

Toward Overtrust-free Advanced Driver Assistance Systems

University of Tsukuba

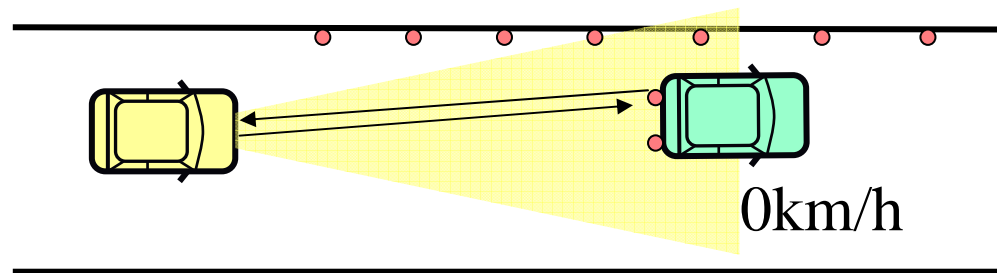
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Questions

- Can advanced driver assistance systems (ADAS) be overtrusted by drivers?
- If so, how can we avoid the overtrust in ADAS?

Can ADAS be overtrusted?

- Reliance on an ACC against a forward stopped vehicle
 - The (conventional) ACC ignores “stopped vehicle”
 - With the laser radar, it is difficult to distinguish the reflectors on a vehicle from reflectors on guardrails



- This feature might be surprising for drivers
 - Since the stopped vehicle is visible for the driver, it is very natural for him/her to assume that the stopped vehicle is detected by the host vehicle.

Experiment

Participants: 6f + 6m daily drivers
no prior experiences of using ACC
explicit info the ignoring is not given

Apparatus

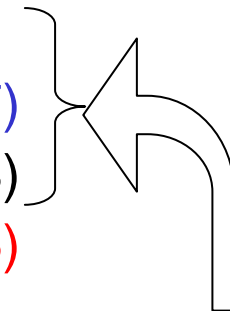
Fixed base simulator of an
expressway

Participants experience the A scenarios followed by B.

At the end of a run, the participant vehicle comes to a traffic jam.



- A. Short driving (5 min for each)
 - A1. 50km/h, no preceding vehicle (2)
 - A2. 50km/h, the preceding vehicle stops at 0.1G. (5)
 - A3. 100km/h, the preceding vehicle stops at 0.1G. (37)
 - A4. 100km/h, the preceding vehicle stops at 0.2G. (18)
 - A5. 100km/h, the preceding vehicle stops at 0.35G. (6)
- B. Long driving (20 min)
 - 100km/h, no preceding vehicle (1)



The driver can let the
ACC have the control

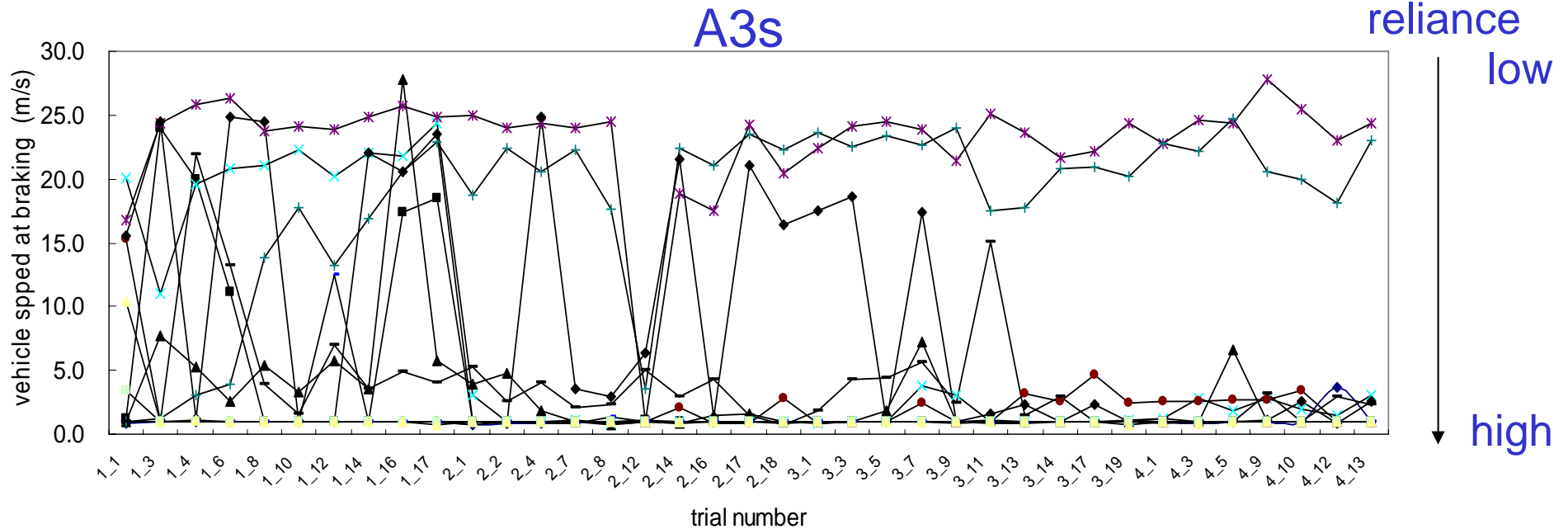
Results:

