

Safety Efficacy Confidence Levels for Bicycle Treatments

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Keywords: bicycle infrastructure, NACTO, literature review.

1 INTRODUCTION

As standards for the design of bicycle-friendly streets continue to evolve in the United States, guidelines such as those published by the National Association of City Transportation Officials (NACTO) are increasingly becoming the state of the practice (1, 2). This paper seeks to provide context for the safety efficacy of various improvements included in the NACTO publications so practitioners can make more informed decisions on each treatment's appropriate application. A review of the literature was completed for 18 treatments to compile key findings about crash reduction and other measures of effectiveness related to safety such as yielding behavior or level of user comfort. The summary tables in this paper provide information on each treatment's documented benefits and limits of use, as well as the quality of the studies. Treatments are organized into three categories based on the confidence of their documented safety efficacy – high, medium, and low.

2 CONFIDENCE LEVEL DESCRIPTIONS

The high confidence level was reserved for devices that include robust safety data and/or consistent findings across multiple studies that show a reduction in collisions. In the absence of documented crash reductions, some devices in this category had no evidence of a negative safety impact and provide an objective safety benefit that would lead to a strong positive recommendation for the treatment. In this category, specific areas of caution are included in the final conclusions and may apply when research is lacking. One example in this category is separated bicycle phasing using traffic signals. The Federal Highway Administration (FHWA) cites that this treatment can reduce the bicycle crash rate by up to 45 percent (3), and a published case study in Davis, California saw reductions from 16 bicycle and motor vehicle collisions before installation to 2 vehicle-only collisions after implementation (4). A video-based study in multiple cities found that there were high levels of compliance at intersections with separated phasing compared to other bicycle treatments (5). While there are a limited number of published studies for this treatment, the available research consistently shows positive safety results which leads to a high confidence level.

Devices were assigned to the medium confidence level when there were gaps in the research but ultimately no significant safety concerns. For example, studies consistently show positive safety impacts for bend-out crossings at unsignalized crossings across the minor street (6, 7); however, additional research is needed to better understand certain situations such as the offset distance for bend-out crossings, the efficacy of bend-out crossings at signalized intersections, and the general efficacy for bend-out crossings in the United States. Many devices in this level have documented crash reductions but they may be referenced from a limited number of studies or there may be several nuances that aren't well understood.

The low confidence was assigned based on the quality of available data, or for devices for which there are limited if any studies. Studies in this category may not have documented the study sites well enough to fully understand the context of the results, such as an FHWA study for the bend-in crossing. This study aggregated data for bend-in crossings from multiple case studies and results were compared across cases where the device was applied on its own and cases where the device was applied with other bicycle treatments; however, those other treatments are not documented nor are other site characteristics that may have contributed to the results. The study showed an increase in the absolute number of bicycle crashes per year (8); however, the data was not controlled for volumes. In general, the low confidence level represents devices for which research is inconclusive or incomplete.

3 RESULTS

A summary of the documented safety efficacy confidence levels for the reviewed bicycle treatments is shown in Table 1. Four of the 18 treatments were assigned a high confidence level, while half were assigned a medium confidence level and the remaining five were assigned a low confidence level.

4 CONCLUSIONS

In order to feel confident in the overall application and effect of several of these treatments, there is a need for more rigorous safety studies. Such studies would allow for inclusion of more of these devices in the Highway Safety Manual and therefore a better quantification of benefits and costs. More rigorous quantification would also likely support bicycle safety projects competing more effectively for limited safety funds. Using standardized data collection protocols for as many projects as possible, especially the collection of bicycle volumes before and after project implementation, would be one key factor to help advance the state of research for bicycle treatments. Consistent, standardized data collection and additional studies of bicycle infrastructure treatments would improve guidance for transportation professionals and facilitate safer facility designs.

Table 1: Summary of documented safety efficacy for bicycle treatments.

| Documented Safety Efficacy Confidence | Treatments |
|---------------------------------------|--|
| High | <ul style="list-style-type: none"> • Bicycle Boulevards • Green Pavement • Raised Bicycle Crossings • Separated Bike Phasing (Traffic Signals) |
| Medium | <ul style="list-style-type: none"> • Bend-Out Crossings • Bike Boxes • Buffered Bike Lanes • Contraflow Bike Lanes • Conventional Bike Lanes • Coordinated Signal Timing • Mixing Zones • One-way Protected Bikeways • Two-way Protected Bikeways |
| Low | <ul style="list-style-type: none"> • Bend-in Crossings • Combined Bike Lanes/Turn Lanes • Intersection Crossing Markings (Non-green) • Through Bike Lanes • Two-stage Left Turn Boxes |

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