

**Project Title**

Pedestrian Safety and Traffic Operations Near Transit Stops

**University**

Utah State University

**Principal Investigators**

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**Research Needs**

Pedestrian injuries and fatalities are increasing (in both number and share), nationally and in Utah. According to a recent report from the Governors Highway Safety Association (<https://www.ghsa.org/resources/Pedestrians20>), pedestrian fatalities have increased by around 50% over the last 10 years and now represent 17% of all traffic deaths. The majority of pedestrian fatalities occur on non-freeway arterials that may be difficult to cross except at signalized intersections. In 2016, nearly 40 deaths and 900 injuries to people walking on Utah streets and highways were reported. As vulnerable road users, pedestrians are more likely to be injured or killed when involved in a collision.

Past research has shown that pedestrian crashes are more frequent at intersections with transit stops. A recently completed UDOT (Utah Department of Transportation) project titled “Safety in numbers? Developing improved safety predictive methods for pedestrian crashes at signalized intersections in Utah using push button-based measures of exposure” found pedestrian crashes are more frequent particularly at intersections with far-side transit stops. However, more detailed analysis and study is required to fully understand the impact of transit stops on pedestrian safety. Also, the “safety in numbers” study and other studies have not balanced transit stop impact on safety with impact on operations in any meaningful way. Also, there is often a tradeoff between

operational efficiency and safety regarding placement of transit stops. For example, if a transit stop is on the near-side of an intersection, it tends to promote pedestrian use of marked crosswalks but may increase delay if buses often arrive on green instead of red. This project would verify and quantify that tradeoff. This project would also build off ongoing UDOT research projects on pedestrian traffic signal violations and conflicts between right-turning vehicles and pedestrians.

Based on Utah crash reports, pedestrian behaviors play a role in around 50% of pedestrian crashes, including contributing factors such as: improper crossing, darting, not visible, inattentive, failure to obey traffic signs/signals, in roadway improperly, and failure to yield right of way. Many of these behaviors and violations are particularly relevant at intersection transit stops. These behaviors may be more common in certain locations (e.g., at far-side transit stops) or under certain conditions (e.g., nighttime, low traffic volumes), but there is limited research documenting these locations and conditions. This research project intends to fill this gap by correlating pedestrian behavior near transit stops with transit, operations, and safety data, analyzing factors and characteristics contributing to greater conflict rates, and identifying potential design and operational treatments (and educational or enforcement initiatives) to improve pedestrian safety while mitigating operational impacts. Overall, this issue is a part of the bigger picture of the pedestrian safety crisis and is important for UDOT to address in order to achieved zero fatalities.

This project has already been selected for funding by the Utah Department of Transportation and Utah Transit Authority, assuming matching funds from the Mountain-Plains Consortium.

## **Research Objectives**

The objectives of this research project are to:

- Investigate the impacts of transit stops on pedestrian safety and traffic operations at intersections.
- Provide recommendation for improving both pedestrian safety and traffic operations at intersections with transit stops.

## **Research Methods**

In the proposed research, an extensive literature review will be conducted to assess the current state of knowledge of pedestrian safety issues and traffic operations at intersections, with a particular focus on transit stops. The results of the literature review will inform the exact structure of data collection, including where and what data to collect.

After consultation with UDOT/UTA personnel, a set of intersections will be selected for study. The selection will likely include a mix of rural, urban, signalized, and unsignalized intersections. The primary data source will be pedestrian and vehicle behavioral data collected from both UDOT camera footage and temporary GoPro footage. This data collection qualifies for Institutional Review Board Exemption 2 (public observation). Approval of the Exemption Application is expected to take up to 4 weeks. Recorded footage will be watched primarily by undergraduate student researchers, who will record information about pedestrians and vehicles around the transit stop observed in the video. The exact information to be recorded will depend

on the results of the literature review. However, past similar studies have included: number of pedestrians in the group, perceived age/gender, distracted behaviors, vehicle reactions to pedestrians, pedestrian crossing paths, pedestrian crossing speed, pedestrian waiting time, post-encroachment time, etc.

In addition to the observational data, pedestrian crash data (e.g., frequency, severity, etc.), traffic operations data (e.g., average delay, volume-to-capacity ratio, etc.), transit data (e.g., bus frequency, average passengers boarding/alighting, etc.), and any other relevant data (e.g., intersection geometry, surrounding land use, etc.) will be assembled for each intersection in the study selection. These data will be used in statistical analyses to identify locations and conditions correlated with increased/decreased pedestrian-vehicle conflicts, pedestrian crashes, and traffic operations impacts. Though the exact analysis methodologies will be determined from the literature review, past similar studies have used: logistic regression of crash frequency, ordered probit modeling of crash or conflict severity, disaggregate binary analysis of pedestrian behavior by pedestrian/group, aggregate analysis of pedestrian behavior by intersection/crossing, etc.

