard et al., 2004*
 - No crash rate reduction *Ker et al., 2005; Nasvadi & Vavrik, 2007*
- Theoretical program + practical training: better effectiveness but costly
 - Improvement of driving knowledge *Marottoli, 2007; Bédard et al., 2008*
 - On-road transfer of driving skills trained on simulator *Roenker et al., 2003; Romoser & Fisher, 2009; Lavallière et al., 2012*
- Cognitive training programs: less costly
 - Improvement of cognitive abilities relevant for driving safety *Marmeleira, et al., 2009*
 - No consensus on the benefits transfer on driving simulator *Cassavaugh & Kramer, 2009; Seidler, 2010; Gaspar et al., 2012*
 - On-road transfer has not been studied yet

➔ **Need to study the cognitive training benefits on**

- **On-road driving performance**
- **Driving self-regulation**

Hypothesis (1/2)



Age-related
cognitive
decline

Correct awareness &
Correct self-
assessment of
cognitive abilities

Adapted driving self-
regulation

**Incorrect awareness &
Incorrect self-
assessment of
cognitive abilities**

**Over-
Estimators
(OE)**

**Under-
estimators
(UE)**

Method to define the cognitive self-assessment status

Lafont et al., 2014



		Subjective cognitive evaluation		
		Less	Like	Better
Objective cognitive evaluation	Low			
	Middle			
	High			

Method to define the cognitive self-assessment status

Lafont et al., 2014



		Subjective cognitive evaluation		
		Less	Like	Better
Objective cognitive evaluation	Low	correct	over	over
	Middle	under	correct	over
	High	under	under	correct

Hypothesis (2/2)



Age-related
cognitive
decline

**Incorrect awareness &
Incorrect self-
assessment of cognitive
abilities**

**Over-
Estimators
(OE)**

**Under-
estimators
(UE)**

**Cognitive
training
program**

→ Improvement of

- Self-assessment of cognitive abilities
- Cognitive performances
- Driving performances (on-road transfer)

Aims

- Compare the effectiveness of a **cognitive training program** associated or not with a **driving simulator experience** on older drivers with a **cognitive self-assessment bias** (OE and UE)
- Effectiveness observed on
 - Cognitive self-assessment status
 - Cognitive performance
 - On-road driving performance (transfer)
- Formulation of recommendations to improve driving self-regulation

To

To + 3 months

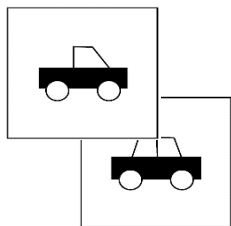
Pre-training

3-month training

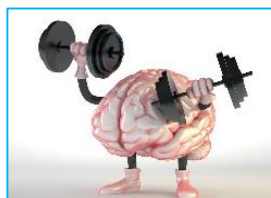
Post-training



+



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CT

36h Computerized cognitive training

Attention – Memory – Visuo-spatial abilities – Executive functions

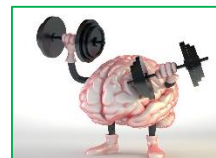
vs

35h Computerized cognitive training

+

1h Driving simulator experience

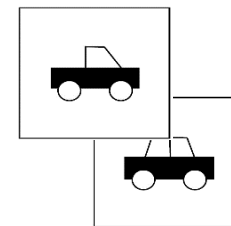
(3 sessions of 20 min each)



CT + DS



+



+



To

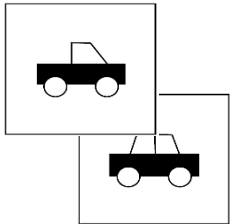
Pre-training



Definition of cognitive self-assessment status

Lafont et al., 2014

+



Cognitive evaluation: UFOV[®] test (3 subtests)

- Processing speed
- Divided attention
- Selective attention

Ball et al., 1990

+



On-road driving assessment (45-min)

On-road driving assessment (1/2)



Test Ride for Investigating Practical fitness to drive (TRIP)

- Total score (/ 100)
- Three sub-scores
 - **Tactical** sub-score
 - **Tactical compensation** sub-score
 - **Operational** sub-score
- A high score = good driving performance

