Multitasking and Aging

esp. language use while driving

Enny Agamez
Dave Howcroft
Marina Oberwegner

Dual-Tasking + Aging

A variety of papers published arguing both sides: aging does / does not affect multitasking.

Verhaegen et al. 2003 meta-study

- Older adults are slower than predicted from general slowing.
- But their accuracy remains the same.

Dual-Tasking + Driving

...to the PDF!

Cell phones + Driving

We expect this to be more dangerous.

From Strayer & Drews 2007*

- inattention blindness: failure to react to visible objects
- tunnel vision: less scanning
- drivers are slower to react when distracted
- on the phone ⇒ EEG activity associated with driving reduced

* adapted from Vera's slides in lecture 3

Cell phones + Driving*

Recall that…

- passengers adapt
  - talking less (Crundall et al. 2005)
  - with reduced complexity (Drews et al. 2008)
- linguistic complexity matters (Demberg et al. 2013)

* adapted from Vera's slides in lecture 3

Cell phones + Driving + Aging

What do you expect?

Older and younger adults show the same amount of **slowing when dual-tasking**.

But **older adults are also slower and leave greater following distances** in general.

Strayer & Drews. 2004. "Profiles in Driver Distraction: Effects of Cell Phone Conversations on Younger and Older Drivers".

Strayer & Drews 2004: the sample

	Younger	Older
age:	20.2 yrs	69.6 yrs
N:	20 (13m; 7f)	20 (14m; 6f)
schooling:	9.6 yrs	15.5 yrs
digit symbol:	84.6	59.1
maze tracing:	15.1	8.1

And we stick them in a simulator one at a time!


GE Capital
I-Sim

Strayer & Drews 2004: the task

Follow a pace car on the highway.

Brake when the pace car brakes.

(in dual-task condition) converse with an RA.

Strayer & Drews 2004: the analysis

2x2 factorial design

- age (young vs. old)
- task (single vs. dual)

Dependent Variables

- brake onset time
- following distance
- driving speed

Statistics

- **M**ultivariate **AN**alysis **O**f **VA**riance
- Split-Plot ANOVA on individual dep. var.s
- significance level at $p < 0.05$

Strayer & Drews 2004: the results

Dependent Var.s	Age	Tasking	Age x Tasking
Brake onset time	$p \approx 0.08$	**dual → slower braking**	$p > 0.64$
Following distance	**old → larger distance**	$p \approx 0.06$	$p > 0.98$
Speed	**old → lower speed**	$p > 0.97$	$p > 0.22$
COMBINED	**$p < 0.01$**	**$p < 0.01$**	$p > 0.23$

dual-tasking leads to more accidents ($p < 0.02$)

Strayer & Drews 2004: time course

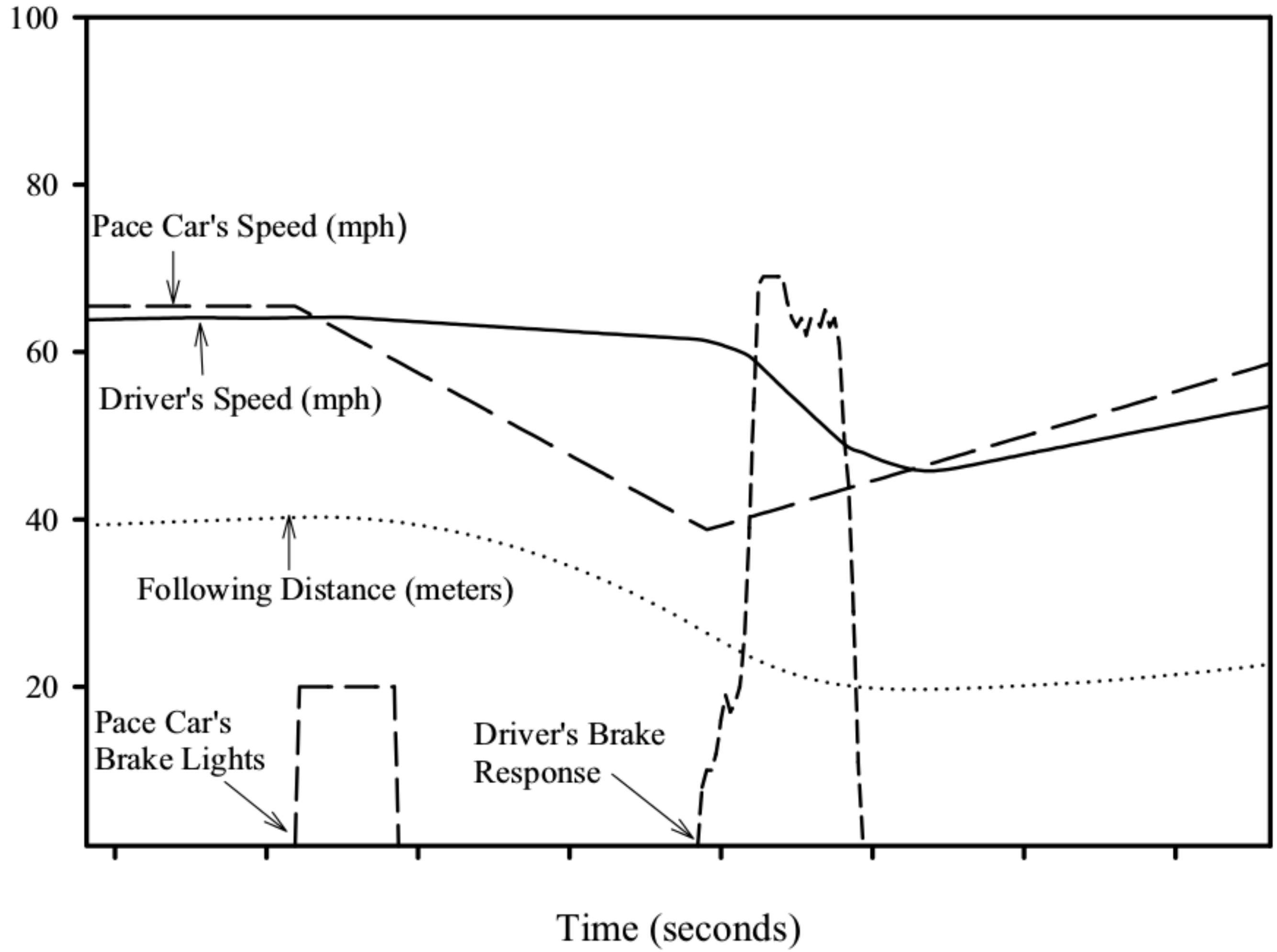

Figure 2. An example of the sequence of events occurring in the car-following paradigm.

