THE UNIVERSITY OF VERMONT
TRANSPORTATION RESEARCH CENTER

Evaluation of the Safety of Pedestrian Crossing Treatments in Small and Rural Communities

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1. Motivation

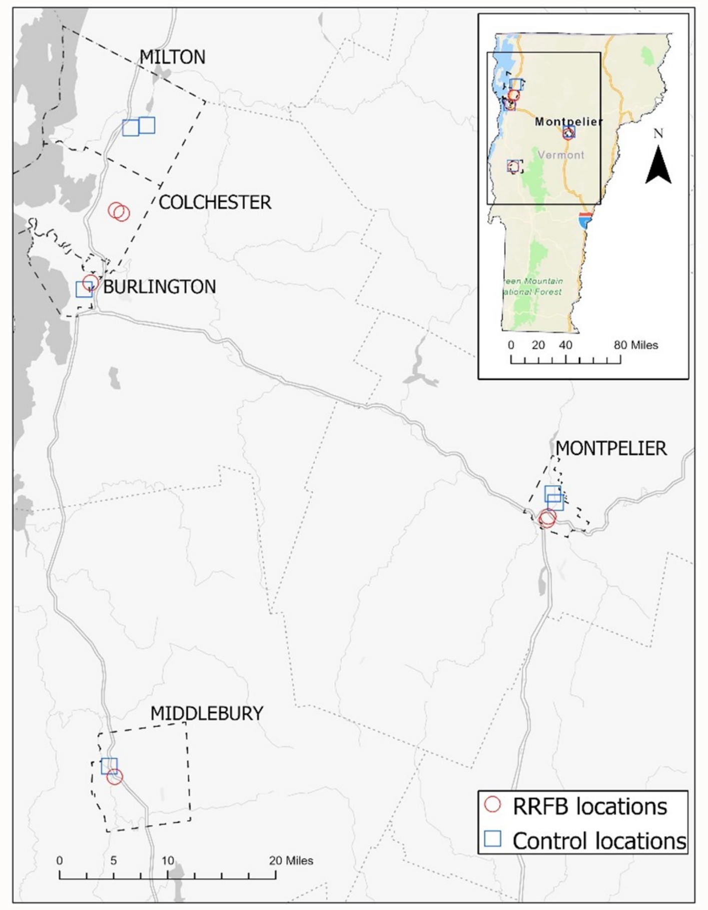
- Rural areas often lack adequate pedestrian infrastructure, leading to increased vulnerability.
- Higher speed limits and less driver awareness heighten the risk of pedestrian collisions in these environments.
- Rectangular Rapid Flashing Beacons (RRFBs) and LED-embedded signs are potential safety interventions.
- The effectiveness of these solutions in addressing rural pedestrian safety challenges is currently uncertain.
- Decision-makers need evidence-based insights to enhance pedestrian safety in rural contexts.

? Do RRFBs and LED-embedded signs improve pedestrian safety in rural areas?

2. Study design

Controlled before-after study:

We use a controlled before-after study design to evaluate the effectiveness of RRFBs and LED-embedded signs compared with traditional crosswalks in improving pedestrian safety. We evaluate driver and pedestrian behaviors using compliance and safety-related outcomes as surrogates for safety.



Vermont boundary and study locations

Rural communities in Vermont:

Vermont's rural context provides valuable insights into the effectiveness of interventions and treatment in similar settings.

3. Methods

Data collection and pairing

We form pairs of control and treatment locations to enhance the validity of the study and to capture the effect of the treatment on outcomes while controlling for other factors.