*Withaar, 2000
De Raedt & Ponjaert-Kristoffersen, 2000, 2001*

On-road driving assessment (2/2)



Behavioural observation grid

- The detailed list of driving situations and potential behaviors

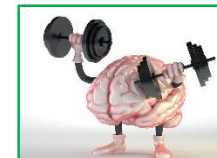
Dobbs et al., 1998; Lafont et al., 2010

- 6 behavioral dimensions

- Visual attention
- Interaction with other road users
- Planning
- Lane positioning
- Speed adaptation
- Car control handling

- A high penalty score = many driving errors

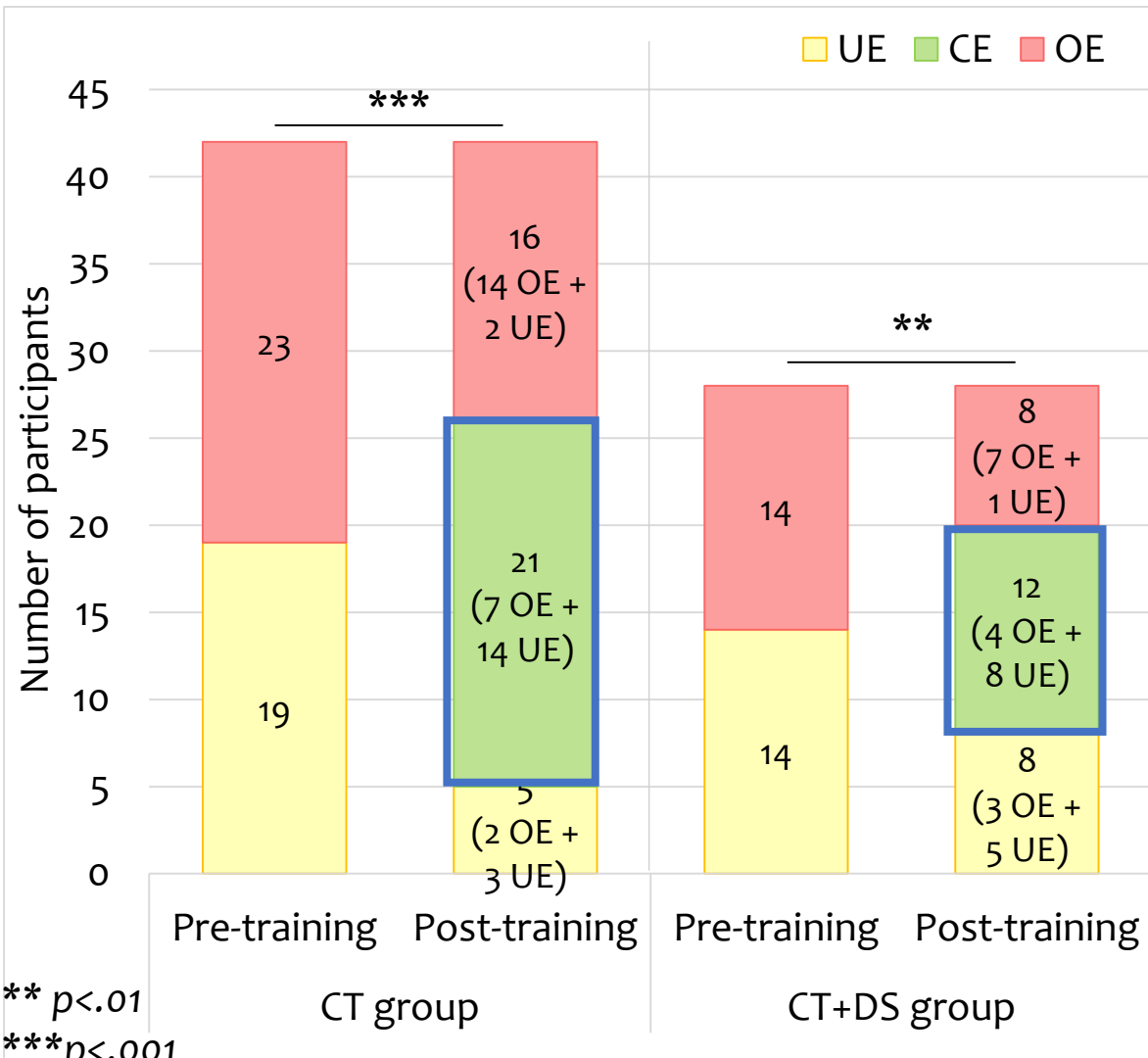
Population



$n_{\text{tot}} = 70$	CT n = 42	CT + DS n = 28
Age (years)	75 ± 3	75 ± 4
Gender	25 ♂ et 17 ♀	20 ♂ et 8 ♀
Self-assessment status	23 OE et 19 UE	14 OE et 14 UE