Strayer & Drews 2004: time course

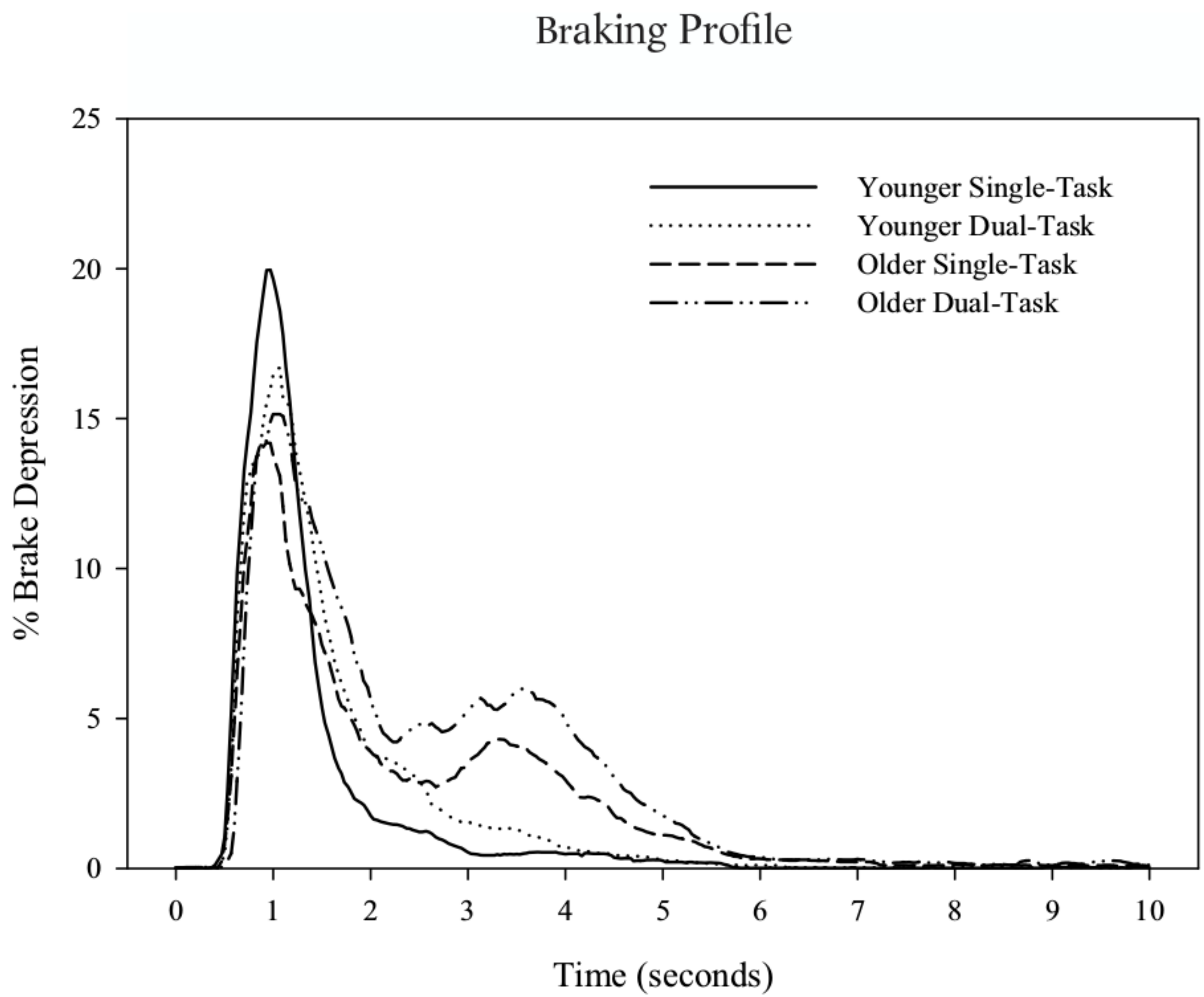

Figure 3. Participant's time-locked braking profile in response to the braking pace car.

Strayer & Drews 2004: conclusion

Effect of cell phone use on driving is the same for older and for younger adults.

But older adults are generally slower and leave greater following distances.

Video game training enhances cognitive control in older adults

by J.A. Anguera, J. Boccanfuso, J. L. Rintoul, O. Al-Hashimi, F. Faraji, J. Janowich, E. Kong, Y. Larraburo, C. Rolle, E. Johnston & A. Gazzaley