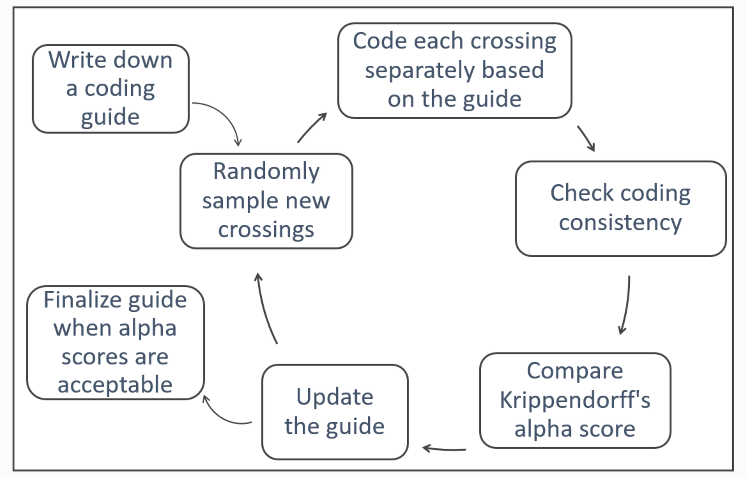

Video camera setup


Recorded video snapshot

Coding Process and Quality Assurance

Our robust video coding technique involves reviewing videos and visually classifying quantitative measures of conditions and outcomes.

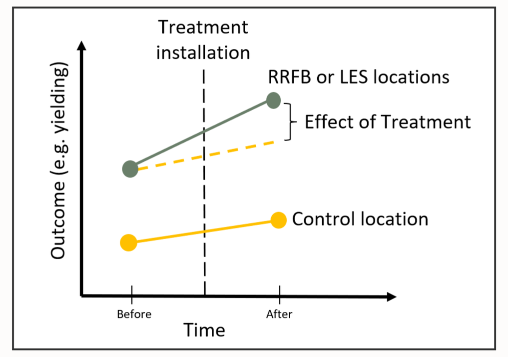
Two coders check intercoder reliability and iterate to create a coding guideline for use throughout the study.



Steps for creating intercoder reliability guideline

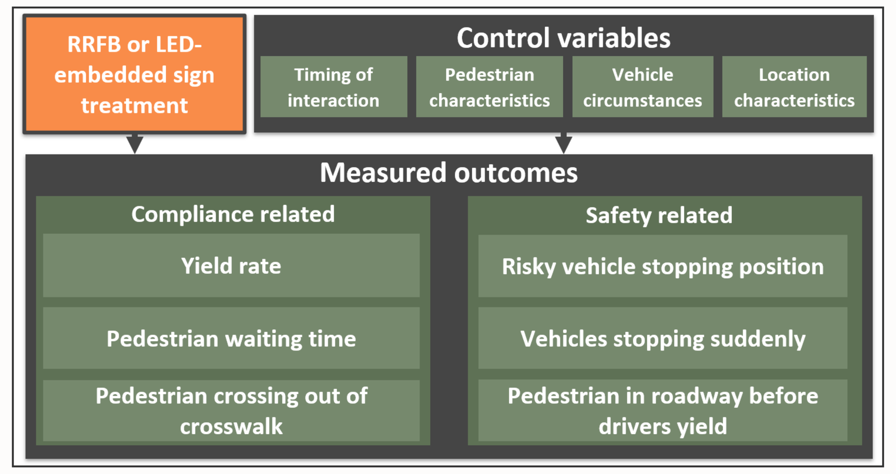
Statistical methods

Difference in difference:
Reveals causation and isolates treatment impact by comparing changes over time in treatment and control groups.



Difference in difference concept

Binomial logistic regression:
Considers the effect of multiple variables simultaneously for a better insights into their effects on the outcome.

