Effect and Influence of Different Factors on Driver Behavior When Vehicles Make Right Turn at Signalized Intersections

Jianqing Wu
University of Nevada, Reno
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Presentation Overview

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1. Introduction

❖Previous Studies about Driver Behavior

- In 2002, approximately 3.2 million intersection-related crashes occurred, representing 50% of all reported crashes.
- Drivers' behavior was identified as a sole or contributing factor in 94% of crashes in the United States.
- Limited studies on the behavior of right-turn drivers have been performed because of the lack of behavior data.
- Previous studies attempted to quantify the relationship between vehicle speed and crash involvement, but available pre-crash speed data is a major limitation of the research.

1. Introduction

❖Objective

This research analyzed driver behavior for right turn movements based on real driver operation and observation data. The purpose of this paper is to analyze the influence of different factors on driver behavior for right turn movement at signalized intersections.

2. Data Source

❖Data Source: SHRP 2 Safety Data (NDS and RID)

The NDS data includes time-series records from the sensors installed on the volunteer vehicles and multi-directional video clips. The RID contains historical crash data, comprehensive roadway and environmental data related to the NDS road network.

- 211 crash and near- crash right-turn events (including between multiple vehicles; between a vehicle and a pedestrian) at signalized intersections were extracted.
- This paper was sponsored by the Student Paper Competition - SHRP 2 Safety Data Bonanza. Only data on InSight was available- limited to front video, non-PII, etc. So some particular data elements might have been in the greater database, but not on InSight.

2. Data Source

❖Data Source: SHRP 2 Safety Data (NDS and RID)

Received Data:

- Time-series data (time stamp, speed, lateral acc, longitudinal acc, brake pedal and gas pedal status, etc)
- Front video
- Crash details table

(event start time, end time, crash type,

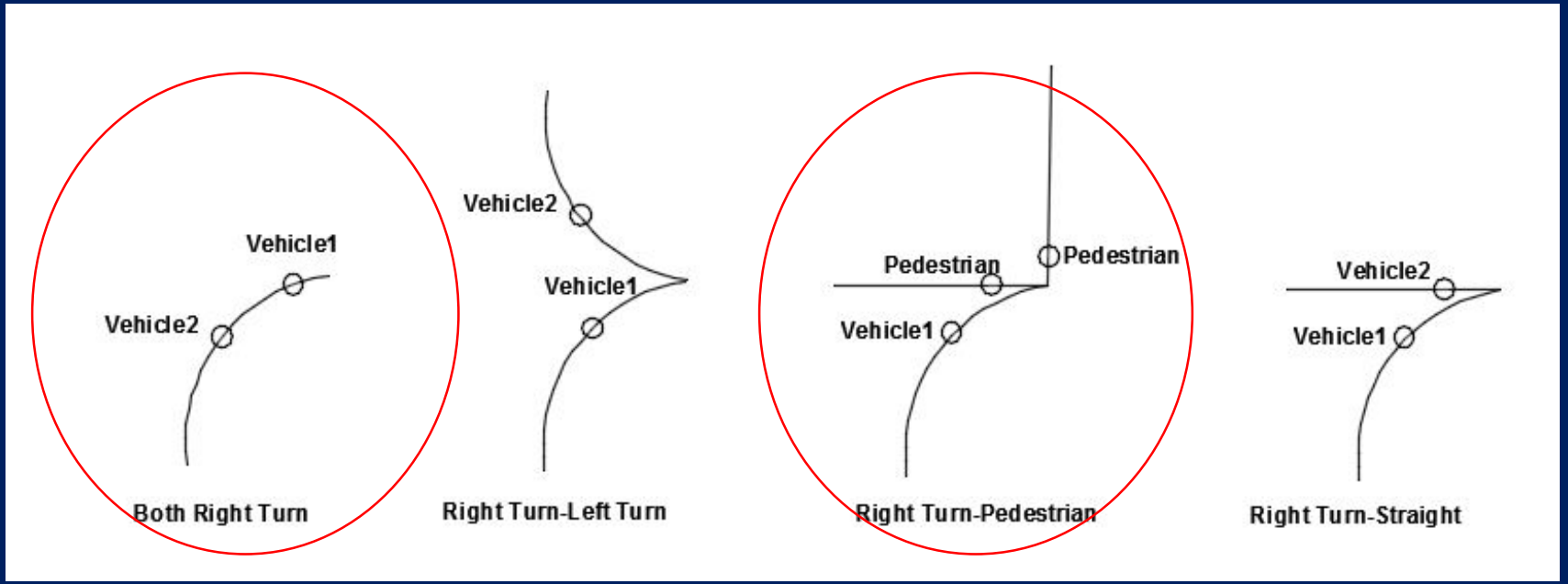
crash severity, driver behavior description, etc)

- RID data

3. Data Processing

❖ Conflict Type

- The most frequent types of conflicts was examined by using RID data.
- Crashes that occurred in a 300-feet radius from all intersection nodes were queried.

