SLR-38-17/Rev.1

A Study on the Effects of Driver Assistance Projections on the Driver's Perception of Nearby Traffic

May 2020

Japan

Background and Purpose

Various countries are studying the introduction of driver assistance projections as part of ADB functions.



In October 2019, an informal document was submitted to GRE by GTB.

Typical requirements for driver assistance projections utilizing ADB functions are that they should:
(1) Not distract the driver with the symbol's visual attraction
(2) Not confuse other road users

To validate the safety of such projections, we conducted an evaluation experiment in Japan.

Experimental Method

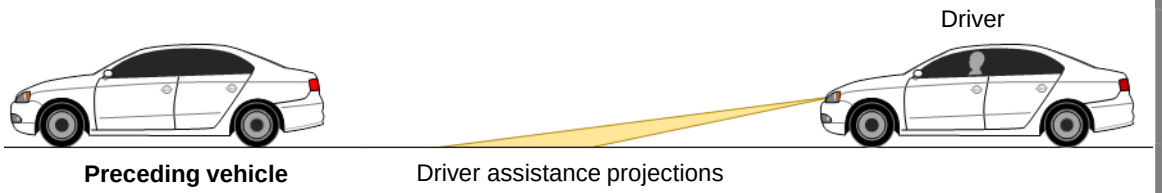
The experiment evaluated the effect of driver assistance projections on the driver's brake reaction time.

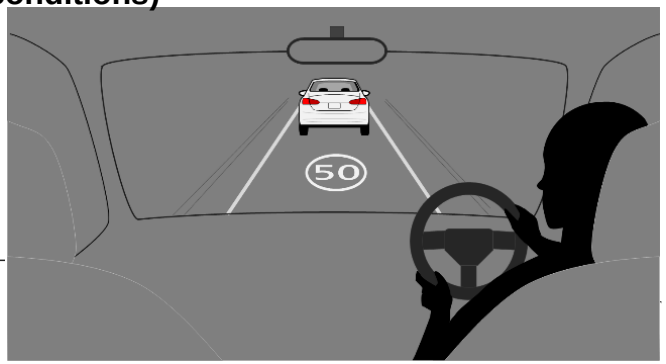
Items evaluated by the experiment:

- How the driver's brake reaction time changed in response to driver assistance projections

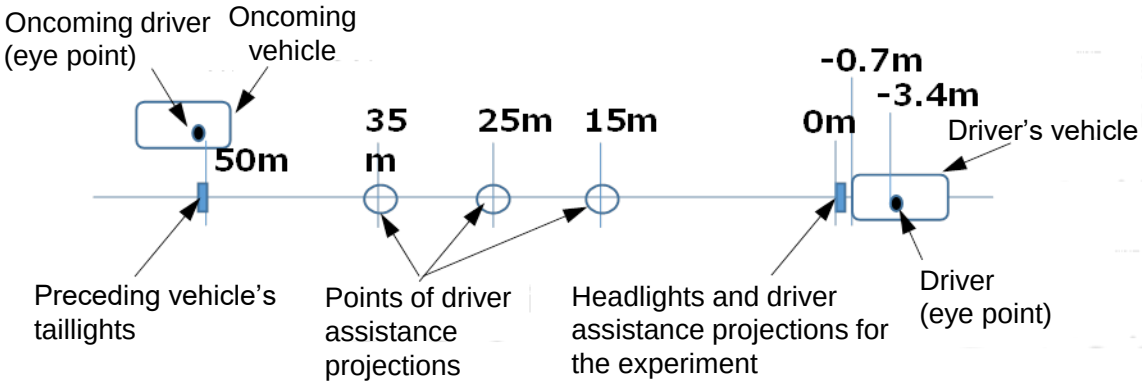
- How the readability of driver assistance projections changed
(with or without driver assistance projections and under various other conditions)