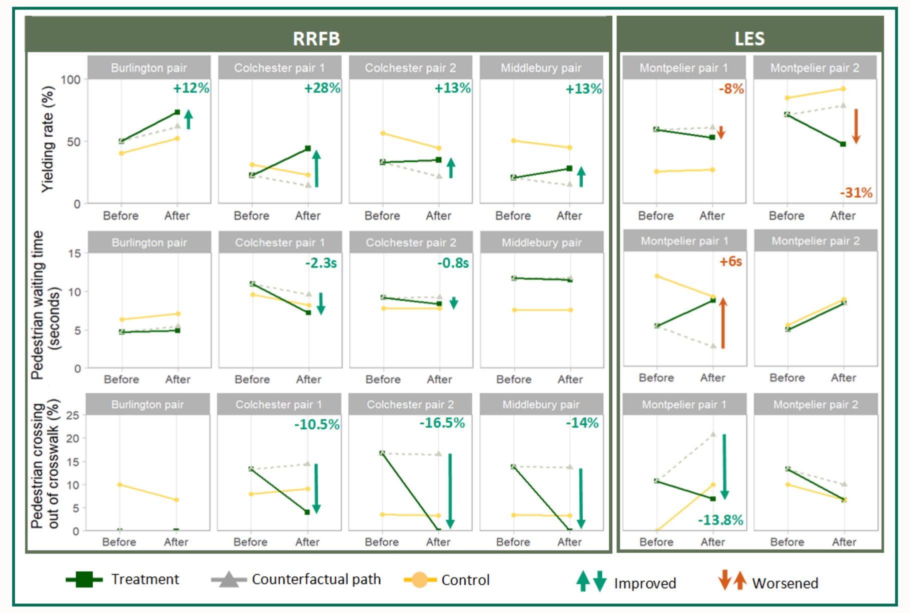


Variables included in the multivariate models

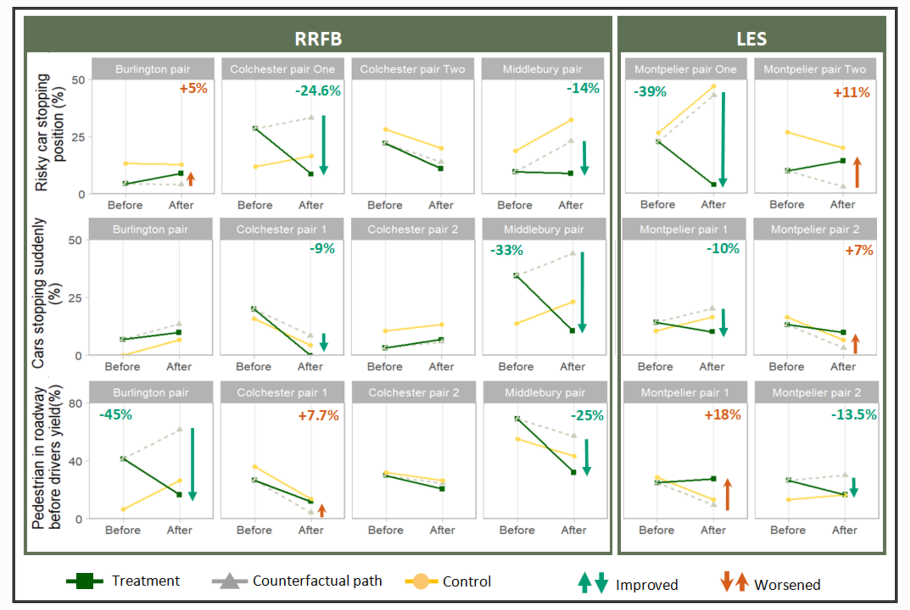
4. Findings

Difference-in-Difference Results

- ▲ ***Yielding rate*** improves only at RRFBs
- ▼ ***Yielding rate*** worsens at LESs.
- ▲ ***Pedestrian wait time*** improves only at RRFBs
- ▲ ***Out-of-crosswalk crossing*** greatly improves with both RRFBs and LESs.


DID results for compliance outcome

- ● ***Risky vehicle stopping position*** shows mixed results
- ▲ The rate of ***vehicles stopping suddenly*** improves only for RRFB
- ● The rate of ***Pedestrians stepping on the roadway soon*** shows mixed results


DID results for safety outcomes

Multivariate Modeling Results

- ▲ ***Treatment activation*** only at RRFBs
- ● Pedestrian ***wait times*** are not significantly different for both RRFBs and LESs.
- ▲ ***Out-of-crosswalk crossing*** greatly improves (less frequent) with both treatments.