Marina Oberwegner

Saarland University
Seminar: Language Comprehension and Aging
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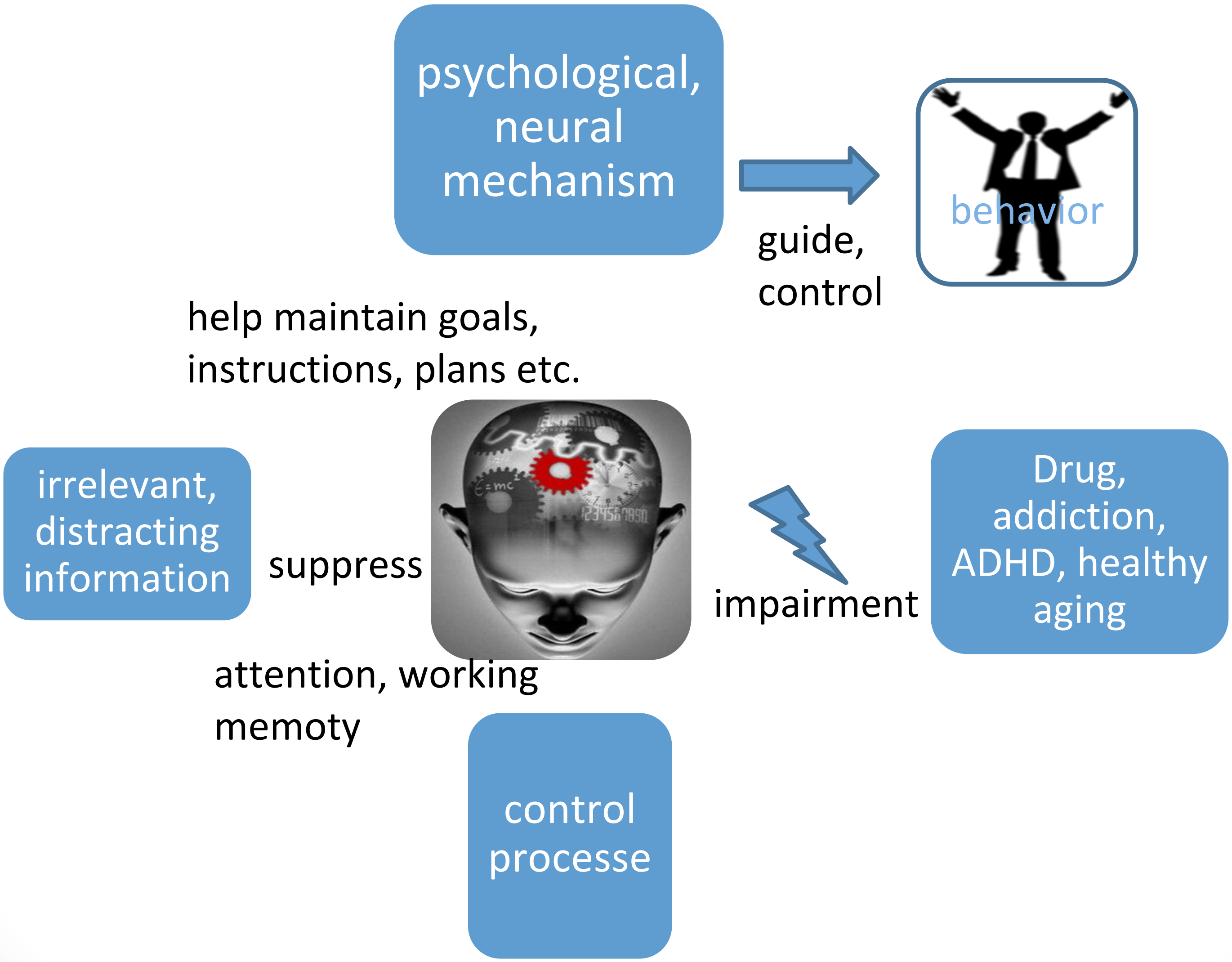
Cognitive Control



Cognitive Control

- manages cognitive processes (e.g. working memory, problem solving, planning)
- **Multitasking** challenges the cognitive control processes
- Problem: multitasking difficulties appear more often with ageing
- previous studies showed:

older adults are **worse** in multitasking than younger adults

Multitasking

Is it still possible to improve multitasking
even when you are an old adult?

Study:

- Investigate whether old people could improve multitasking by taking part in a video game training

→ experiments

Participants

Experiment 1	N 174	Mean age
20 year olds	31	24.5
30 year olds	29	33.4
40 year olds	28	45.6
50 year olds	29	53.7
60 year olds	27	65.9
70 year olds	29	73.3

6 decades of life

non-gamers: played less than 2h per month of video game

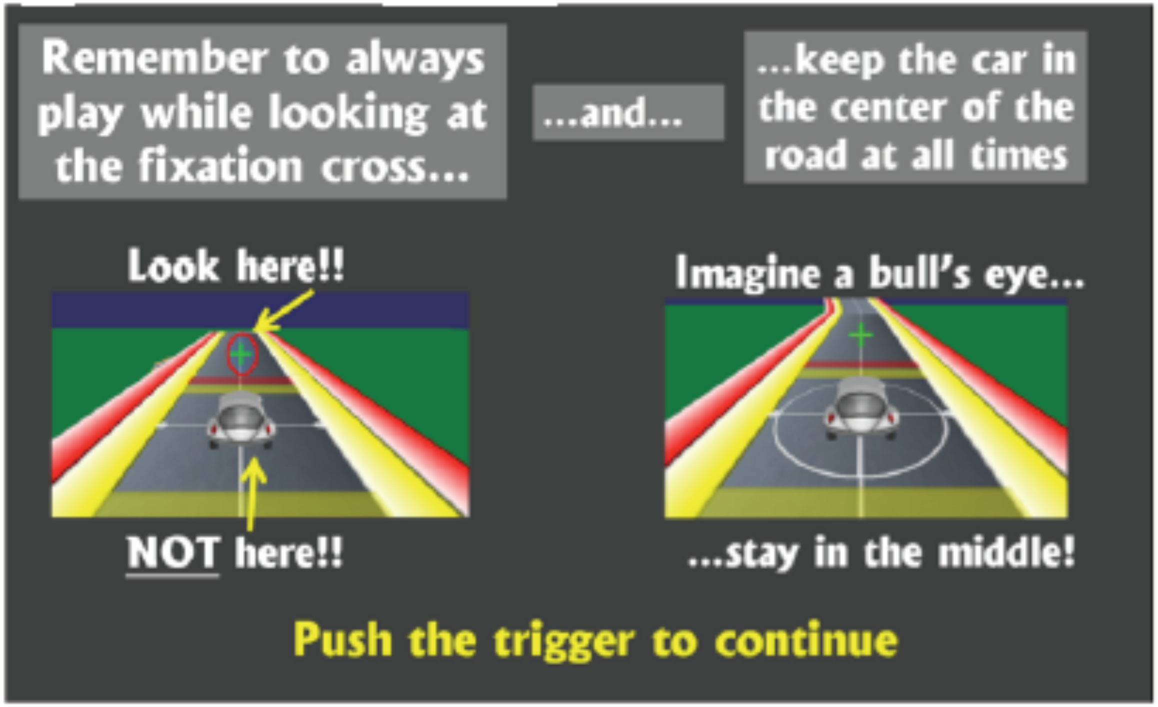
Experiment 2	N 46	Mean age
Multitasking training	16	64.9
Single task training	15	68.8
No-contact control	15	66.8

Video game design

- 3D video game
- Road: curves, uphill, downhill (shallow and steep grade)
- different rates of speed: uphill – required more acceleration, downhill – more breaking
- 200 different road levels (minimum and maximum speed)
- 54 sign levels (max of time participant had to respond to presented target, 250msec – 1000msec)

Video game design

- left thumb for tracking
- right index finger for responding to sign on gamepad controller

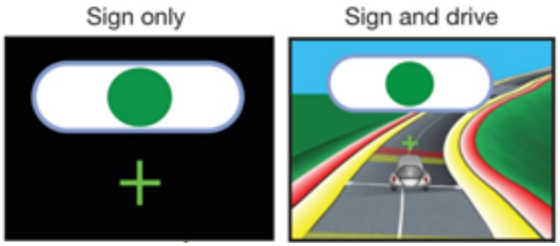


Experiment 1

How does the multitasking performance change across the adult lifespan?