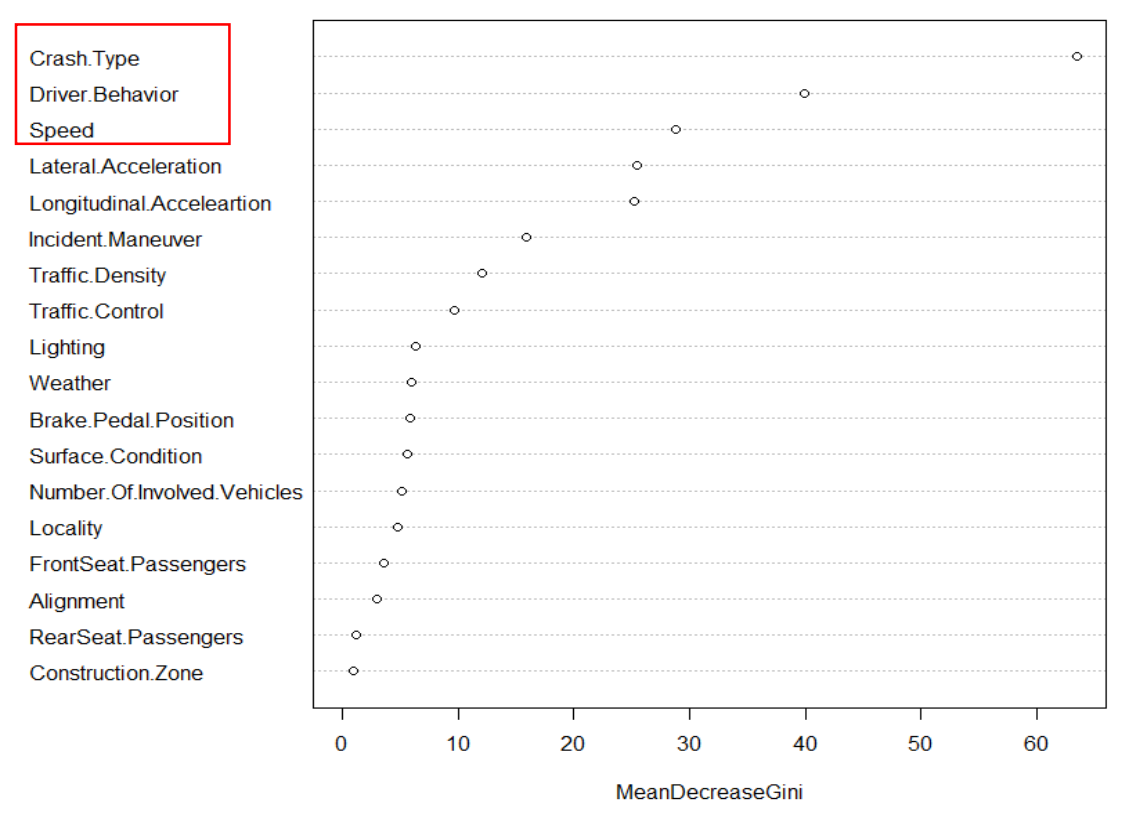


The historical right-turn crash data in RID database showed the two most frequent conflict types were “Both Right Turn” and “Right Turn-Pedestrian”.

3. Data Processing

❖ Prioritized Influencing Factors of Crash Severity

Method: Random Forest in R language



Severity	Not a Crash
	Low-risk Tire Strike
	Minor Crash
	Police-reportable Crash
	Most Severe
Crash Type	Rear-end
	Pedestrians/Pedalcyclists-related
	Head on
	Sideswipe
	Hitting Object
Driver behavior	None
	Signal Violation
	Sign Violation
	Distracted
Speed	Speed variance of 60 seconds to 30 seconds before crashes

"Crash Type", "Driver Behavior" and "Speed" are top 3 most important factors on crash severity

3. Data Processing

❖ Prioritized Influencing Factors of Crash Severity

Method: Ordered Probit Model

	Variables	Estimate	Std.Error	z value	Pr(>|z|)	Significant Code
(Driver.Behavior)1	Signal Violation	0.33553	0.3793	0.885	0.376373	.
(Driver.Behavior)2	Sign Violation	0.90359	0.33738	2.678	0.0074	**
(Driver.Behavior)3	Distracted	1.2887	0.39818	3.236	0.00121	**
Speed Variance		0.0134	0.00492	2.723	0.006475	**

