Increasing awareness of distracted pedestrians at railway level crossings with illuminated in-ground lights

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Abstract

Pedestrian distraction is a growing problem. Current signage at railway level crossings may not be effective for pedestrians distracted by mobile devices, as it is designed for users looking ahead when walking rather than looking downwards as when using a mobile. Illuminated in-ground lights are an innovative solution to address this issue but have not been evaluated for use with distracted pedestrians. We conducted a 2 (in-ground lights yes/no) x 3 (distraction task none/auditory/visual) repeated measures field study (N=34) at a railway level crossing to assess whether distracted pedestrians could detect illuminated in-ground lights and how this impacted on visual scanning behaviour. Pedestrians detected the lights as accurately when distracted (visually or auditorily) compared to when not distracted, and eye scanning behaviour of the rail tracks with the in-ground lights was the same as for non-distracted levels. This is the first study to suggest that illuminated in-ground lights could be effective in attracting the attention of distracted pedestrians at railway level crossings.

Background

One major contributor to pedestrian risk of injury and death at railway level crossings is when pedestrians are complacent, distracted or inattentive (Edquist, Stephan, & Wigglesworth, 2009; Larue, Naweed, & Rodwell, 2018). Distraction and inattention tend to become more prevalent with increased usage of mobile phones and headsets. The current form of pedestrian protection at railway level crossings is a sign, sometimes associated with pedestrian barriers and a warning bell when the crossing is actively protected. The effectiveness of such warning devices is likely to be reduced by the increased usage of mobile devices and headphones.

An innovative solution to combat the issue of distracted pedestrians is the use of visual warning lights installed in the ground. Such devices are installed at road intersections and have been trialled in some locations around the world (Potts, 2016; Sulleyman, 2017; Timson, 2016) . While affective at attracting the attention of distracted participants in laboratory conditions (Larue, Watling, Black, Wood, & Khakzar, 2020), there has currently been no publicly-available field-based evaluations of the safety improvements obtained from such interventions for level crossings or other intersections. This research aimed to evaluate pedestrians' accuracy in detecting illuminated in-ground LEDs and their scanning behaviour toward railway crossings while conducting a distracter task with a mobile device or headphones.

Method

A field study was conducted at a railway level crossing in New Plymouth, New Zealand, where in-ground lights had been installed. Participants included 34 individuals (mean age: 33.6; SD=8.6) who were regular users of mobile devices while walking. The research design consisted of six different conditions, which were randomly ordered across participants, which investigated pedestrian behaviours without (control) and with in-ground lights at the crossing (Figure 1) for different types of distraction induced by a mobile device (none, visual, and audio). The in-ground lights comprised yellow flashing lights, which were activated by the movement of pedestrians as they entered into the

maze of the level crossing. Once activated, the lights flashed for 10 seconds, alternating every second. The distractor tasks were simple reaction time tasks requiring the participant to tap on the smartphone; these tasks were similar to those used by Larue et al. (2020). Participants walked through the crossing six times for each condition. Participants wore eye tracking glasses and their accuracy in detecting the in-ground lights, as well as their gaze behaviour towards the crossing was recorded. Appropriate scanning behaviour consisted of looking for trains on both sides before entering the crossing. Statistical analyses were conducted with Generalised Linear Mixed Models.

Figure 1. View of the level crossing (Left: Trial configuration (with in-ground lights); Right: Standard (control) configuration)

Results

Participants were shown to be engaged in the distractor task, and their behaviour observed at the crossing reflected that of distracted pedestrians: they responded with high accuracy (above 90%) and rapidly (in less than a second) to the distractor task. With the visual distractor task at the control crossing, the duration of down gazes tripled while approaching the crossing, from 3 to 9 seconds ($t=28.38$, $d.f.=945$, $p<.001$) compared to when not distracted, and significantly reduced scanning behaviours toward the rail tracks, with participants being significantly more likely to fail to check for trains ($t=-4.96$, $d.f.=1,188$, $p<.001$) (Figure 2). These effects were not observed with the audio distractor. The addition of in-ground lights attracted the attention of pedestrians, even when they were distracted, with detections between 94% and 96% in all distracted conditions. Adding the lights did not affect scanning behaviour with the audio distractor task, but slightly decreased scanning behaviour with the visual task ($t=2.07$, $d.f.=1,188$, $p=.038$). The behaviour was however very close to the control condition, and much better than when visually distracted without the in-ground lights.

Conclusions

This study highlighted positive effects of illuminated in-ground lights at railway crossings in terms of attracting the attention of pedestrians who were visually or auditorily distracted by a mobile phone. It also improved train scanning behaviour when visually distracted: with the flashing lights, the scanning performance while distracted was similar to that when not distracted. Our study is the first to demonstrate that an in-ground light intervention at a railway crossing could be effective in attracting the attention of distracted pedestrians. This study used a repeated measure design and learning effects may have an impact on the findings. Further studies should be conducted to confirm these positive effects in a more naturalistic setting. Given the rapid increase in pedestrian distraction with mobile devices, this approach shows promise for reducing the risk of fatalities and major injuries.

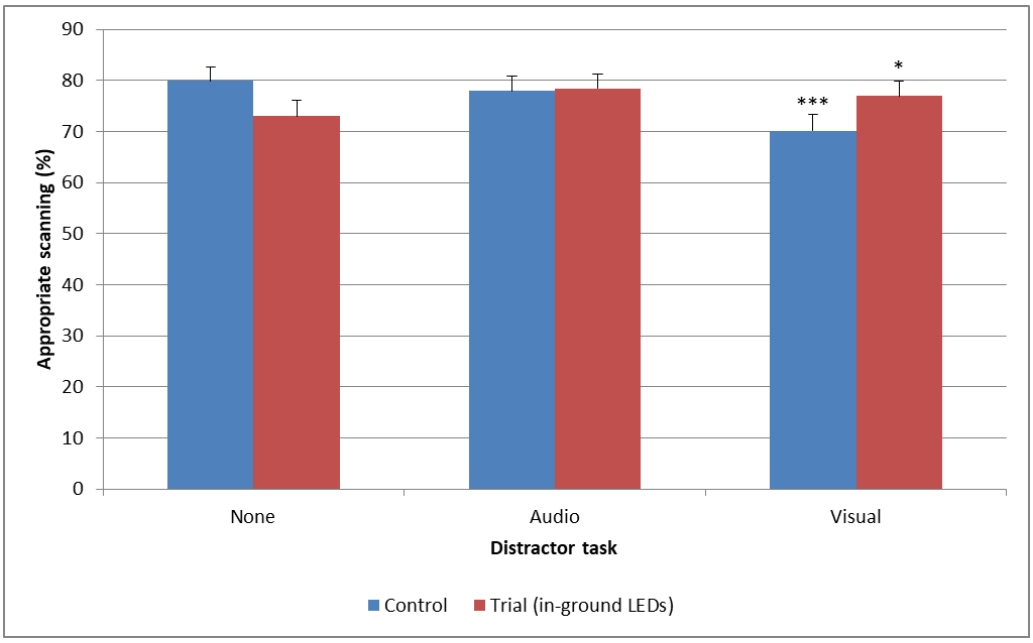

Figure 2. Percentage of appropriate scanning behaviour towards rail tracks with Standard Error of the Mean (statistically significant differences are highlighted: *** p < .001, * p < .05).

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