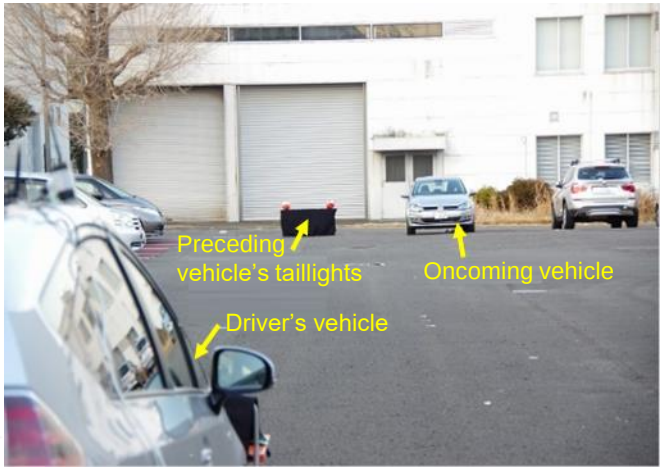
- Schematic of the Experiment





- Experiment Setup

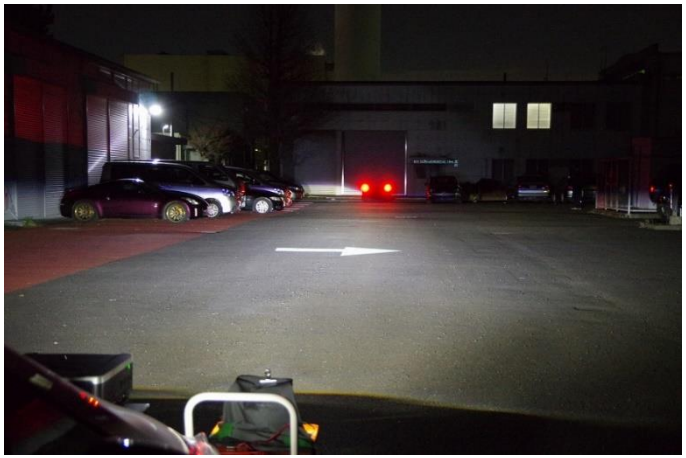




Experimental Method

Change in the brake reaction time in response to various driver assistance projections

(a) Brake lights off



(b) Brake lights on

The driver pushes a switch at hand in response to the braking lights turning on.

The time from when the braking lights turned on to when the driver pushed the switch was measured.

This is called "the brake reaction time".

Conditions of the Experiment

- **Luminous intensity of the driver assistance projections: 140,000 cd, 90,000 cd, and 50,000 cd**
- **Size of the driver assistance projection symbol (character width): 2.5 m (large or "L") and 1.2 m (small or "S")**
- **Points of driver assistance projections (distance between the symbol and the driver assistance projections): 15 m, 25 m, and 35 m**

There are five types of driver assistance projection symbols: 30, 40, 50, ←, and →.

Drivers*1 in the Experiment

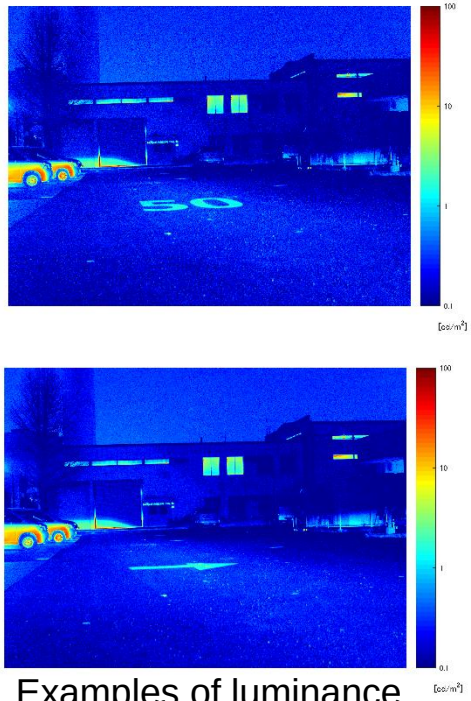
*1: Vehicles with driver assistance projections and their drivers.

