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Lighting is not the only answer

Reference; **Fotios S, Price T. Road lighting and accidents: Why lighting is not the only answer. Lighting Journal 2017; 82(5); 22-26.**

Tony Price and Steve Fotios point out that while road lighting can be a significant counter measure to accidents, and that higher levels might help, the presence of road lighting does not guarantee all accidents will be avoided.

Lighting and accidents

In the UK in 2015 there were 186,189 reported road accident casualties of all severities, of which 23,874 were killed or seriously injured (KSI) [1]. One reason for installing lighting along main roads is to reduce the frequency and severity of road traffic accidents after dark. Road lighting is expected to do this because it improves a driver's ability to see potential hazards not otherwise revealed by a vehicles headlights.

There is evidence that, in general, this approach is successful. First, consider the impact of installing road lighting: the Cochrane review of road traffic studies concluded that road lighting may prevent road traffic crashes, injuries and fatalities [2]. On Dutch roads, road lighting reduces injury accidents during the hours of darkness by approximately 50% [3].

The next consideration is whether the amount of light matters. A study from New Zealand found a 19% reduction in after-dark crashes (across all types of reported accident) for each 0.5 cd/m² increase in average luminance [4]. The reduction varied with context, ranging from 15% for crashes on wet roads to 56% for midblock collisions with pedestrians. Note that these figures are for an increase in luminance and therefore are likely to underestimate the benefit of lighting a previously unlit road. Note also that these data were collected on roads with average luminances of approximately 0.5 to 1.75 cd/m² and that further increase of luminance above this will at some point bring negligible return.

Neither the presence of road lighting, nor an increase of luminance, is a universal solution for all accidents. If enough light were all that mattered there would be no accidents in daylight, and that is not the case. Some accidents may arise because the driver (or pedestrian or cyclist) was distracted. We know that drivers are less responsive to hazards when distracted by actions such as operating the audio system or using a mobile phone [5].

Mobile phone use can cause a greater distraction, and significantly slower reaction times, than that associated with the legal limit for blood alcohol level [6].

One type of accident known to benefit from road lighting is collisions involving pedestrians. A novel approach to isolating the effect of light on accidents is to compare accident rates for the same hour in periods that are either in daylight or after dark according to the annual variation in daylight hours: using this method it was found that for pedestrians there is a 100% increase in the risk of being involved in a road accident after dark, but there was no change in risk for car occupants [7]. A study using Dutch accident data found that after dark the risk of pedestrian collision on unlit roads increases by 360% compared with daytime, but that this reduces to 140% on lit roads [3].

Drivers are not solely responsible for collisions involving pedestrians. A study of 6,434 pedestrian crashes in Florida, in the three-year period 2008-2010, concluded that pedestrians were at fault in 53% of the cases and drivers for 28.2 % [8]. Using lighting to improve the vision of drivers is less likely to reduce those accidents where pedestrians are at fault.

Lighting and specific accidents

This type of information is useful knowledge for road lighting professionals who are under pressure to install road lighting, or improve road lighting, in response to an accident. There are many such reports in the media but here we focus on one, an online article from a tabloid newspaper [9].

The accident involved a young driver who was struck by a lorry whilst walking on a motorway. The accident happened at 03:30am, the driver having just finished a late shift (18:00 to 03:00) at work. Initially, the driver's vehicle had struck the central reservation of the motorway: the driver was struck whilst subsequently walking outside the vehicle. According to the newspaper report "Witnesses reported seeing [the] car swerve from the inside lane across three lanes of traffic before crashing into the central reservation before coming to a stop in the inside lane. [The driver] got out of the vehicle and fled to the hard shoulder and told a witness that [he/she] had 'nodded off' at the wheel. But [he/she] returned to the car to inspect the damage and to put on the car's hazard warning lights and was struck by a passing HGV." (Note – text changed to hide the driver's identity)

The section of road was apparently unlit. According to an attending police officer "the fact that street lights were not on in that stretch of road had played a major part in the incident".

The coroner is reported to have concluded “I accept what [the police officer] said that if there had been lights in this area that the collision would not have occurred”

There is no basis for the coroners statement that the accident would not have happened had there been road lighting. As shown in the accident studies reported above, road lighting reduces the frequency of accidents after dark but does not prevent all accidents.

The first element of this incident was that the driver hit the central reservation: an analysis of accidents using the daylight savings transition (i.e. comparing accidents for a specific time of day which is dark or daylit at different times of year) suggests there is little effect of ambient light for crashes involving a single vehicle running off the road [10]. In particular, road lighting may have more effect at junctions than locations between junctions. The New Zealand study found that a luminance increase did not have significant influence on midblock collisions involving overtaking, head-on collisions or where there was a loss of control on straight sections.

In this case the coroner refers to other contributory factors. For example “From the evidence, it is likely that [the driver] was drowsy or had a short period where [he/she] may have gone to sleep”. Crash risk is far greater amongst drivers who are drowsy (a 14-fold increase in risk according to one study [11]) and drowsiness is specifically noted to affect people driving home after a night shift [12]. The driver was young (aged 23) and it is known that greater experience improves the ability to acquire and assess information in inherently risky situations [13]. It was also apparent that the driver perceived the absence of road lighting be dangerous, and should therefore have been able to consider in advance the need for caution. Despite these contributory factors the coroner still claims that the accident would have been avoided had the road been lit.

This accident may be considered as two separate events. First, the driver hit the central reservation, and second, the driver was hit by a lorry when walking outside of the vehicle. Motorway drivers do not expect to see pedestrians and they are therefore less likely to attract attention and be easily recognised as pedestrians in time to take appropriate action.

There is a tendency for pedestrians and cyclists to overestimate their own visibility to motorists [14] or similarly to overestimate drivers visual capabilities [15]. Retroreflective material on the arms, wrists and ankles is known to increase conspicuity; with retroreflective trim on their clothing a pedestrian can be detected at a distance of over 300 m, but at distances of less than 100 m if wearing only dark clothing [16]. However, retroreflectance is

of little benefit if it is not illuminated by the drivers headlights; what may be better is an active approach to raising the conspicuity of roadside pedestrians, such as an LED band or electroluminescent material [17]. If it were required that vehicles carry such active devices for pedestrian conspicuity alongside a warning triangle and high-visibility vest, then this might have increased the chance of the driver being seen by the lorry driver much more so than if the road were lit.

Conclusion

A key priority of the 2015 British Road Safety Statement [18] is the protection of vulnerable road users such as pedestrians. While accident statistics suggest that road lighting reduces accident frequency, this refers to a large number of cases and not to a specific event. For any specific accident, there are likely to be multiple contributory factors. Lighting professionals should resist pressure to install lighting in response to an accident unless it is clear that the underlying cause was lack of lighting. This will prevent attention and resources being diverted from where they will be most effective.

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