Scenario B (long drive, no preceding vehicle)

- Participant #11 crashed into the tail of the traffic jam.
 - He was neither sleepy nor distracted. He was looking at the preceding stopped vehicle.
 - According to the interview after the run, he expected that the ACC would decelerate the vehicle speed.
- The other participants did not.
 - Lack of information on the limitation of automation does not always cause the inappropriate reliance.
 - Two chances were available for the drivers to experience ACC's "ignoring fixed object" in A1

Why did participant #11 expect the ACC's deceleration?

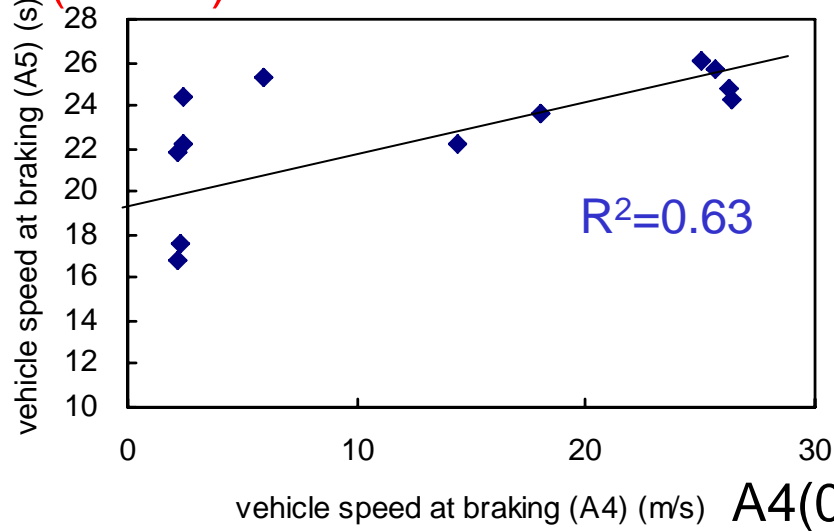
Participants became reliant on the ACC gradually