Distraction ↑, Severity ↑

Speed Variance ↑, Severity ↑

4.Driver Behavior Analysis

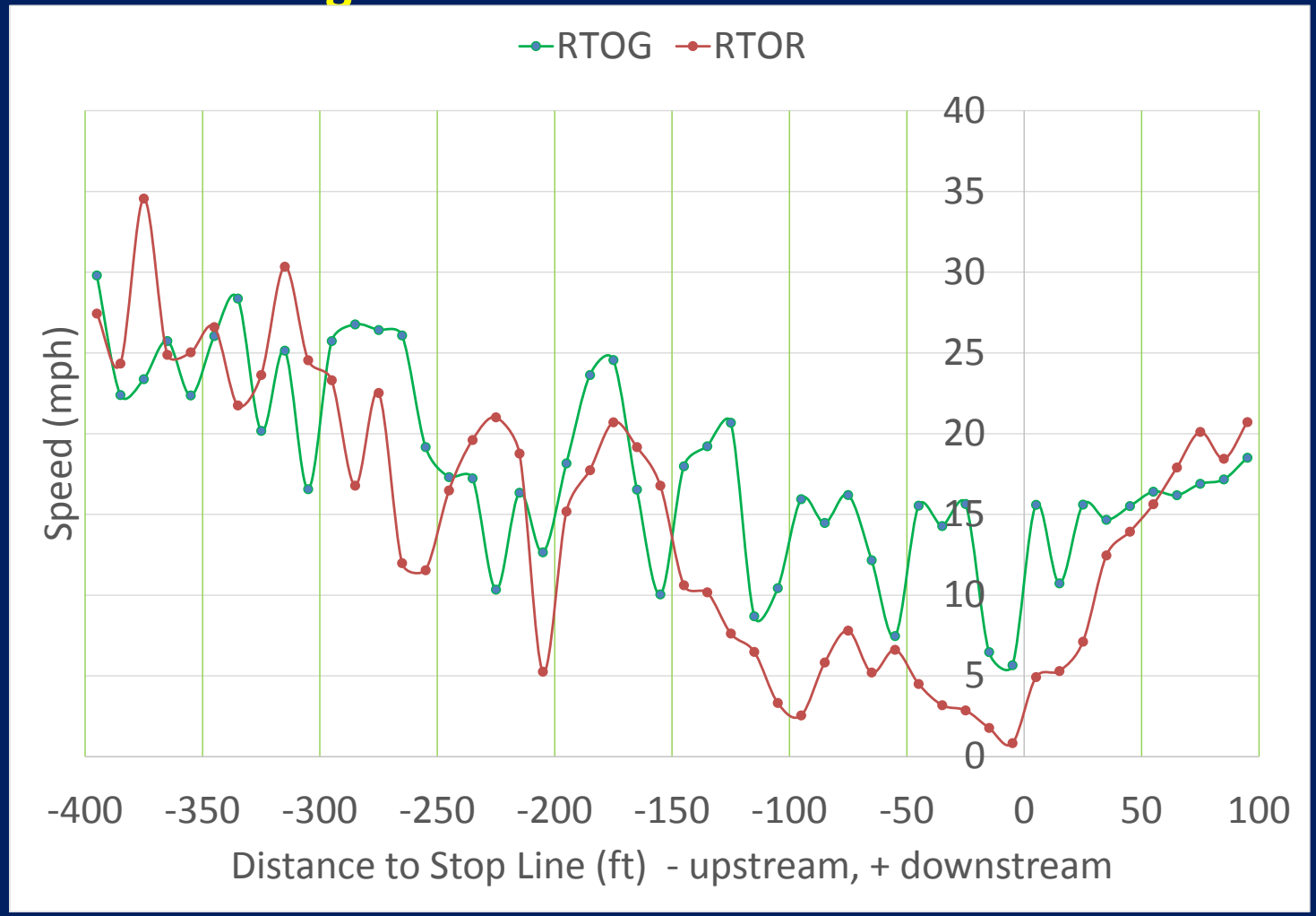
❖ Selected factors to be analyzed

Based on their influence on driver behavior in Random Forest

- Traffic Signal
- Geometric Design (Channelization)
- Influence of Pedestrians
- Conflicting Traffic Volume