Experiment 1

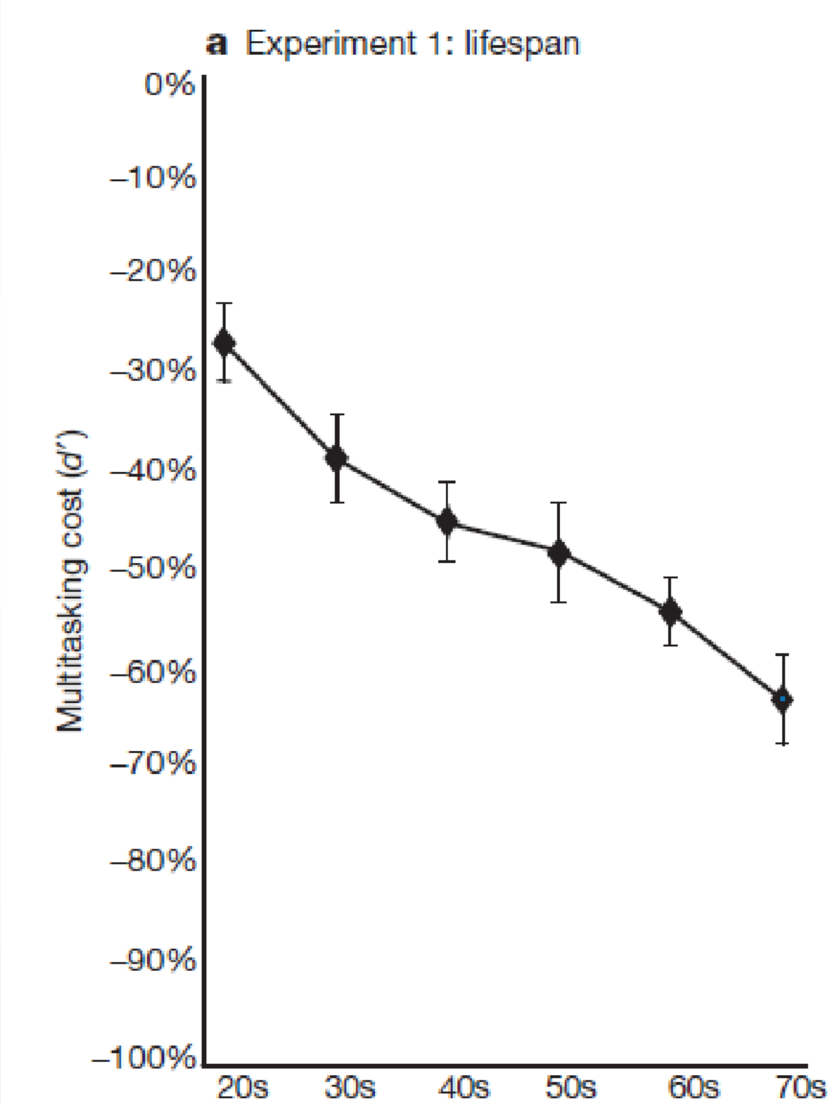
- performance evaluated using two distinct game conditions:



- multitasking performance calculated using percentage change in d' from sign only to sign and drive → greater cost (more neg. percentage cost) = increased interference when simultaneously engaging in the two tasks

- multitasking cost index d' = $\frac{sign\ \&\ drive - sign\ only}{sign\ only} * 100$

Experiment 1 - Results



- **linear decrease** of multitasking performance across the adult lifespan
- significant decrease from 20s to 30s
- consistent with performance decline across lifespan observed for fluid cognitive abilities

(e.g. reasoning, working memory)

Experiment 2

Do older adults who trained by playing NeuroRacer in multitasking mode show improvements in their multitasking performance?

Video game training enhances cognitive control in older adults

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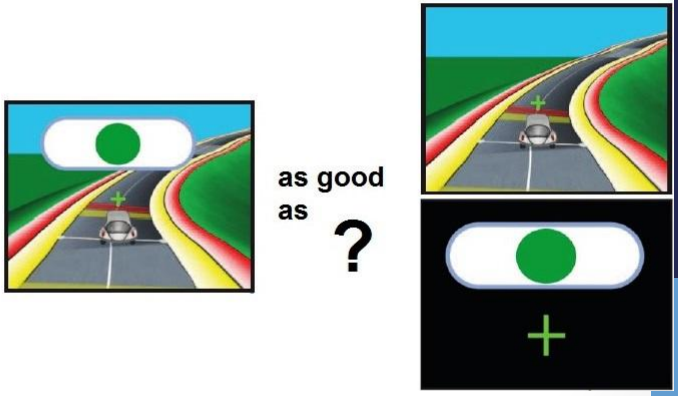
Experiment 2

- investigated whether training increased their cognitive control abilities beyond those who trained on the component tasks in isolation

- cognitive control tests (broadness of training benefits)
- EEG recording at pre- and post-training during NeuroRacer performance (neural basis of training effects)