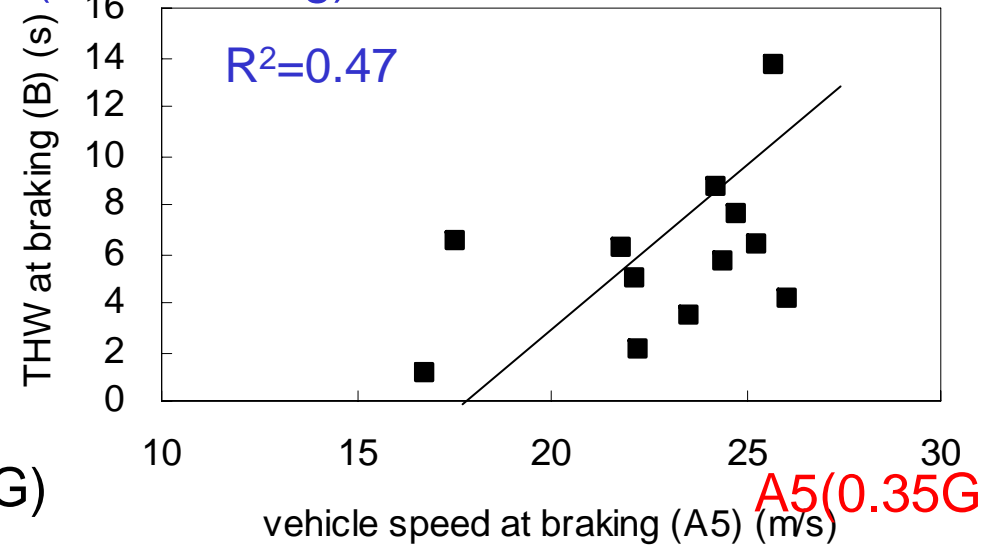
A3: 100km/h, the preceding vehicle stops at 0.1G.
In this case, the ACC decelerates the vehicle speed to approximately 5km/h or so.

Participants became reliant on the ACC gradually

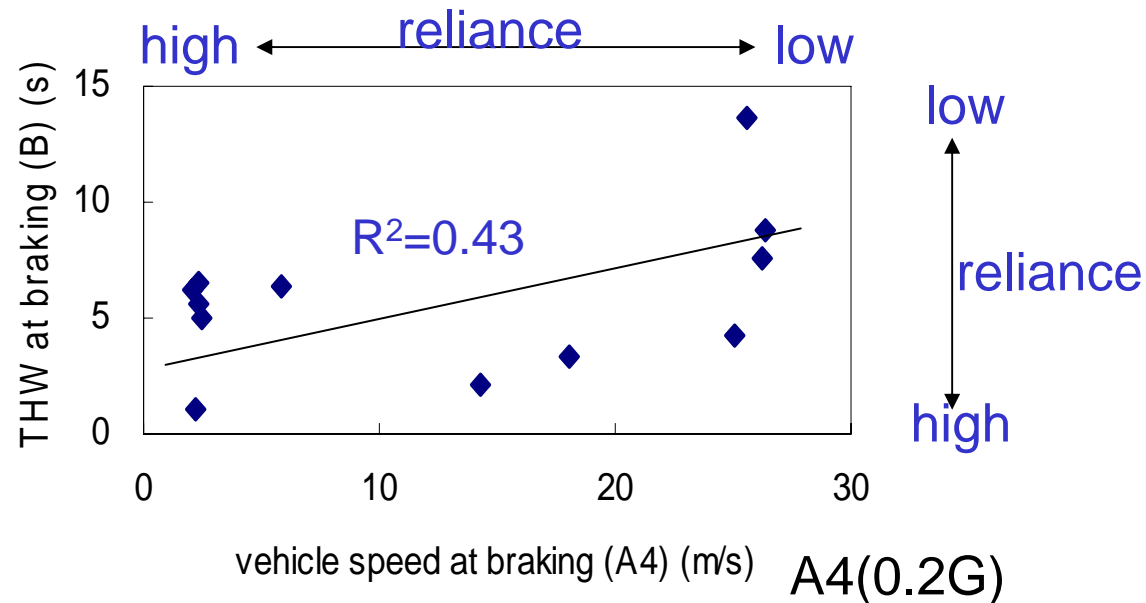
A5(0.35G)