Experiment still in progress (Active Control group)

1 - Cognitive self-assessment status

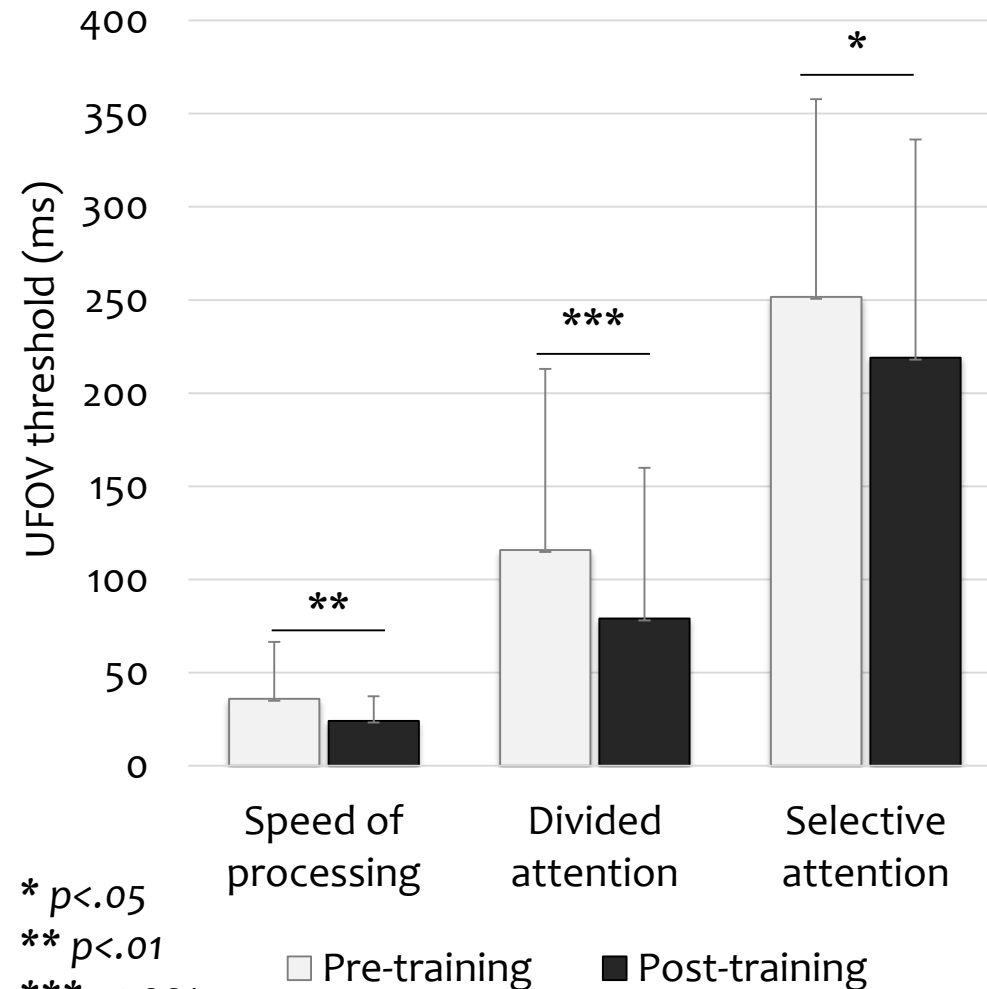
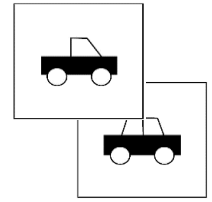


→ 33/70 participants correctly self-assess their cognitive abilities

→ Among these CE: twice as many initially UE as OE

→ Improvement of self-assessment of cognitive abilities

2 – Cognitive performances – UFOV test (1/2)

