International Co-operation on Theories and Concepts in Traffic Safety

Examining the effects of separation, surfacing and lighting conditions on bicyclist and pedestrian behaviour through video analysis

[1]*Yastremska-Kravchenko, O., [1]Johnsson, C., [1]Laureshyn, A., [1]Rahm, J., [1]Johansson, M., [2]Niska, A., [1]D'agostino, C., [1]Gildea, K.

*lead presenter, oksana.yastremska-kravchenko@tft.lth.se
[1]Lund University, Sweden
[2] Swedish National Road and Transport Research Institute (VTI), Sweden

The implementation of separated facilities for vulnerable road users, such as shared-use paths, plays a critical role in fostering sustainable mobility. Shared-use paths are used by non-motorized road users and can either be designed for them to mix freely within the space (unsegregated) or feature surface markings and signage to allocate specific areas to each group (segregated) (Delaney et al., 2017). These paths are designed to reduce conflicts with motor traffic, thereby enhancing safety for pedestrians, bicyclists and other path users (Kutela et al., 2023; Delaney et al., 2017).

Beyond separation from motor traffic, numerous factors including the physical design of the facility and the environment—such as path width, clearance, signage, and illumination—affect the safety and functionality of these paths (Kutela et al., 2023). Ensuring high visibility during all hours is crucial, as studies have indicated increased bicycle crashes during darker hours (Boufous et al., 2013; Schepers & den Brinker, 2011). This study addresses the need to explore the intricate relationship between physical environment changes and path user behaviour, which has significant implications for urban safety and sustainability.

The primary aim of this study is to evaluate the impact of physical interventions on shared-use paths on traffic safety for pedestrians and bicyclists, with a focus on behaviour metrics such as speed and directional stability (slalom). The specific objectives are:

- To assess how alterations in design, surface quality and lighting conditions influence the behaviour of path users in terms of speed and slalom.
- To analyse how these behavioural impacts vary across different interventions on path conditions, defined by unique combinations of physical and lighting changes.

Data were collected using drone technology on shared-use paths in two cities in Sweden (Linköping and Lund). The study took place over five data collection periods, all conducted during late autumn and winter (October to early March), in order to allow for the capture of behaviour under different lighting conditions—daylight and electric lighting. The paths underwent several modifications between data collection periods, including new surfacing, design and lighting, to study the effects of these physical environmental alterations. A two-way ANOVA was used to analyse the influence of these changes on user speed and slalom, supplemented by post-hoc testing to detail specific condition effects.

The findings demonstrated that physical changes significantly affect the path users' behaviour in terms of speed and slalom performance. In Linköping, the new surfacing and the add segregation of pedestrians and cyclists with a white line and symbols resulted in safer, more predictable user movements during daylight, decreasing deviations. However, the impact of the segregation line was less effective under poor lighting conditions, underscoring the essential role of adequate lighting in ensuring pathway safety.

In Lund, the results suggest that better pavement conditions significantly impact path users' behaviour, particularly cyclists. Under electric lighting conditions, however, sufficient lighting is essential to improve path user movements by reducing deviations and enhancing visibility for more predictable movement. These findings align with those from the Linköping site.

The study highlights the importance of implementing high-quality surface materials and well-designed lighting to enhance traffic safety on shared-use paths. The benefits of such interventions vary with local physical environment conditions and lighting, suggesting the need for tailored approaches in pathway design to optimize safety outcomes. The study also emphasizes the complex interplay between physical environment and user behaviour, pointing to the necessity of designing with a nuanced understanding of both the concrete, physical aspects of the environment and perceptual needs of the users.

It is worth noting the video-based method used in the study, which proved effective in detecting differences in bicyclist and pedestrian behaviour under various path and lighting conditions.

This research shows that strategic physical interventions on shared-use paths have an impact on pedestrian and cyclist speed and directional stability, which may improve traffic safety through increased predictability and safer behaviour patterns. Urban planners and policymakers are encouraged to consider these findings in future urban infrastructure projects to enhance the safety and sustainability of transportation networks. Further studies are recommended to refine these interventions and evaluate their effectiveness across diverse urban landscapes, ensuring that shared-use paths meet the highest standards of safety and usability under all conditions.

References

Boufous, S., L. de Rome, T. Senserrick, R. Q. Ivers (2013) *Single- versus multi-vehicle bicycle road crashes in Victoria, Australia*. Injury Prevention 19 (5), 358-362: 10.1136/injuryprev-2012-040630

Delaney, H., G. Parkhurst, S. Melia (2017) *Walking and cycling on shared-use paths: The user perspective*. Proceedings of the Institution of Civil Engineers: Municipal Engineer 170 (3), 175-184: 10.1680/jmuen.16.00033

Kutela, B., S. Das, I. N. Sener (2023) *Exploring the Shared Use Pathway: A Review of the Design and Demand Estimation Approaches*. Urban, Planning and Transport Research 11 (1): 10.1080/21650020.2023.2233597

Schepers, P., B. den Brinker (2011) *What do cyclists need to see to avoid single-bicycle crashes?* Ergonomics 54 (4), 315-327: 10.1080/00140139.2011.558633