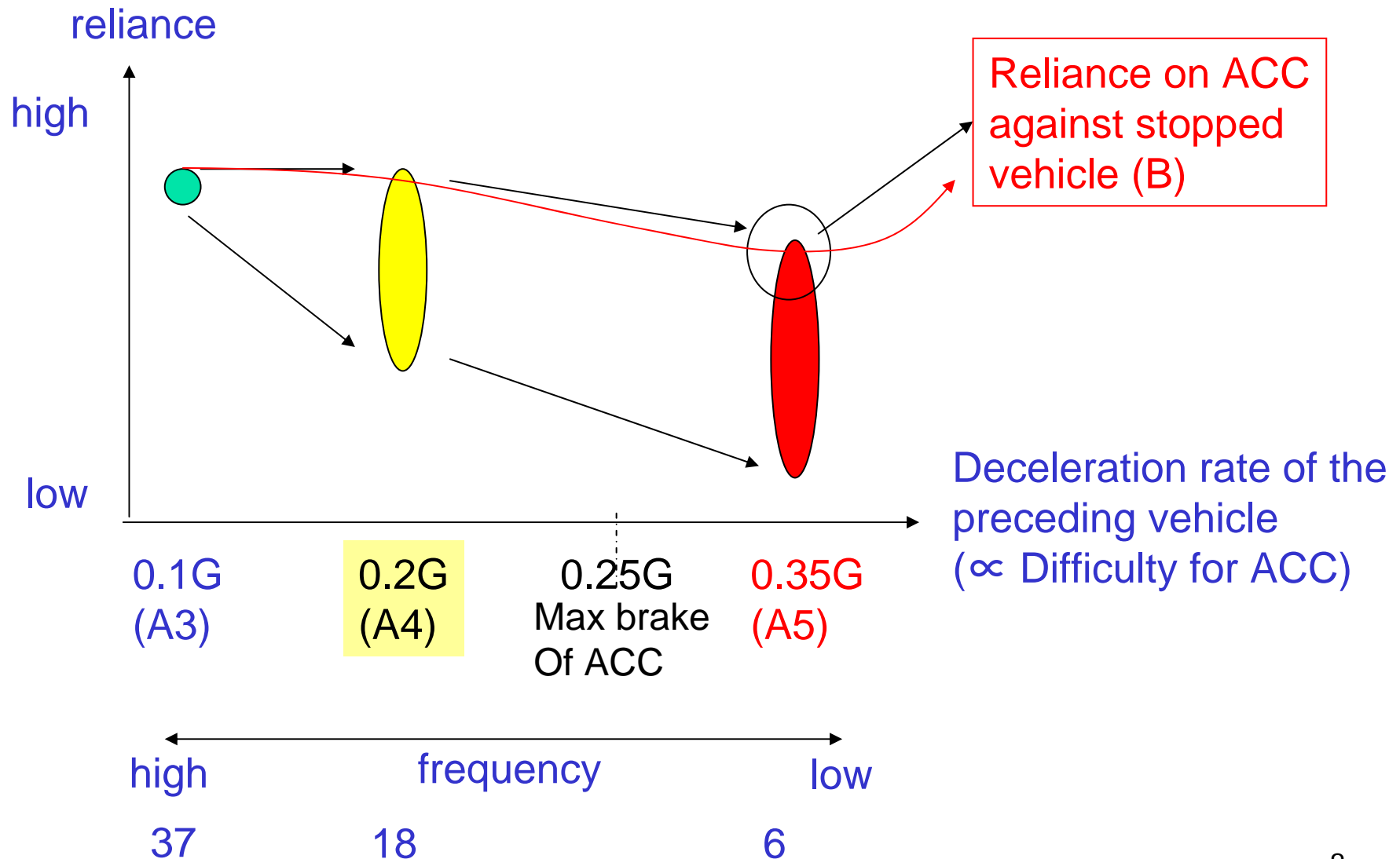
B (no following)



B (no following)



What the results suggest?



How can we avoid Overtrust?

In order to clarify what should be done to prevent overtrust-related problems from occurring, it is necessary to develop the theoretical framework.

- **Two Aspects of Human Decision Making**

1. situation diagnostic aspect: Overtrust
2. action selection aspect: Overreliance

- Three axes on overtrust

- (1-1) dimension of trust
- (1-2) target object
- (1-3) **chances of observation**

This framework was planned to present at HUMANIST conference in 2010 by Inagaki & Itoh.

