Evaluation of Transportation Safety and Security Barriers in Bicyclist Accessibility

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Project Objective

The further motivation of cycling as a utilitarian and sustainable travel alternative to the automobile has been identified as a practical response to societal concerns regarding physical inactivity, climate change, and transportation-related inequities. Yet, even as policymakers, practitioners, and researchers continue to pursue strategies for increasing cycling activity in many American cities, significant challenges remain in the provision of safe bike infrastructure that could attract a more general population to cycling. In this research project, we present the Cyclist Routing Algorithm for Network Connectivity (CRANC) planning tool as an innovative strategy for identifying spatial disparities in cycling access to daily life destinations and investigating the interrelationships between the perceived security and objective safety of cyclists.

Problem Statement

A noteworthy segment of the American population is considered to be interested but concerned about cycling for daily purposes (e.g., commute to work) due to the perceived and objective barriers in existing bike networks. As such, the realization of cycling as a widely-available mobility option is predicated on a greater introduction of low-stress facilities in which cyclists have less contact, and subsequent conflict, with motorists. Importantly, thoughtful consideration must be given to the viability of cycling for lower income and historically marginalized residents who are disproportionately affected by the rising costs of vehicle access and are more likely to reside in neighborhoods with high rates of motorist-cyclist crashes.

Research Methodology

This research project describes the design and implementation of the CRANC (https://rc.nau.edu/cranc) planning tool across eight Arizona metropolitan regions. This accessibility-oriented cyclist routing engine application integrates the planning concepts of cyclist types and level of traffic stress (LTS) in providing a strategy for modeling the varying route preferences of cyclists with different thresholds of risk aversion to network conditions and analyzing the potential for cycling to nearby out-of-home activity sites given the segment-level LTS presented by the bike network. In the first study, local and regional discrepancies in cycling access to jobs, schools, and grocery stores are measured using a quarter-mile grid cell system to model bike routes for the interested but concerned, enthused and confident, and strong and fearless cyclist types. The weighted average of cycling access to job opportunities within a 15-minute commute for a prospective interested but concerned cyclist are then investigated across neighborhood indicators of socioeconomic status to identify potential inequitable access gaps. In the second study, a conceptual framework associating residential context, perceived cycling accessibility, and objective cyclist safety is presented and operationalized using a two-part statistical analysis. The high-stress cycling accessibility (HSCA) of 15-minute routes to nearby jobs and schools for an interested but concerned cyclist type is measured and modeled as a function of the different sociodemographic and economic characteristics of neighborhood residents in the first analysis. In the second analysis, predicted HSCA values and selected characteristics of cyclists involved in nearby motorist-cyclist crashes are modeled as determinants of the frequency of nearby motorist-cyclist crashes and severity of injury incurred by a crash-involved cyclist.

Results

In carrying out these two studies, this research project intends to offer city officials and transportation researchers both a decision-support tool and the accompanying evidence needed to identify perceived and objective traffic safety barriers that are likely hindering a more widespread and equitable increase in bicycle mode adoption and utilitarian cycling activity. The descriptive and illustrative findings from the first study highlight perceived barriers in high-quality bike infrastructure access for prospective cyclists with a greater risk aversion to riding in mixed traffic conditions and spatial disparities in cycling access to jobs, schools, and grocery stores across different residential locations and contexts. The model results of the second study underscored a connection between residential content and perceived cycling access to important destinations and a positive relationship between high-stress cycling accessibility and revealed cyclist safety. Taken together, the results of this research project suggest a continued need to alleviate perceived network barriers to utilitarian cycling through future investments in safer bike infrastructure aimed at reducing cyclist-motorist conflicts and ultimately an improvement in observed cyclist safety.

Figure 1. Application of Cyclist Routing Algorithm for Network Connectivity (CRANC) across three cyclist types

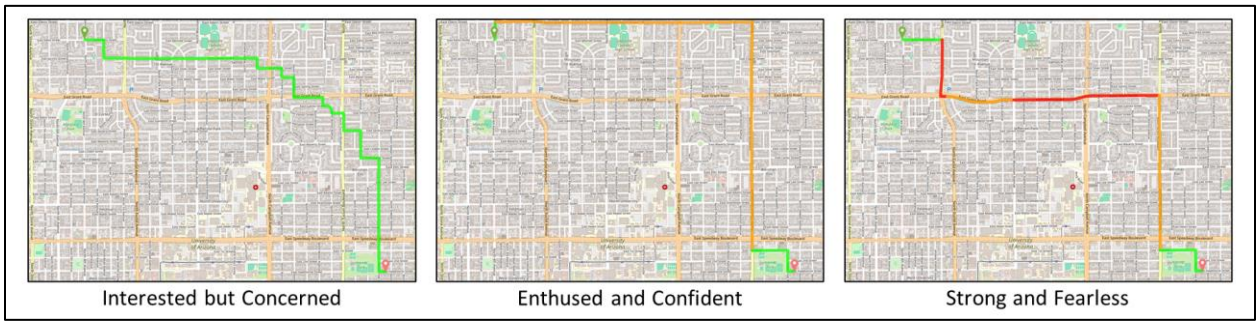

Figure 2. Conceptual framework linking cycling accessibility to residential context and observed cyclist safety