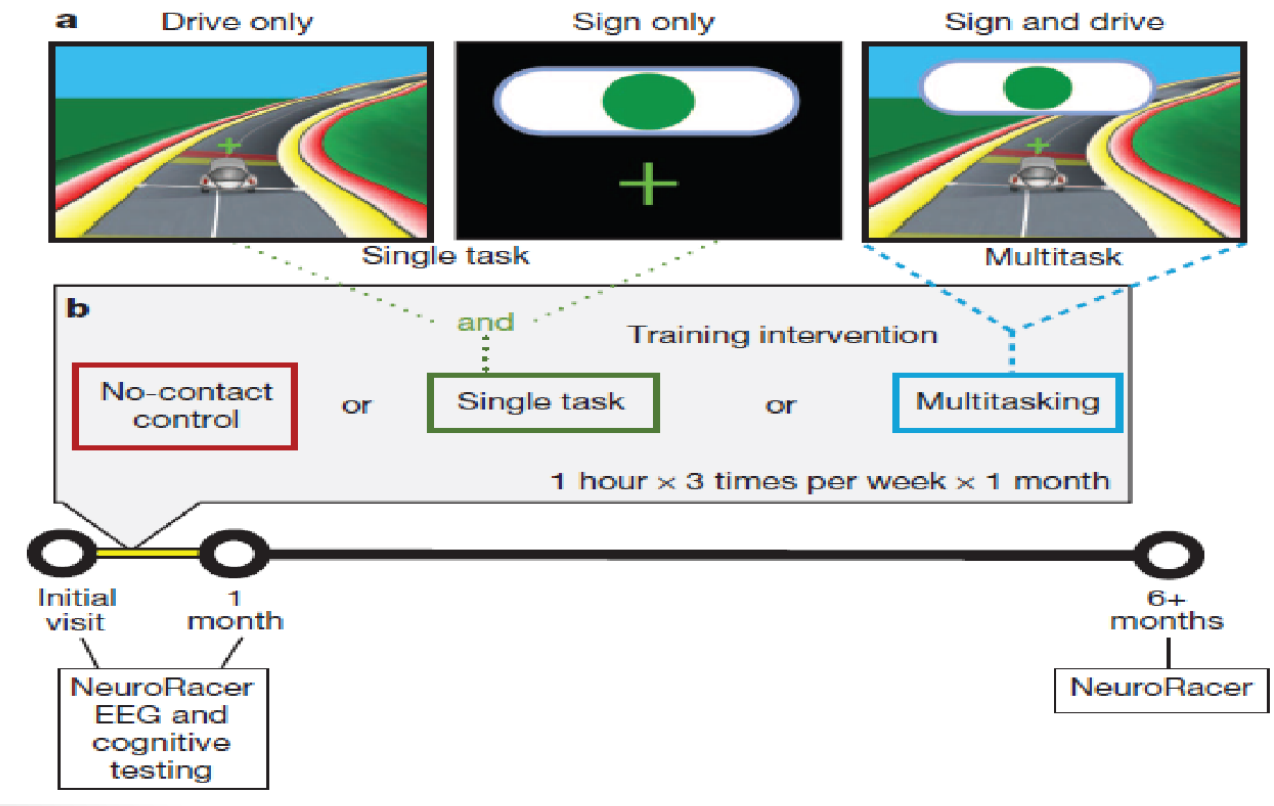
- 46 naïve older adults (60-85 years):
  - MTT (Multitasking training)
  - STT (Single task training)
    (active control group or no-contact control group)



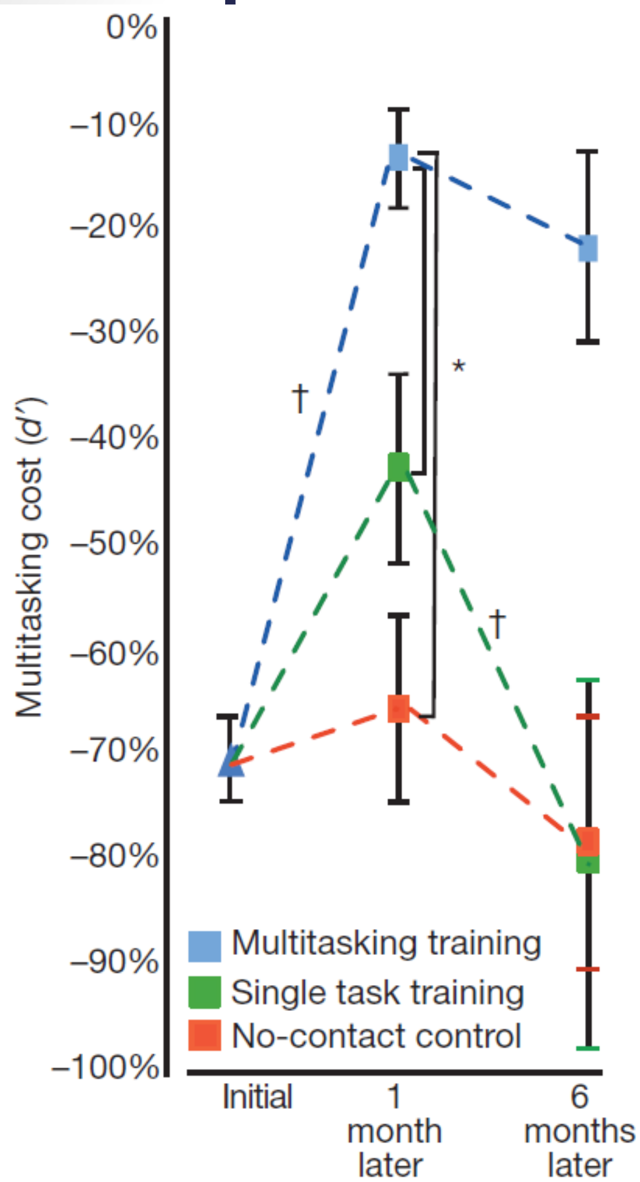
Experiment 2

Training:

- at home for 1h a day, 3 times a week for 4 weeks (total: 12h of training)