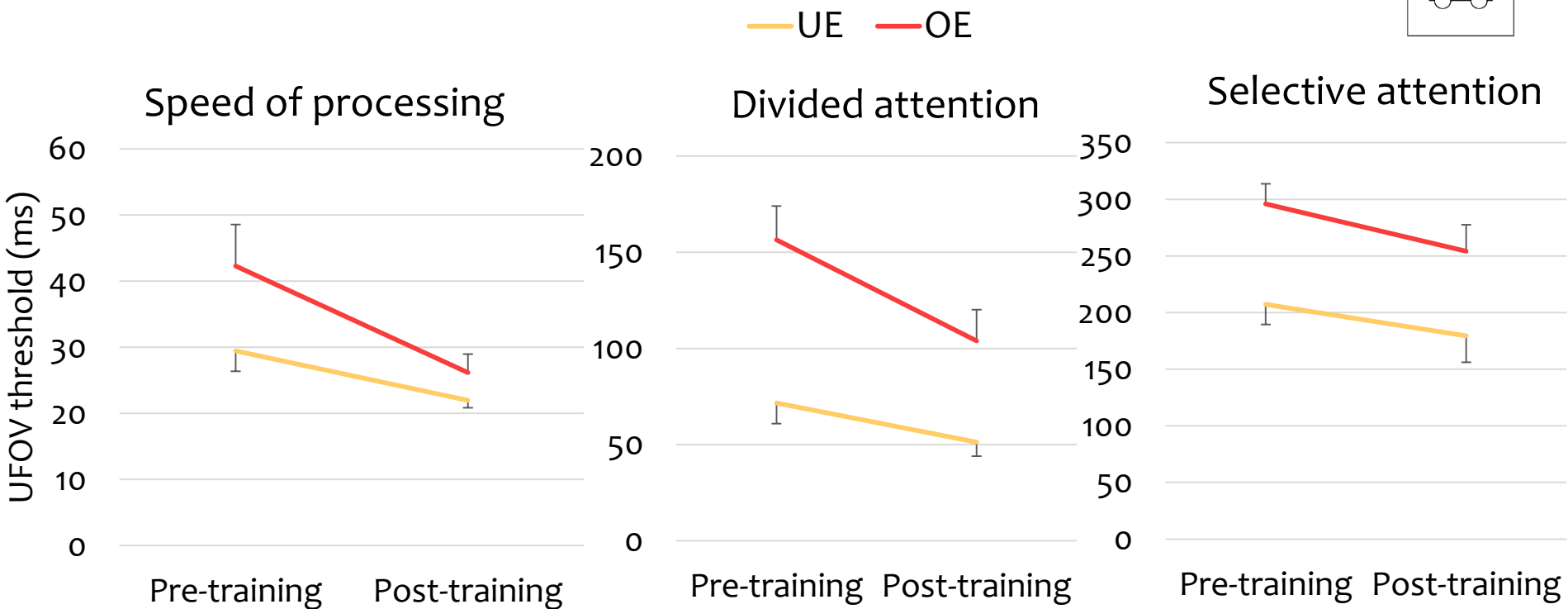
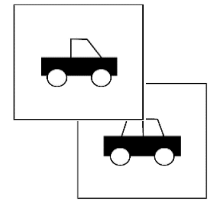


- Intervention effect: improvement of reaction time in all UFOV subtests after training

➔ All participants improved their **visual attention performances**, regardless of the training type

➔ Improvement of cognitive performances for both training groups

2 – Cognitive performances – UFOV test (2/2)

