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Research Results

Developing segment- and intersection-level BLOS measures for the SHS

Developing segment- and intersection-level Bicycle Level of Service (BLOS) measures for the California State Highway System.

Modal

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Project Title: Developing Segment and Intersection-Level BLOS measures for the SHS

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WHAT WAS THE NEED?

Bicycle Level of Service (BLOS) measures are essential tools for transportation agencies to monitor and prioritize infrastructure improvements for cyclists. They attempt to relate objective measures of the roadway environment to subjective measures of cyclist safety or comfort. Existing BLOS measures were developed in other regions and do not account for the roadway features and driving culture in California. Additionally, as bicycle facility improvements have advanced, existing measures do not account for many of the changes. A previous BLOS pilot study utilized and tested a statistical and behavioral modeling approach to developing a BLOS measure for the California state highway system (SHS).

WHAT DID WE DO?

The proposed methodology was developed following a four-step process:

1. **Design of the VR scenarios:** Thirty Virtual Reality (VR) scenarios were developed to resemble roads and bike facilities found on the SHS. Each video is unique and shows different bicycle facilities and roads with varying levels of traffic, surface conditions, and bike infrastructure. The VR videos were created by first identifying key variables that impact individuals' biking preferences. Key variables included were: urban/rural context, traffic volume, vehicle speed, proportion of heavy-duty vehicles, bike lane width, buffer width, barrier height, and pavement quality. Second, an orthogonal design was implemented to systematically combine these variables in a balanced manner. Lastly, the estimated variable combinations were

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incorporated into the development of the VR videos, creating a diverse set of scenarios for participants to evaluate during the stated-preference survey

2. **Design of the stated preference survey:** The survey captured people's stated preferences for bike routes along with self-reported socio-demographic data, bicycling experience and frequency, perceptions of level of skill or comfort on a bike, and preferred facility types. The survey sought to capture responses from a large pool of Californians, including groups that are typically underrepresented in research, and was therefore distributed online, both in English and Spanish, to numerous cycling organizations and one community-based organization.
3. **Model Estimation:** Two Latent Class Choice Model (LCCM[JD1.1]) models were estimated. The first one, with three classes, is a constrained version of the second one, with four classes, and both are very closely related.
4. **BLOS development:** A BLOS measure was constructed using the utility equations of the four-class LCCM model. The BLOS measure is a set of tables that illustrate how the probability of riding on a road segment with any bike facility versus one that has no bike facilities increases as new features are added and as the dimensions of those features increase.

WHAT WAS THE OUTCOME?

Design of the VR Scenarios:

The scenarios were completed and results captured in final report. It is noted that the research team further investigates the validity of using VR videos by comparing results with a follow-up in-person experiment where participants are asked to ride on the bike simulator. Participants ride through the same pairs as the ones they were presented in the survey and asked to respond the same questions. Findings for this part of the experiment can be found in the Griswold 2022 STRP Report.

Design of the Stated Preference Survey:

Overall, the survey collected some diversity of responses from individuals with varying biking habits and perceptions about biking. The vast majority of respondents were frequent bikers between the ages of 21-40 that like to bike and do so for a variety of purposes, but in particular for recreation. Yet, despite the prevailing trend, the survey did captured input from individuals of all age groups, genders, and different biking habits and preferences. Notably, respondents expressed a range of opinions concerning bike comfort and safety, pointing to some heterogeneity.

Model Estimation:

The four-class model unveiled the following typology for California bicyclists:

- *Road Cycling Enthusiasts (7%):* Members of this class are individuals who are 40+ years old who bike a few times a month or less, and typically bike for recreational purposes only. They have a strong inclination towards biking and would bike on any street, regardless of the type of infrastructure available. Road cycling enthusiasts respond positively to bike lanes, strongly dislike buffers of any kind (barriers, median, parking lanes, simple buffer strips), and prefer to bike on multi-lane streets and avoid streets with high traffic volumes.
- *Occasional Recreational Bicyclists – Moderate Sensitivity to Bike Infrastructure (25%):* Members of this class are 40+ years old, do not bike frequently, and consider bike infrastructure to be more important to them than Road Cycling Enthusiasts. Members of this class inherently prefer not to ride a bike. They respond positively to bike facilities like bike lanes, buffers, and barriers for protection, and prefer to ride roads with light traffic, a small percentage of heavy-duty vehicles, and good pavement conditions.
- *Occasional Recreation Bicyclists – High Sensitivity to Bike Infrastructure (27%):* Members of this class

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are mostly identical to Moderate Sensitivity to Bike Infrastructure class members. They differ in that they show greater sensitivity to bike infrastructure and to poor traffic conditions.

- *Indifferent to Bike Infrastructure (39%):* Members of this class are individuals for whom bike infrastructure is not very important when choosing their bike route. These individuals have a weaker, almost neutral, response to most bike infrastructure, especially compared to the other classes.

BLOS Development:

Having identified distinct groups of people with distinct biking preferences, new BLOS metrics can be constructed using the utility equations estimated for each group.

WHAT IS THE BENEFIT?

The output of this project will support the Bicycle Collision Monitoring Program (BCMP) by allowing Caltrans to evaluate the impact of specific improvements on bicycle level of service using empirical data. Furthermore, such models can potentially be used to refine the identification of high-collision bicycle corridors, which are an important part of BCMP.

IMAGES

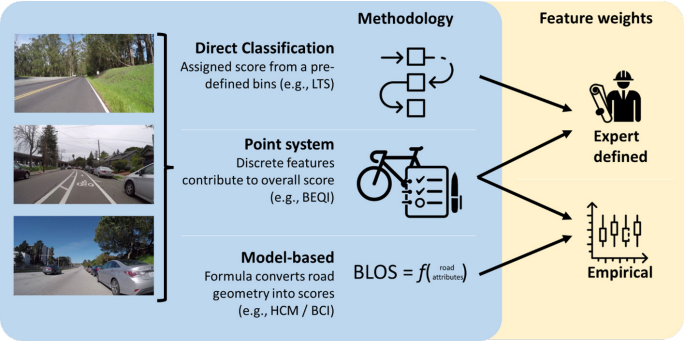


Image 1: Diagram of methodological and feature weighting approaches.



Image 2: Multi-lane urban road with protected bike lane.



Image 3: Multi-lane rural road with bike infrastructure.

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