

The Effect of Pattern-Projection Headlamps on Reducing Nighttime Pedestrian Accidents

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Vehicle-to-pedestrian accidents remain a major concern at night because drivers have difficulty detecting pedestrians under low-illuminance conditions. This study evaluated a pattern-projection headlamp that projects a geometric pattern onto pedestrians. The system was designed to improve pedestrian visibility for drivers and facilitate pedestrians' awareness of approaching vehicles while reducing annoyance.

Real-vehicle experiments were conducted on a straight test track. The standard pattern-projection condition was set to a luminous intensity equivalent to that of the driving beam below the pedestrian's chest and to 50% of that intensity above the chest. In the driver-perspective experiment, pedestrian detection distances were measured for 12 participants under passing-beam, driving-beam, and pattern-projection conditions. White, gray, and black pedestrian clothing was used. In the pedestrian-perspective experiment, vehicle detection distance and the subjective ease of noticing an approaching vehicle were evaluated by 16 participants under the same three headlamp conditions. The annoyance caused by the apparent flashing of the projected pattern was evaluated separately by comparing above the chest luminous-intensity settings of 50% and 100%. The results revealed the following:

1. The pattern-projection headlamp significantly increased pedestrian detection distance compared with the passing-beam for all clothing colors (Fig. 1).
2. Pedestrians detected the approaching vehicle at a significantly greater distance with the pattern-projection headlamp than with the passing-beam (Fig. 2a).
3. The pattern-projection and driving-beam conditions received significantly higher ratings for ease of noticing the approaching vehicle than the passing-beam condition (Fig. 2b).
4. The annoyance rating was significantly lower at 50% luminous intensity than at 100%. The mean rating at 50% remained at or below the acceptable level (Fig. 2c).

These results indicate that the pattern-projection headlamp can improve mutual awareness between drivers and pedestrians. The 50% upper-body luminous-intensity setting may provide visibility benefits while maintaining an acceptable level of annoyance.

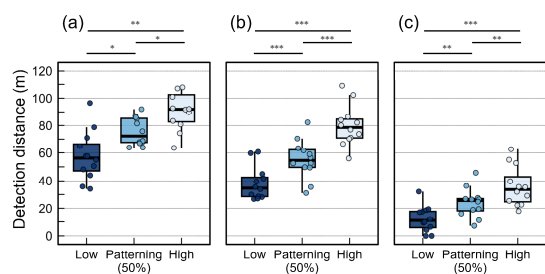


Fig.1 Pedestrian detection distance from the driver's perspective (n = 12)
(a) White clothing (b) Gray clothing (c) Black clothing

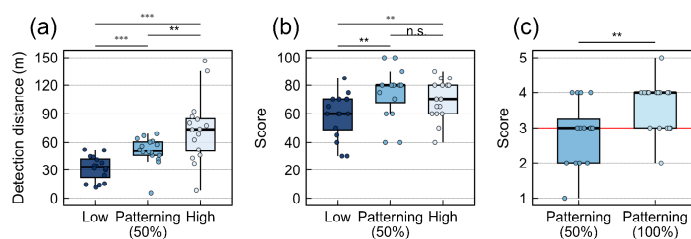


Fig.2 Vehicle detection distance and subjective ratings from the pedestrian's perspective (n = 16)
(a) Vehicle detection distance
(b) Ease of noticing the approaching vehicle
(c) Annoyance caused by the flashing of the patterning headlamp
The solid red line represents the acceptable level