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Title
Visual impairment and drivers' ability to recognise pedestrians at night

Introduction

Driving at night is dangerous:

- The fatality rate at night is 3x higher than that for daytime and the night-time elevation in road safety risk is even greater for pedestrians who are 7x more vulnerable to a fatal collision at night than in the day.
- While multiple factors contribute to this increased crash risk, reduced visibility and conspicuity of pedestrians at night has been shown to be the most important.

The most common clothing intervention adopted to improve pedestrian conspicuity at night-time is a reflective vest.

- BUT studies have suggested that night-time pedestrian visibility can be better enhanced using strategic placement of reflective markers.
- Recent interest in applying perceptual phenomenon of biological motion to improving pedestrian visibility at night, where reflective strips are attached to the moveable joints illuminated in the headlight beam, known as 'biomotion'.
- Effects useful for both young and older drivers but the way in which visual impairment and glare impact on the ability of 'biomotion' clothing to improve pedestrian conspicuity is unknown.

The aim of this study was to investigate how visual impairments and headlamp glare affected pedestrian conspicuity and determined whether clothing configurations that have been shown to improve pedestrian conspicuity are robust to the effects of visual impairment.

Methods

28 young visually normal licensed drivers were tested under three visual conditions: normal vision, refractive blur and simulated cataracts:

- Cataracts: frosted lenses.
- Blur: acuity matched to cataract condition.
- Normal: full distance refraction.

Pedestrians walked in place at the roadside and wore one of three clothing conditions:

- Black: black tracksuit.
- Vest: black tracksuit and a reflective vest.
- Biomotion: black tracksuit with the reflective strips positioned on the moveable joints.

Pedestrian recognition distances were recorded while participants drove an instrumented vehicle: along a closed-road course at night.

- A dual-camera parallax-based video measurement system was utilized to determine the distance at which the participant (as a driver) first recognised the presence of a pedestrian.

Oncoming headlamps were present for 16 participants and absent for 12 participants.

The frequency at which drivers recognised the presence of pedestrians was determined as well as the distance at which drivers first recognised the presence of pedestrians.

Results

- Visual impairment, pedestrian clothing and headlamp glare all significantly affected drivers' ability to respond to pedestrians.
- Although simulated cataracts and blur significantly degraded recognition performance, the simulated cataracts were more disruptive than the blur, even though visual acuity was matched across conditions.
- Pedestrians were recognised more often and at longer distances when they wore 'biomotion' clothing than either the reflective vest or black clothing, even in the presence of visual impairment and glare.

Discussion

Common visual impairments had a significant effect on pedestrian visibility:

- Cataracts had the greatest detrimental effect on pedestrian conspicuity even though acuity was equal for the blur and cataract conditions.

Pedestrian visibility is reduced in the presence of oncoming glare:

- In the presence of glare pedestrians wearing black were rarely seen.

'Biomotion' clothing configuration is relatively robust to the effects of visual impairment and maximises pedestrian conspicuity across all conditions:

- Pedestrians wearing 'biomotion' were recognised more often and at greater distances than pedestrians wearing either the reflective vest or black clothing.
- The conspicuity benefits of 'biomotion' clothing were evident even in the presence of visual impairment and glare.

Conclusions

- Drivers' ability to recognise pedestrians at night is degraded by common visual impairments.
- 'Biomotion' reflective clothing maximises pedestrian conspicuity, even in the presence of visual impairment and glare.