

Submitted by the expert of France

Informal Document: **ACSF-18-08**

Results of the Study on Transition for level 3 Automated Driving system

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(VEDECOM)

France

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Objectives of the Study

1. To study transition from Level 3 Automated Driving system to manual driving after a request to intervene.
 - (1) Measures of takeover time and driving recovery time after a request to intervene.**
 - (2) Evaluation of the efficiency of the manual driving after the takeover**
2. To test the efficiency of various HMI (not presented here) on the takeover time and manual driving.

Elsa Yousfi (2018). *Situation awareness and driving performance subsequent to manual takeover*.

PhD manuscript in preparation

Yousfi et al. (submitted). *The effect of time budget and driver assistance on manual takeover performance in a highly automated vehicle*. Human Factors and Ergonomics Society Europe Chapter Annual Meeting.

Experimental conditions

Scenarios made with the software SCANeR studio

The other task was performed with a touch pad on the dashboard (Mah Jong game)



Simulator of Vedecom

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Experimental conditions

Experiment carried out during the first semester 2017

Participants:

N = 70 including 35 women.

Inclusion criteria:

- 1) Under 45 years old
- 2) Driver's license since at least 3 years
- 3) To drive at least once a week.

Description of participants:

Mean age = 32 years

Driving experience = 13 years (Mean)

Average distance driven by year = 13914,25 km (Mean)

Experimental conditions

Highway 2 x 3 lanes

Speed = 110 km/h

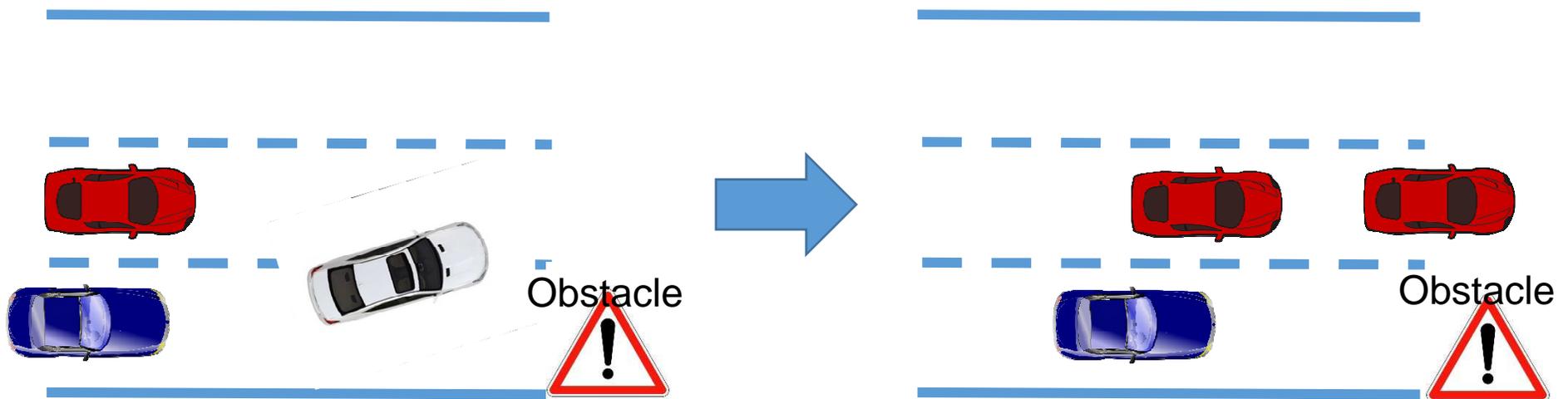
2 conditions:

Group1 « TTB4 »: TTB = 4 s ↔ 122 m from the obstacle

Group2 « TTB8 »: TTB = 8 s ↔ 244 m from the obstacle

TTB = Total Time Budget

Vehicles overtaking the participant's car :



Experimental conditions

For each participant,

Psychological tests

Training

Experiment with 3 trials:

3 counterbalanced trials with a different HMI each time

Psychological tests and interview

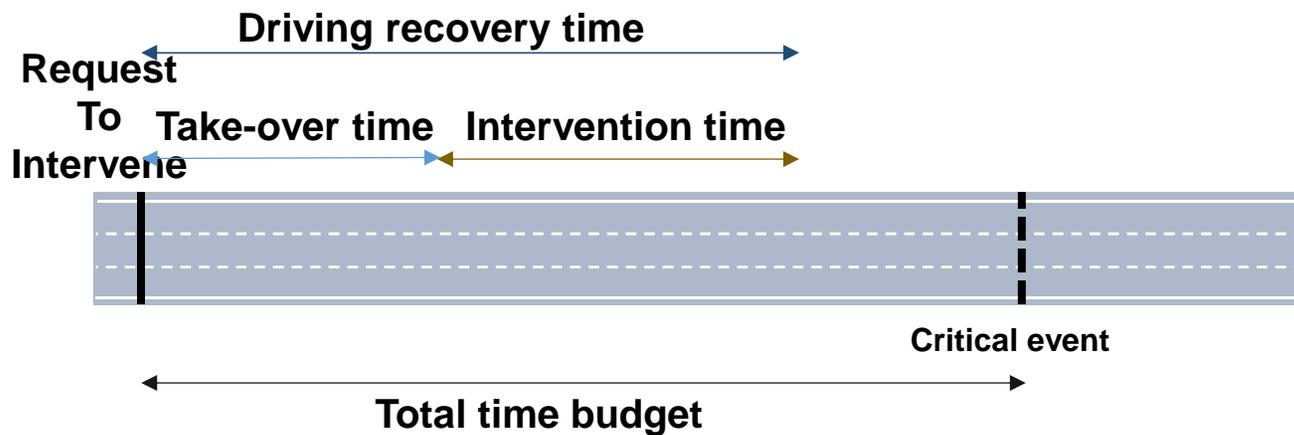
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Take-Over Time / Driving recovery Time