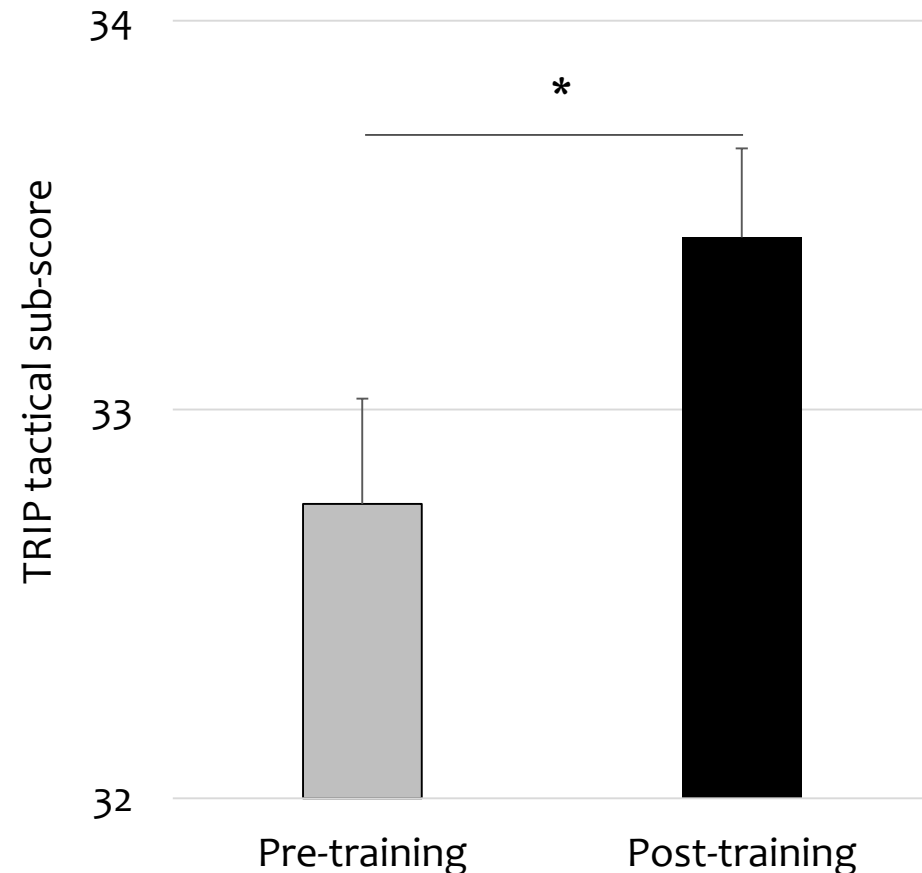


- Self-assessment status effect: UE faster than OE

➔ Improvement OE > UE (threshold effect)

➔ Even after training, OE still have lower performances than UE

3 – On-road driving performance - TRIP (1/2)



- Intervention effect: Improvement of **tactical choices and driving style** (lane positioning, safety distance, speed adaptation and anticipation)

➔ Improvement of the driving behavioral adaptation for both training groups

3 – On-road driving performance – Behavioral adaptation grid (2/2)

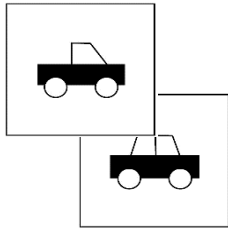


- **Speed adaptation** (Interaction Intervention X Training type, $p < .05$)
 - CT + DS group: faster after training than before, conversely to CT group
- **Car control handling** (Interaction Intervention X Training type, $p < .05$)
 - CT + DS group: more difficulties with the mechanical control of the vehicle after training than before, conversely to CT group

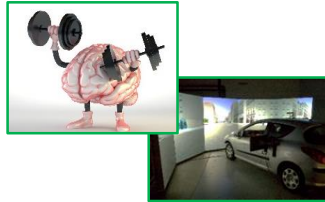


➔ Increase of driving errors related to the observance of speed limits and car control handling

OLDER DRIVER



VS



21 CE / 42
(UE>OE)

12 CE / 28
(UE>OE)

↗ Visual attention

Marmeleira et al., 2009

+

↗ Driving behavioral adaptation

Excessive engine speed and car control handling errors

➔ Feedbacks seem more effective for UE than for OE

➔ Even though OE improved their performances, they were still lower than UE

Crash risk reduction

De-Raedt & Ponjaert-Kristoffersen, 2001; Roenker et al., 2003

➔ DS: not effective for the on-road transfer as evaluated in our study

Perspectives

- Data analysis from the Active Control group
 - Reliable change index (taking into account practice effect)
 - Training gain better explored
- Identify objective behavioral indicators reflecting the driving self-regulation
- Formulate recommendations to provide the most adapted intervention for older drivers to keep them driving longer and safer



Thank you for your attention

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