Examining Effective and Safe Self-Explaining Design Elements in Bicycle Infrastructure through an Observational Study

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Abstract

Cycling is a sustainable and clean mode of transportation in urban areas. In recent years, the popularity of bicycles has significantly increased, particularly due to the COVID-19 pandemic. The availability of cycling infrastructure is a crucial factor in determining whether to use a bicycle or not.

This thesis examines the behavior of cyclists at intersections in Wuppertal on various bicycle infrastructure elements, both with and without self-explaining features. The thesis analyzed international guidelines, prioritizing search terms, which emerged from a comprehensive literature research, such as understandability, safety, and recognizability, as well as infrastructure that mitigates conflict situations according to the guidelines. From this analysis, five infrastructure elements were identified as potential candidates for self-explaining bicycle infrastructure. These are the staggered stop line, the bike box, a two-stage left turn, the outward bend of the cycle track and roundabouts.

For the observational study in Wuppertal, the staggered stop line element was selected. For this element, it was also possible to find an intersection in Wuppertal that included this element and a neighboring intersection that was similar in design but did not include this element. The study data was analyzed using a new qualitative-quantitative approach. A subsequent binary regression analysis revealed significant results. Intersection 1, which has self-explaining bicycle infrastructure elements, had significantly fewer interactions than intersection 2, which lacks these elements. This thesis reveals a significant contrast between the two intersections analyzed. The study suggests potential design flaws in intersection 1, particularly when turning left, as evidenced by the deviation from the usual routes across the intersection. Objects located on or near the bike lane can influence a cyclist's decision-making process, often resulting in the cyclist leaving the prescribed route and traveling a greater distance past the object, leading to a partial departure from the bike lane.

The study found that the presence of pedestrians had a positive impact on cyclists' behavior, leading to increased adherence to traffic rules. However, the study also revealed that some cyclists tended to skip intersections that were not clearly marked, which could lead to potentially dangerous situations. Additionally, the study found that cyclists who were traveling straight were more likely to follow traffic rules than those who were turning. It is unclear whether the red-marked cycle paths directly contribute to the intersection being self-explaining, as the binary logistic regression needs to provide this information. However, it is reasonable to assume that these paths play a significant role, as many vehicle drivers brake at the first intersection when cyclists are on this path.

Finally, it is recommended that the regulations not only incorporate best practices from the German guidelines but also include successful examples from other countries. For instance, the combination of the staggered stop line with a red bike box from the Dutch CROW manual could be considered.

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