Finally, the results of the statistical analyses and any quantitative findings from the observation will be used to develop recommendations for UDOT/UTA to apply. Recommendations may include but are not limited to: changes to transit stop placement, implementation of crossing protections near transit stops, changes in intersection design/geometry, changes in intersection operations, etc.

### **Expected Outcomes**

This research is intended to provide increased understanding of the factors affecting different aspects of pedestrian safety (recorded crashes, observed conflicts and behavior, etc.) and traffic operations (delay, queueing, etc.) related to transit stops at intersections. It will provide further insight into potential causes of pedestrian crashes. UDOT (and other transportation agencies) could use research findings to: (1) identify transit stop locations with high numbers or severities of pedestrian crashes, or with high potential for such crashes, to prioritize for safety treatments; (2) refine design and operational guidance around transit stops at intersections, and/or (3) quantify the tradeoff between safety and operations at intersection transit stops.

Recommendations may include (but are not limited to): transit stop placement (near-side vs. far-side), strategies for discouraging crossing outside the crosswalk (median fencing, curb fencing or natural barriers), intersection designs and traffic operations that reduce conflicts with pedestrians (curb extensions, leading pedestrian intervals), pedestrian and/or driver education and training, etc. Expected tangible products from this project include a final report (detailing the literature review, data assembly, data analysis, results, and recommendations) and a recorded webinar for educational and training purposes.

Overall, this research will support UDOT's strategic goal of "zero crashes, injuries and fatalities," core value of "safety," and emphasis areas of "integrated transportation" and "innovation." Determining the factors that contribute to greater or fewer numbers of pedestrian crashes, injuries, and deaths will help UDOT to evaluate and implement countermeasures to improve pedestrian safety. Furthermore, improving safety and operations around transit stops will help UDOT achieve a fully integrated, multimodal transportation system.

This research also supports and complements three existing UDOT research projects (UT19.316, UT20.312, UT20.313): improving predictive methods for pedestrian crashes at signalized intersections, an analysis of conflicts between right-turning vehicles and pedestrians, and an analysis of pedestrian traffic signal violations.

### **Relevance to Strategic Goals**

The proposed project contributes to the U.S. Department of Transportation (USDOT) strategic goal of Safety, as identified by the FAST Act. The findings of this project will promote the improvement of pedestrian safety while maintaining operational efficiency. By better understanding pedestrian-vehicle conflicts near intersection transit stops, this project will contribute to the overall goal of Zero Fatalities.

### **Educational Benefits**

It is expected that this project (combination of UDOT/UTA and MPC funding) will support two graduate students and several undergraduate researchers. Relevant findings may be incorporated into USU's "Transportation Data/Safety Analysis" course.

### **Technology Transfer**

Research results will be disseminated through publication in peer-reviewed professional journals and presentations at state and national meetings and conferences. In addition to a final report, one of the final deliverables will also be a recorded webinar summarizing the project and findings. As part of the UDOT/UTA funding side, the project will also be presented at the UDOT Annual Conference after completion.

### **Work Plan**

The proposed project (for the MPC side of funding) will be carried out over a 12-month period under the timeline below (to be completed by July 31, 2023). The UDOT/UTA side of funding will cover an 18-month period (the additional 6 months will be dedicated to any additional data collection needs, development of the recorded webinar, and presentation at the UDOT Annual Conference).

<b>Task</b>	<b>Duration</b>	<b>Completion Date*</b>
<p><b>Literature Review</b></p> <p>We will conduct a comprehensive literature review on pedestrian safety issues and traffic operations issues near transit stops. This task will also include submission of Exception Application to IRB.</p>	2 months	2
<p><b>Data Assembly</b></p> <p>We will select a set of study intersections with input from UDOT/UTA. We will assemble all relevant data, with the bulk of time dedicated to video data collection.</p>	6 months	8
<p><b>Data Analysis</b></p> <p>We will conduct statistical analyses of the data to assess pedestrian safety and traffic operations at intersections with transit stops. Recommendations will be developed from the results of the analyses.</p>	2 months	10
<p><b>Product Development</b></p> <p>The literature review, methodology, and overall findings will be written in the final report.</p>	2 months	12

**Project Cost**

Total Project Costs:	\$151,615.72
MPC Funds Requested:	\$ 70,000.00
Matching Funds:	\$ 81,615.72
Source of Matching Funds:	Utah Transit Authority, Utah DOT, \$20,000.00 Utah State University, \$61,615.72