- Two types of overreliance

- (2-1) commission-error like action selection decision
 - e.g., risk compensating behavior such as speed increasing
- (2-2) omission like action selection decision
 - e.g., distraction by depending on ADAS

Overtrust in and overreliance on ADAS

- Overtrust

- the human trust is inappropriately high

- “The ACC can hit the brake upon detecting a stopped vehicle.”

- Overreliance


- the human reliance is inappropriately high

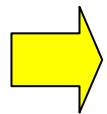
- “I will let the ACC control even though a stopped vehicle is there.”

Relationship between overtrust in and overreliance on ADAS

- Overtrust does not always cause overreliance.
 - Suppose a driver believes that an ACC hits the brake when it detects a stopped vehicle ahead. But he/she does not necessarily quit watching forward.
- Overreliance may occur even when a driver does not overtrust ADAS.
 - A driver may allocate his/her resources to something else by relying on ACC if he/she thinks that hazardous situations do not occur because of the peacefulness of the current traffic.

Chance of Observation

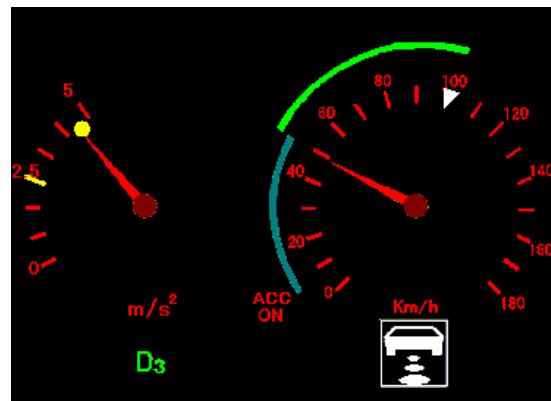
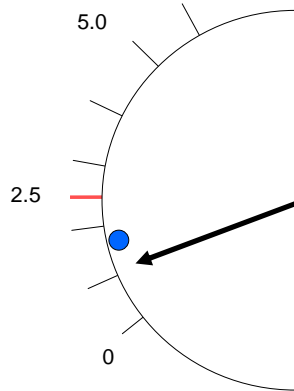
- (a) ADAS for use in normal driving
 - The driver can observe the system's 'intelligent' behaviour repeatedly.
 - Overtrust may emerge by inappropriate induction
 - “The ACC maintained the distance successfully against the stopping vehicle.”
- 
- “The ACC could maintain the distance against the stopped vehicle. “
- (b) ADAS for use in emergency
 - Since such an ADAS is activated only in cases of emergency, it would be very rare for an ordinary driver to see the ADAS works.



The process of emerging overtrust in ADAS depends on the type of observation chance

Countermeasures against overtrust

- Clear explanation on **what the ADAS does not do and why**
 - “The ACC ignores a stopped vehicle BECAUSE
- Provide info to help drivers develop an appropriate MM
 - E.g., Deceleration meter of ACC (Itoh, 2009)



- Improve the spec as drivers expect if possible

Countermeasures against overreliance not due to overtrust in ADAS

- Attention management based on driver monitoring
 - The ADAS monitors the driver's behaviours and traffic conditions to evaluate whether the driver is paying adequate attention to the driving.
 - If a deviation from normality is detected, the ADAS gives the driver some feedback, including reminders, alerts, to make him or her return to normality
- Detection of a deviation from normality
 - Drowsiness
 - Distraction
 - Visual distraction
 - Cognitive (and auditory) distraction
 - **Biomechanical distraction**



Concluding remarks

- ADAS for emergency themselves may be overtrusted if their purpose and the method are not explained to drivers appropriately. However, overreliance on the ADAS may not be so significant.
 - Drivers do something avoidance maneuver (automatically) when a collision is imminent if the drivers are attentive.
- On the other hand, ADAS for normal driving may suffer from overreliance.
- Therefore, overreliance on ADAS for normal driving results in overreliance on ADAS for emergency if those two types of ADAS are integrated.
- The attention management based on driver monitoring will be important for future ADAS.