Experiment 2 - Results

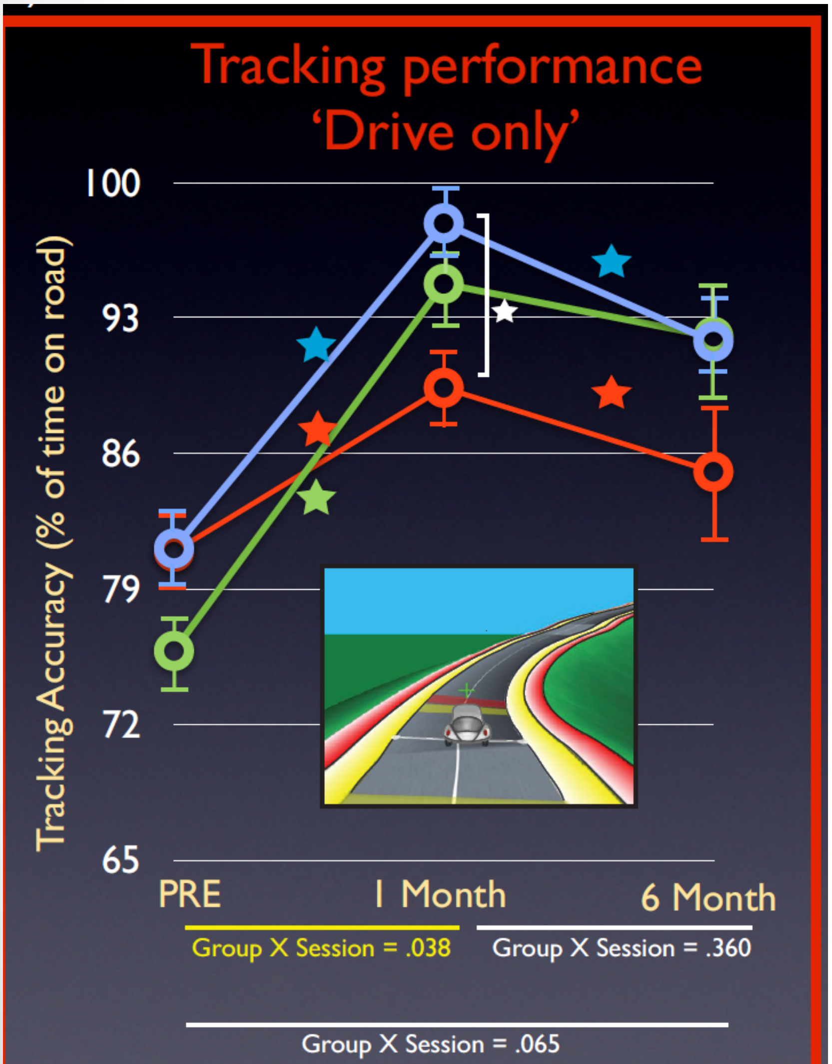


- MTT: significantly improved from pre- to post-training
- STT, MTT: improved in their tasks

Experiment 2 - Results

= p < .05

Multitasking training
Single task training
No-contact control

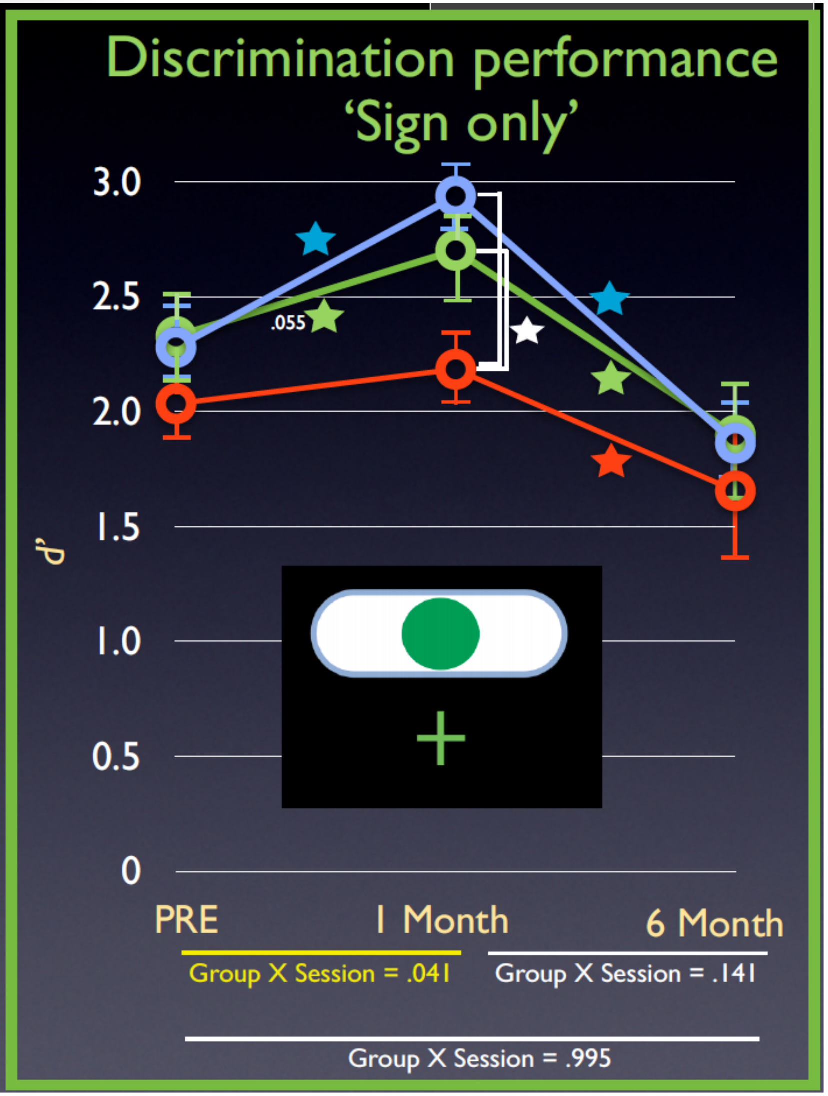


→ enhanced multitasking ability was result of:

- component skills
- function of learning

→ MTT's post-training improved **beyond** the level of the **20 years** olds playing a single session of the game

Experiment 2 - Results



→ enhanced multitasking ability was result of:

