Bicycle Safety Lights and Driving Behaviour: A Real-World Pilot Study

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Background

The latest UK National Travel Survey (2019) revealed that 60% of respondents felt it was "too dangerous…to cycle on the roads", which is unsurprising, given the high proportion of road crashes in which cyclists are involved (Useche, Alonso, Montoro, & Esteban, 2019). Cyclists are also 29 times more likely to sustain an injury than car drivers, and 10 times more likely to be fatally injured (Nilsson, Stigson, Ohlin, & Strandroth, 2017).

Evidence suggests that crashes between cyclists and other road users are more likely to occur in low light conditions (Asgarzadeh et al., 2018), but are less likely to occur when cyclists use safety lights (Høye, Johansson, & Hesjevoll, 2020; Madsen et al., 2013). However, to our knowledge, no research to date has investigated whether road user behaviour may vary according to the type of light used. Consequently, the aim of the present study was to explore the influence of various commercially available bicycle-mounted safety lights on driver behaviour in relation to a cyclist.

Methods

Design and Participants

An unbalanced between-groups design comprising 222 driver participants was employed.

Equipment and Materials

Front- and rear-facing video footage was acquired using two GoPro HERO7 cameras mounted on a head-worn Lazer O2 cycle helmet. A road bicycle (Specialized Allez Elite) was fitted with three different sets of safety lights (manufacturer and model): a helmet light (CatEye Rapid Mini), a seat post light (Light And Motion Vis 180 Pro), and handlebar lights (CYCL WingLights 360 Fixed).

Procedure

Data Acquisition

The first author cycled in low light conditions at a speed of 29.8-34.9 kph (M = 31.8 kph, SD = 1.3 kph), northbound and southbound, along a 1.91 km stretch of an English rural single carriageway road (end point coordinates: 51.724839, -0.597857; 51.740367, -0.586001). The road was dry and free of obstructions; it also comprised three speed zones (48, 64 and 96 kph) and one staggered junction.

Data were acquired for four conditions (*helmet light*, *seat post light*, *handlebar lights*, *no lights*), each of which was represented twice in both travel directions, in each of the first and second halves of the total data collection period.

Data Analysis

Captured footage was imported into video editing software. A bespoke grid was superimposed over the timeline footage, to enable frame-by-frame coding of the positions of vehicles relative to the cyclist, under all conditions. The frame-by-frame data were used to generate five dependent variables (DVs), which collectively embodied driver behaviour: *Approach Rate*, *Indicator Use* (yes/no), M*oving-out Rate*, S*peed of Return to Lane*, and A*cceleration Rate* (away from the cyclist).

Once all footage had been coded, data were screened for outliers; all univariate outliers were deleted, and two multivariate outliers were removed. The data were significantly non-normal for all DVs, so Independent Samples Kruskal-Wallis tests were employed.

Results

There was a significant difference across the four conditions for *Approach Rate*, $\chi^2(3) = 20.49$, $p = 0.0001$ and *Acceleration Rate*, $\chi^2(3) = 14.72$, $p = 0.002$. Post hoc tests adjusted for multiple comparisons revealed that drivers were slower to approach the cyclist when handlebar end lights were being used, relative to the seat post light ($U = 40.03$, $p = 0.00006$); the difference between the handlebar end lights and the helmet light approached significance on this measure ($U = 29.93$, $p = 0.099$). Drivers were slower to accelerate away in the seat post light condition, relative to both the helmet light, ($U = 9.49$, $p = 0.012$), and handlebar end lights ($U = 7.81$, $p = 0.031$). There were no significant differences between the no lights condition and the three light conditions.

Conclusions

Our analyses yielded differences in two behavioural measures – namely, the rates at which drivers approached and accelerated away from a cyclist – as a function of different safety light configurations. Based on our data, it is possible that lights mounted on handlebar ends may elicit more cautious approach behaviour in drivers, which has the potential to improve driver-cyclist interactions, and therefore cyclist safety. A systematic approach, using a combination of experimental and real-world approaches, is required to elucidate these findings.

References

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Data Statement

All raw data can be obtained from the first author, on request via daniel.bishop@brunel.ac.uk.