No.	Gender	Age	Binocular visual acuity*2	Date	Road surface condition
1	Male	50	0.9	2020/01/09	Dry
2	Female	50	0.7		
3	Female	55	1.5		
4	Female	50	1.5		
5	Male	24	1.5	2020/01/14	Dry
6	Female	32	1.5		
7	Male	20	1.5		
8	Female	22	1.2		
9	Male	22	1.2	2020/01/15	Wet
10	Male	22	1.2		
11	Female	22	1		
12	Male	22	1.5		
13	Male	36	1.2	2020/01/16	Dry
14	Male	50	1		
15	Female	23	1.5		
16	Female	24	0.7		

***2: The reciprocal of the minimum angle of the gap of the Landolt-C that is perceivable for the driver (in minutes). (In Japan, drivers require a BVA of 0.7 or more to get a driver's license for standard motor vehicles.)**

Results of the Experiment (1)

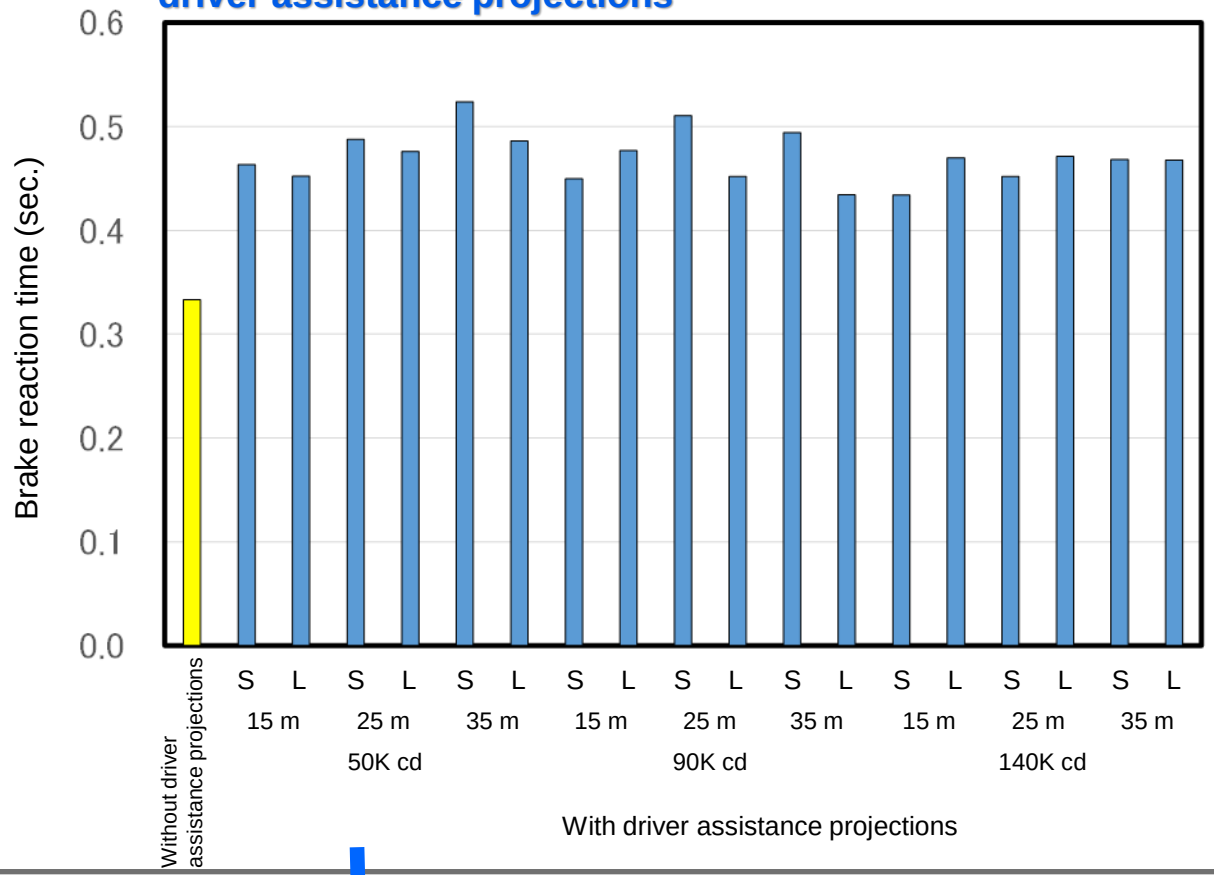
Brake reaction time in response to various driver assistance projections