Variable group	Variables	Yielding rate (%)	Pedestrian waiting time	Pedestrian crossing out-of-crosswalk
		Odds Ratio	Coefficient	Odds Ratio
	Intercept	0.87	6.42	0.05
Timing of interaction	Weekend	1.19	0.38	1.58
	Poor visibility	0.94	-0.9	0.41
	PM peak (ref: non-peak)	1.28	-0.92	0.93
	AM peak (ref: non-peak)	1.38	-1.32	0.70
	Study phase (after)	1.1	0.13	1.46
Pedestrian characteristics	Runner	1.15	-1.54	3.03
	Biker	0.74	1.79	3.9
	Vulnerable users	0.98	2.8	2.7
	Pet	0.95	1.66	1.18
	Grouped crossing	1.94	-0.95	0.47
Vehicle circumstances	Nearside vehicle	0.88	0.41	1.04
	Sun in eyes	1.15	-0.38	1.02
Location characteristics	**RRFB** present and activated (ref: not present or activated)	2.59	-0.71	0.15
	LES present and activated (ref: not present or activated)	1.03	-0.55	0.11
Observations / R^2		1522 / 0.094	660 / 0.091	689 / 0.153

Logistic and OLS models of compliance

RRFBs and LESs show no significant effects on:

- ● ***risky vehicle stopping***
- ● ***vehicles stopping suddenly***
- ● ***pedestrians stepping out of the crosswalk***.

Variable group	Variables	Risky vehicle stop position	Vehicles stops suddenly	Pedestrian in roadway before drivers yield
		Odds Ratio	Odds Ratio	Odds Ratio
	Intercept	2.14	0.07	0.30
Timing of interaction	Weekend	1.02	0.84	0.71
	Poor visibility	2.02	0.44	0.61
	PM peak (ref: non-peak)	0.95	1.05	0.9
	AM peak (ref: non-peak)	0.78	0.89	0.91
	Study phase (after)	0.86	1.49	1.91
Pedestrian characteristics	Runner	2.64	1.53	0.81
	Biker	1.27	0.55	0.74
	Vulnerable users	0.32	0.79	0.96
	Pet	0.95	0.66	0.81
	Grouped crossing	0.76	0.65	0.87
Vehicle circumstances	Nearside vehicle	0.85	0.712	1
	Sun in eyes	1.00	0.92	0.85
Location characteristics	**RRFB** present and activated (ref: not present or activated)	0.86	1.14	1.08
	LES present and activated (ref: not present or activated)	3.84	1.35	1.21
Observations / R^2		632 / 0.064	689 / 0.051	689 / 0.065

Logistic models of safety

5. Key takeaways

	Treatment effect on…	Prior literature	Difference-in-difference analysis		Multivariate modeling	
			RRFB	LED-embedded	RRFB	LED-embedded
Compliance-related	Driver yielding	Improve	Improve	Worsened	Improve	NS*
	Pedestrian waiting time	No Data	Improve	Worsened	NS	NS
	Pedestrians crossing out of crosswalk	Improve	Improve	Improve	Improve	Improve
Safety-related	Driver stopping position	No Data	Unclear	Unclear	NS	NS
	Vehicles stopping suddenly	Improve (crashes)	Improve	Unclear	NS	NS
	Pedestrians stepping into the roadway before drivers yield	No Data	Unclear	Unclear	May improve	NS
Overall effectiveness	Outcomes in general contexts	Improve	No Data	No Data	No Data	No Data
	Outcomes in Vermont's small and rural communities	No Data	Improve	Unclear	Improve	NS

* Not significant

Summary of the outcomes from literature, difference in difference and multivariate analyses

- RRFBs improve compliance and safety-related outcomes in small and rural communities, while LED-embedded signs only improve pedestrian compliance.
- Results are consistent across centrally located crossings and in rural to urban transition zones.

Acknowledgement

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