In case of a critical event after the driving recovery time

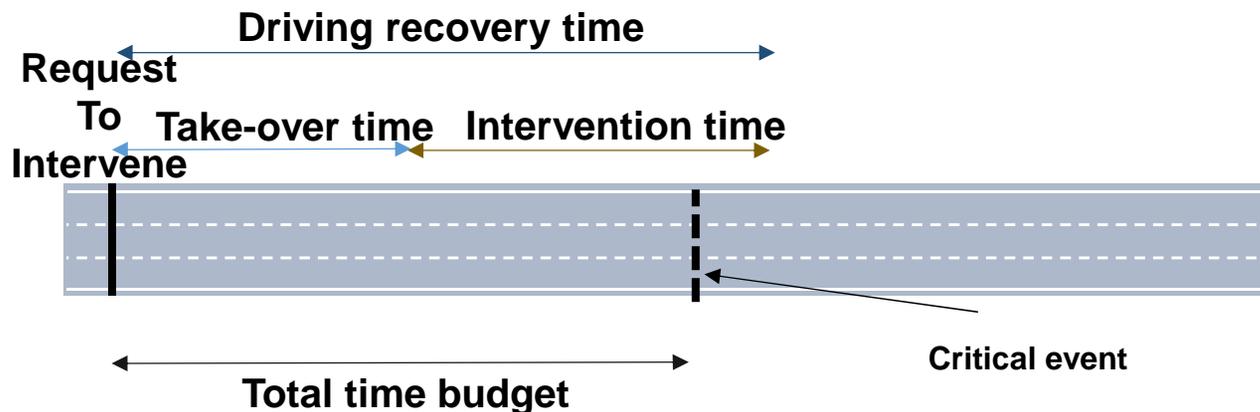


Safe situation, if Driving recovery Time < Total time budget

Driving recovery time = take-over time + intervention time (with success)

Take-Over Time / Driving recovery Time

In case of a critical event before the end of the driving recovery time



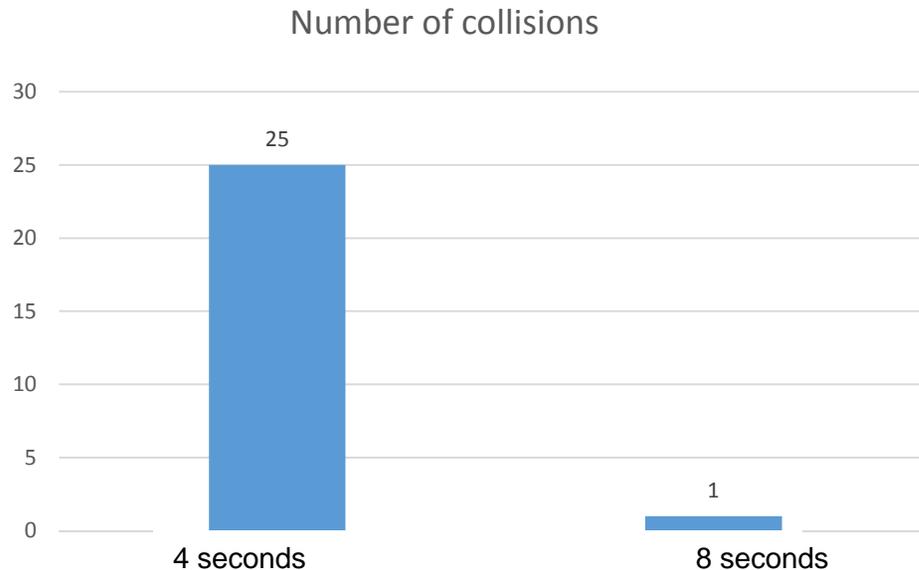
Not a safe situation

- if $\text{Take-over time} < \text{Total time budget} < \text{Driving recovery time}$
- if $\text{Total time budget} < \text{Take-over time} < \text{Driving recovery time}$

Driving recovery time = take-over time + intervention time (with success)

Results

Experiment with 2 groups to test the total time budget (4s / 8s) in critical situations.



n = 98 (33+32+33)

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Mean TOT : 2.38 ± 0.82

2.84 ± 0.90 :

Max TOT 5.05

6.6

High number of collisions

when the total time budget is 4 seconds : 26% (25/98).

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Take-Over Time / Driving recovery Time

The driving recovery time includes:

- 1) The takeover time
 - 2) Intervention time: Adapted actions if needed
- ↓ Time needed to rebuild the situation awareness

Each time depends on various factors that induce a variability.

That implies to work with a range of values and needs to take into account the drivers who will not takeover in time

Summary

- The French study (speed = 110 km/h) shows that :
 - The shorter the total time budget, the shorter the mean take-over time. However % collisions + near collisions increases
 - 26% of collisions when Total Time Budget is 4s
 - 1% of collisions when Total Time Budget is 8s
- If a critical situation occurs before the end of the driving recovery time, it cannot be well tackled by the dynamic driving intervention of the driver.
- Driving Recovery Time shall be taken into account in the regulation, instead of Take-Over Time.
- Need to take into account the drivers who will not takeover in time.