- component skills
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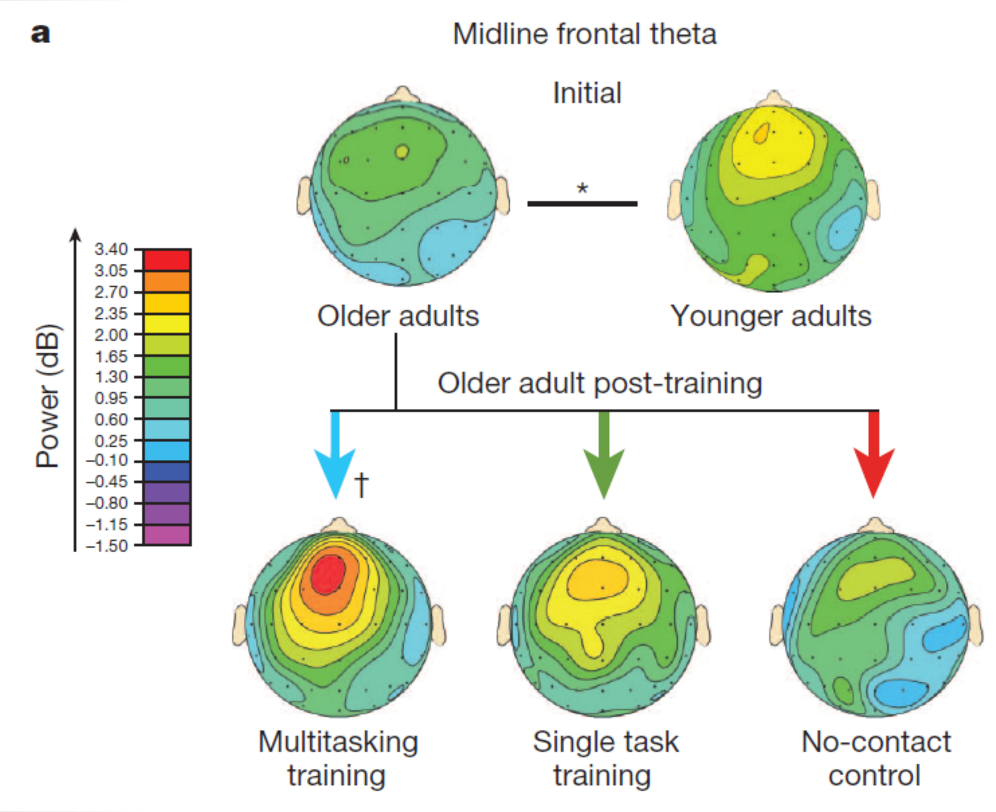
→ MTT's post-training improved **beyond** the level of the **20 years** olds playing a single session of the game

→ improved multitasking performance **stayed stable 6 months after training**

Experiment 2 - Results



- improvement only for MTT group from pre- to post-training
- improvement in working memory and sustained attention

Summary

- **linear decrease** of multitasking performance across the adult lifespan
- MTT's post-training improved **beyond** the level of the **20 years** olds playing a single session of the game
- improved multitasking performance **stayed stable 6 months after training**

→ Deactivation of medial prefrontal cortical activity (suppression of default network) during cognitively demanding tasks is associated with reduced susceptibility to internal distraction and better task performance

Summary

“We consider the older brain to be ‘plastic’ – meaning it has an ability to reshape itself in response to a certain stimulus. If we can target these areas, we may be able to improve brain performance throughout older life.” – Dr. Adam Gazzaley

Summary: Talking, Driving, Aging

What do we know?

What can we do?

Discussion Questions

Are these really age-related differences? Or differences in working memory, etc?

If you're leaving a larger following distance, doesn't it make sense to have a less abrupt deceleration?

Might the older adult's performance in Aksan et al. (2012) be a result of better discriminative modeling / memory à la Ramscar.

Discussion Questions

How useful might cognitive training be in the long-term view?

What do you think about the result that older people improved to the level of the 20 years old in performance?

References

Aksan, Nazan, Jeffrey D. Dawson, Jamie L. Emerson, Lixi Yu, Ergun Y. Uc, Steven W. Anderson, & Matthew Rizzo. (2012). "Naturalistic Distraction and Driving Safety in Older Drivers". *Human Factors*, 55(4), 841-853.

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Demberg, Vera, Asad Sayeed, Angela Mahr, & Christian Müller. (2013). "Measuring linguistically-induced cognitive load during driving using the ConTRe task". In *Proceedings of the 5th International Conference on Automotive User Interfaces and Interactive Vehicular Applications (AutoUI)*, Eindhoven, The Netherlands.

Strayer, David L., & Frank A. Drews. (2004). "Profiles in Driver Distraction: Effects of Cell Phone Conversations on Younger and Older Drivers". *Human Factors*, 46(4): 640-649.

Verhaegen, Paul, David W. Steitz, Martin J. Sliwinski, & John Cerella. (2003). "Aging and dual-task performance: a meta-analysis". *Psychology and Aging*, 18(3): 443-460.

Further Reading

Gaspar, John G., Whitney N. Street, Matthew B. Windsor, Ronald Carbonari, Henry Kaczmarski, Arthur F. Kramer, & Kyle E. Mathewson. (2014). "Providing Views of the Driving Scene to Drivers' Conversation Partners Mitigates Cell-Phone-Related Distraction". *Psychological Science*, 25(12): 2136-2146.