Examples of luminance distribution

Projection point: 35 m ahead;
Symbol size: Large (L)
Luminous intensity: 140,000 cd;
Road surface: Wet

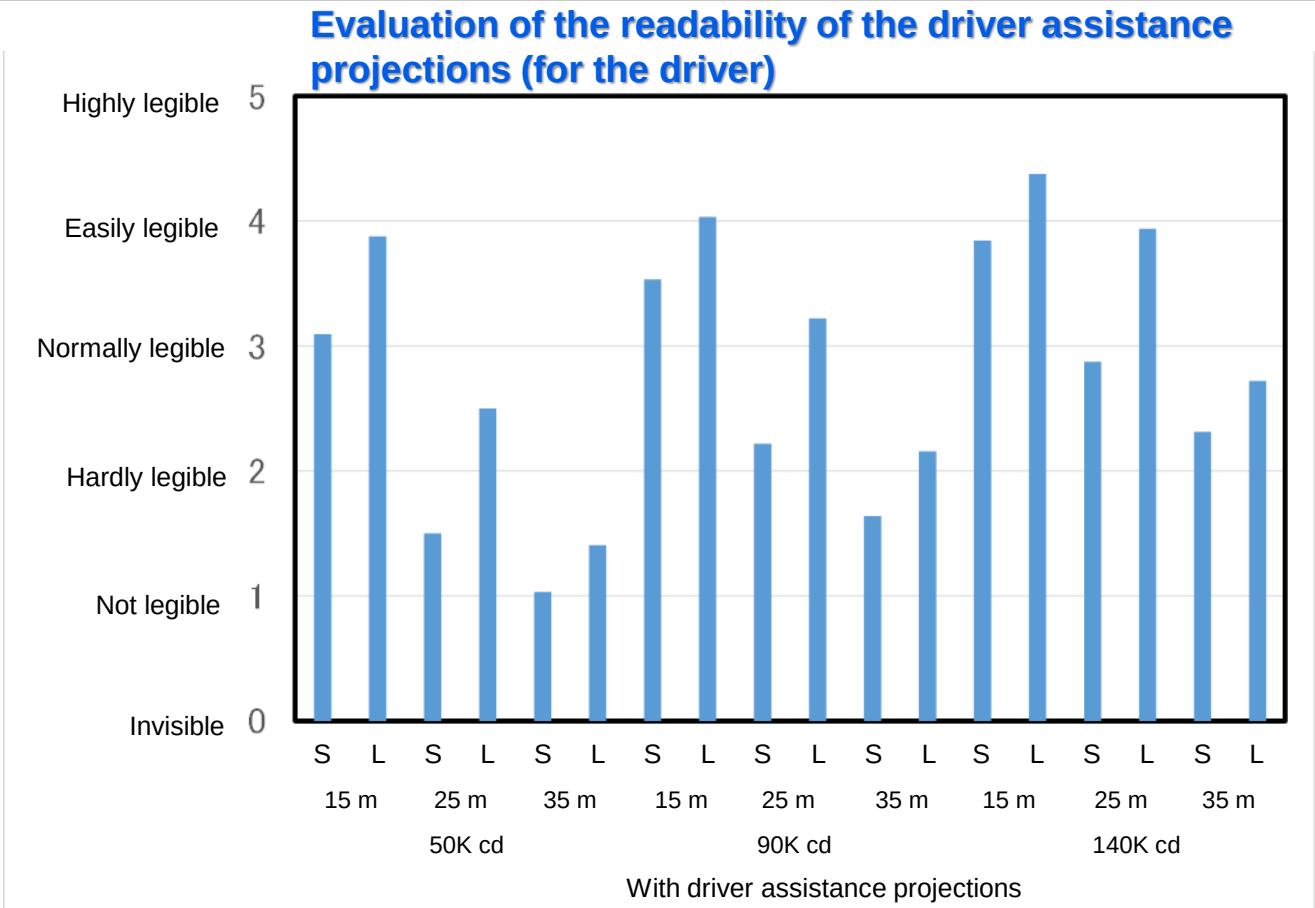
Change in the brake reaction time in response to various driver assistance projections