Additional temporal profiles

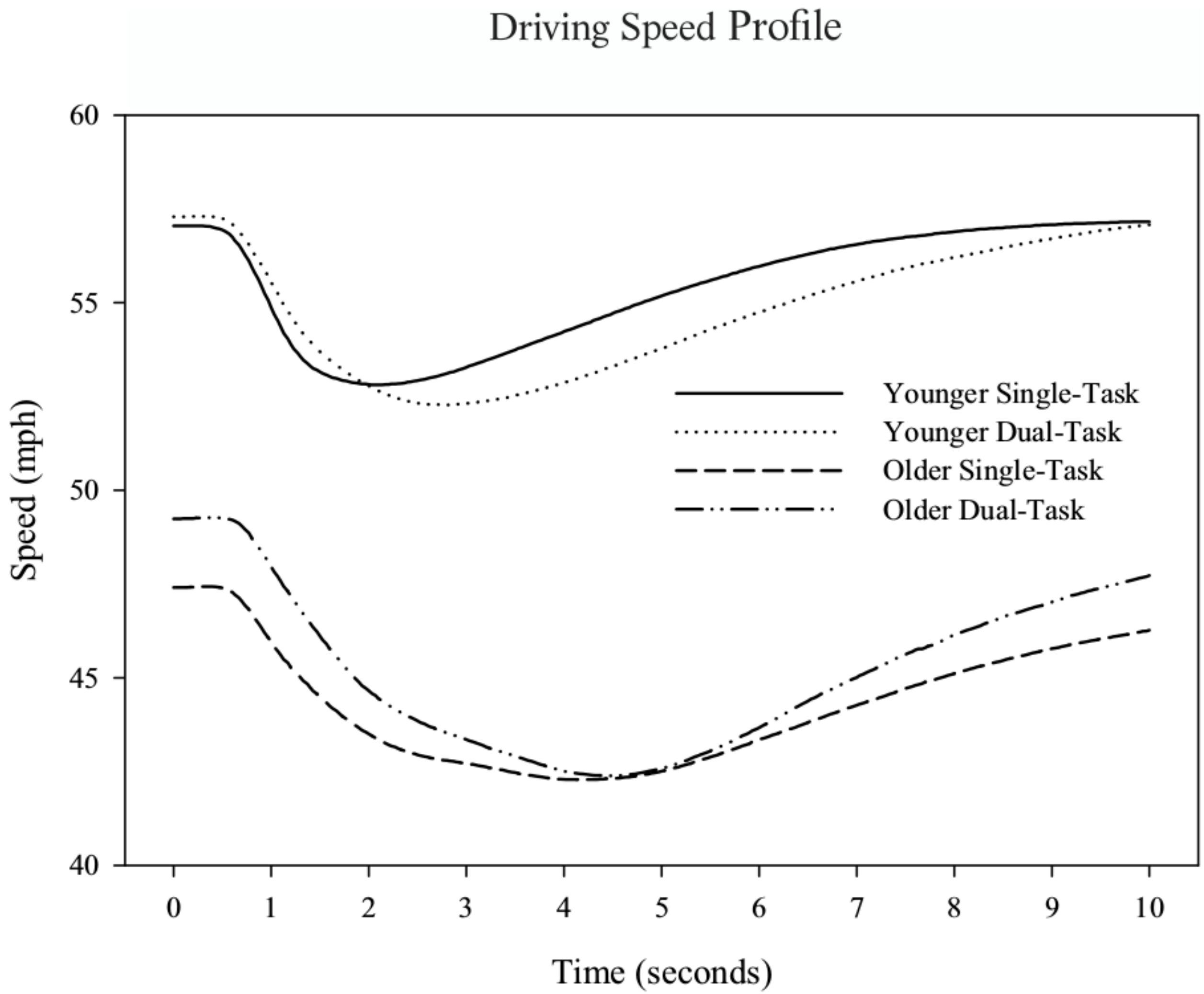

Figure 4. Participant's time-locked driving speed profile in response to the braking pace car.

Additional temporal profiles

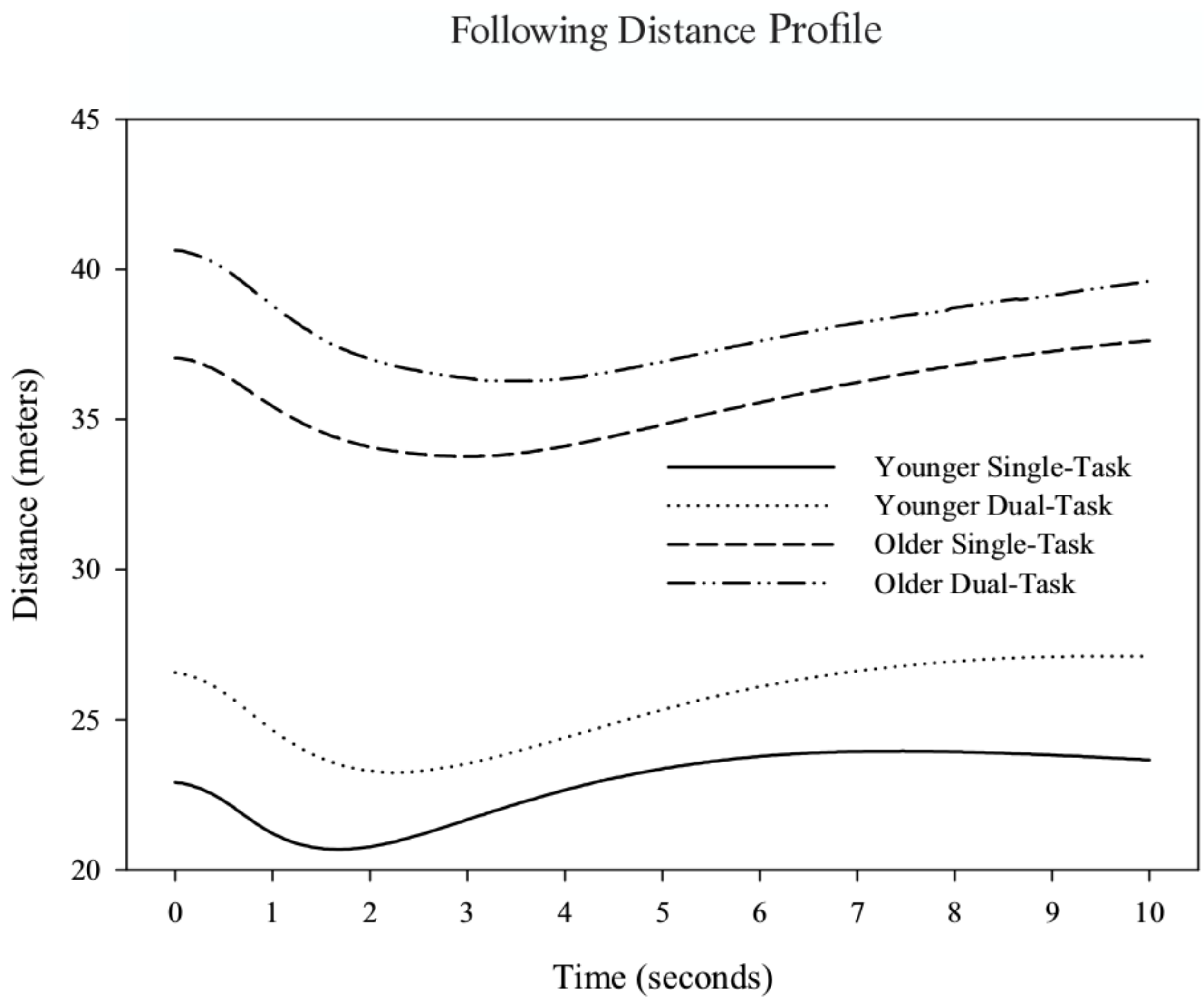

Figure 5. Participant's time-locked following distance profile in response to the braking pace car.