The driver assistance projections ahead caused a delay in the driver's brake reaction time of 0.1 to 0.2 seconds (statistically significant differences that cannot be disregarded as coincidence).

Results of the Experiment (2)

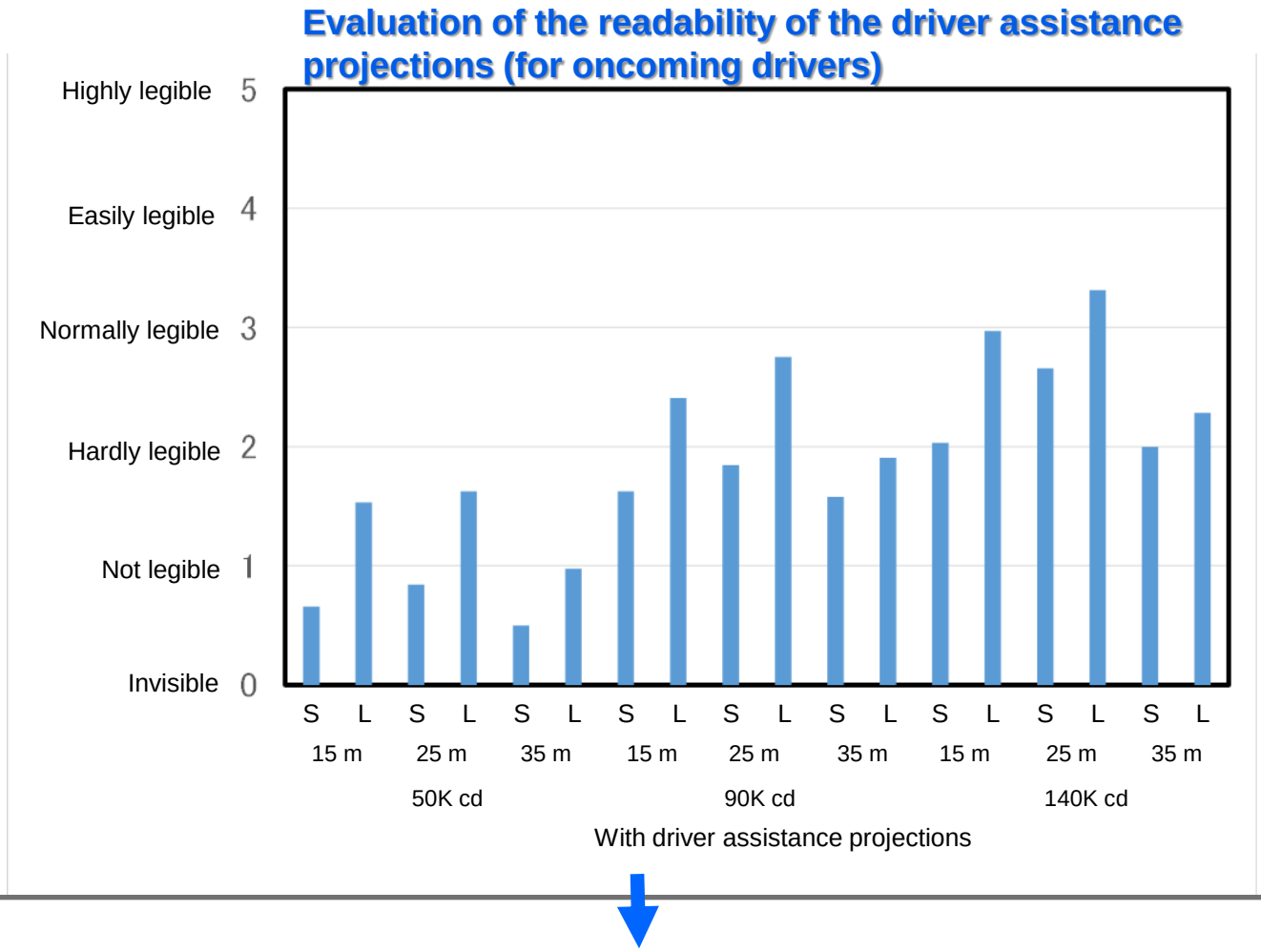
Evaluation of the readability of the driver assistance projections



The readability of projected symbols for the drivers increased with higher luminous intensity and closer symbols to them.

Results of the Experiment (3)

Evaluation of the readability of the driver assistance projections

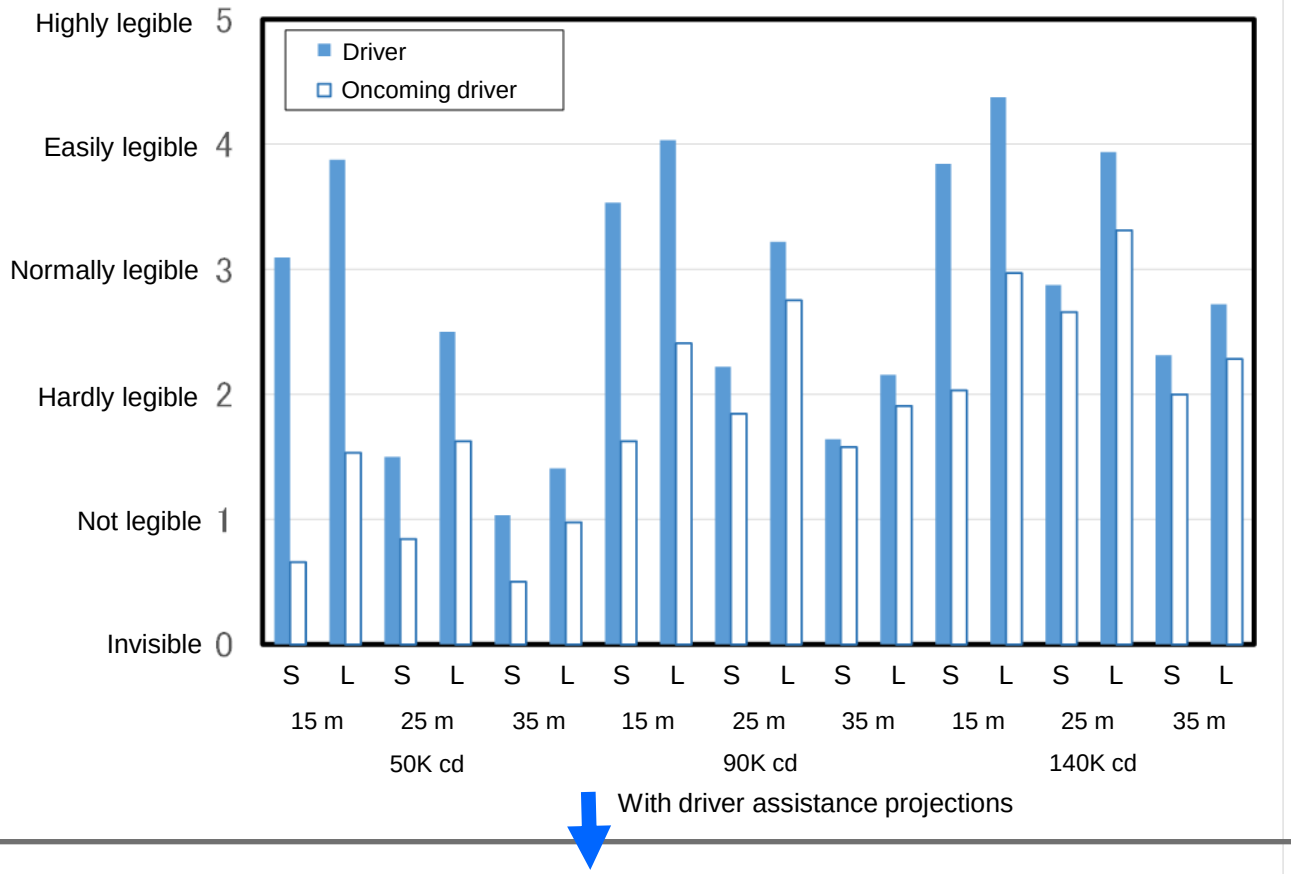


The readability of driver assistance projection symbols for oncoming drivers 50 m away from the driver tended to increase when the symbol was projected at 25 m.

Results of the Experiment (4)

Evaluation of the readability of the driver assistance projections

Evaluation of the readability of the driver assistance projections (comparison of driver and oncoming driver)

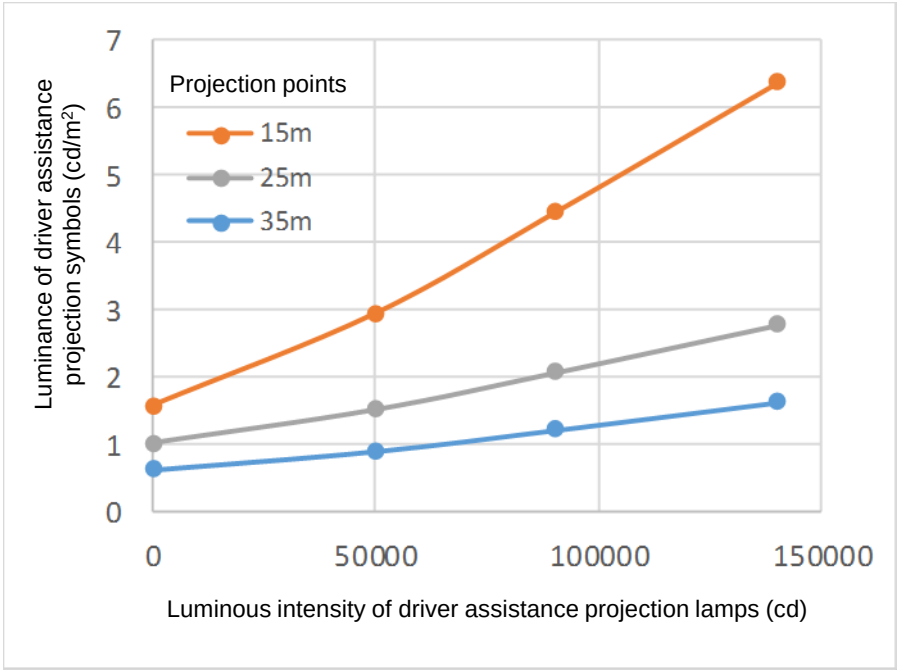


Readability of projected symbols **for oncoming drivers** was **lower than for the drivers.**

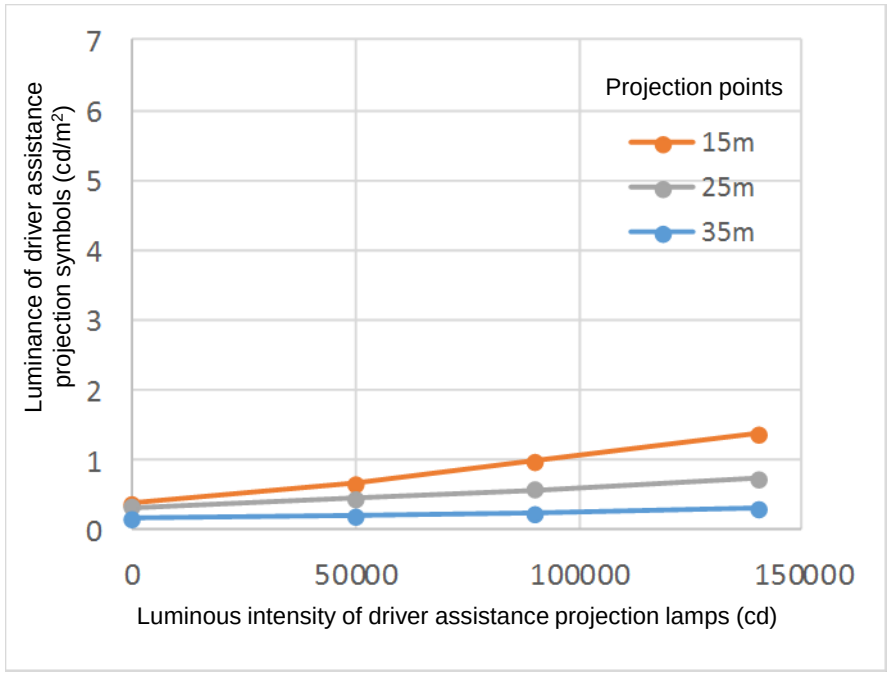
(Driver assistance projections that are visible to the drivers and less visible to oncoming drivers are possible by adjusting the projection parameters, e.g. at 15 m at a luminous intensity of 50,000 cd.)

Results of the Experiment (5)

Luminance of driver assistance projection symbols



(a) Dry road surface



(b) Wet road surface

As seen from around the driver's vehicle, the luminance of symbols projected on a wet road surface drops to approx. 20% of that on a dry surface.

Discussion

- **Under the conditions of this experiment, driver assistance projections caused a delay of 0.1 to 0.2 seconds in the brake reaction time.**

- **By appropriately setting the points of projection of driver assistance projection symbols and their luminous intensity, it is possible to generate symbols that are more visible to the driver of vehicle which set driver assistance projections but less visible to oncoming driver.**

- **As seen from vehicle which set driver assistance projections , the reflection luminance of driver assistance projection symbols on a wet road surface may drop to approx. 20% of that on a dry surface.**

Comments

- This is a report on the study we mentioned at the 82nd session of GRE in last October, stating "Japan will conduct a study on the reaction time".

- The reaction time is one of the important issues in evaluating the safety of driver assistance projections, but this is not necessarily the whole picture.

- The test having been conducted using a simple hand switch, it is well possible that the reaction is delayed if the test is conducted using a foot pedal.

- In addition, the test being a static one, it is also well possible that the reaction is delayed if it is a dynamic one.

- The study showed that it is possible to produce driver assistance projections that are visible to the drivers while being less visible to oncoming drivers by appropriately setting the points of projections, luminous intensity of the lamp, etc.

- On the other hand, the proposals currently submitted to GRE (GRE/2020/4, GRE-82-04, GRE-82-40) mostly adopt the AFS regulations on points of projection, luminous intensity, etc. as they are. We think we need to study more in detail the requirements for driver assistance projections that will not negatively affect other road users.

- There are other factors than points of projection and luminous intensity that may negatively affect other road users, such as the form and size of projected symbols, so we will need to carefully examine these issues.

- Japan plans to conduct further surveys on those issues.

- Any comments or suggestion on the kinds of surveys we might conduct in the future are welcome.