4.Driver Behavior Analysis

❖ **Traffic Signal**

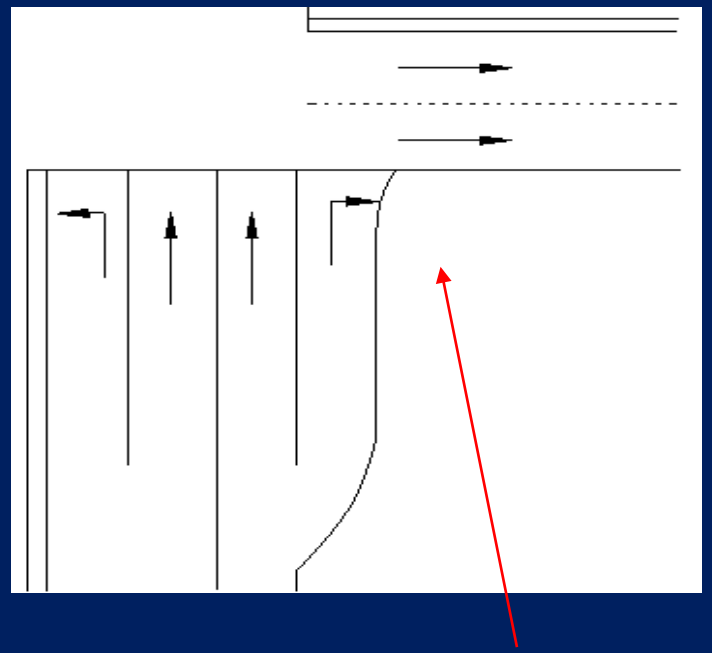


- 80% of drivers did not fully stop when they reached stop bar at Right Turn on Red (RTOR) (By viewing front video and time-series data)
- Drivers have high acceleration under RTOR when they leave the intersections

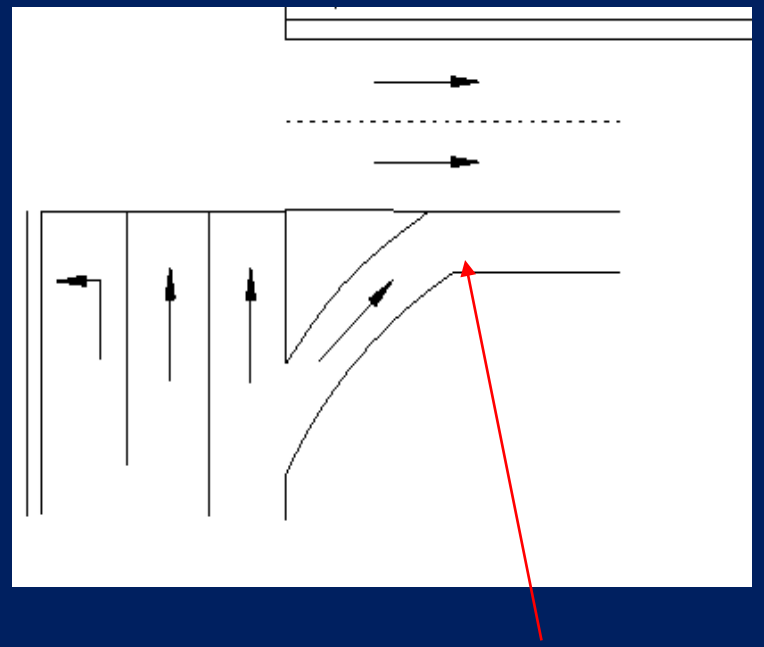
4.Driver Behavior Analysis

❖ **Channelization**

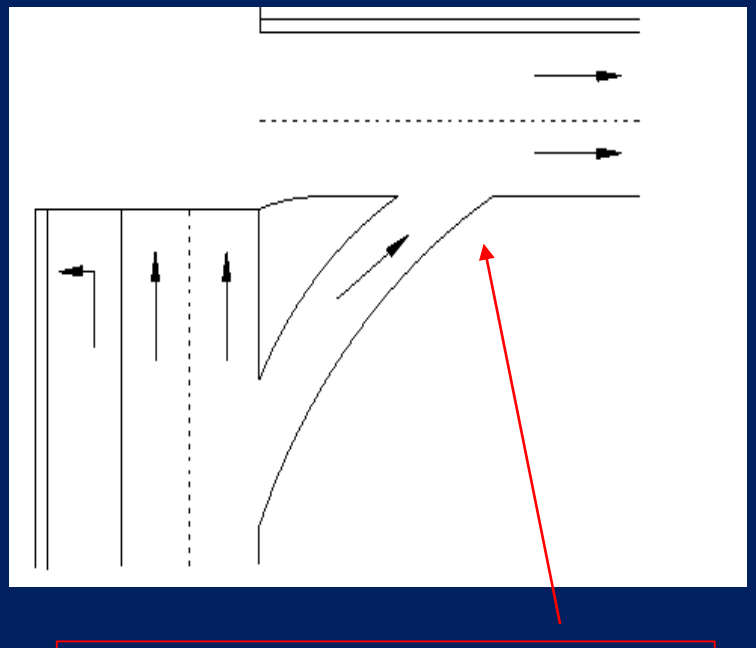
Three different types



No Channelization



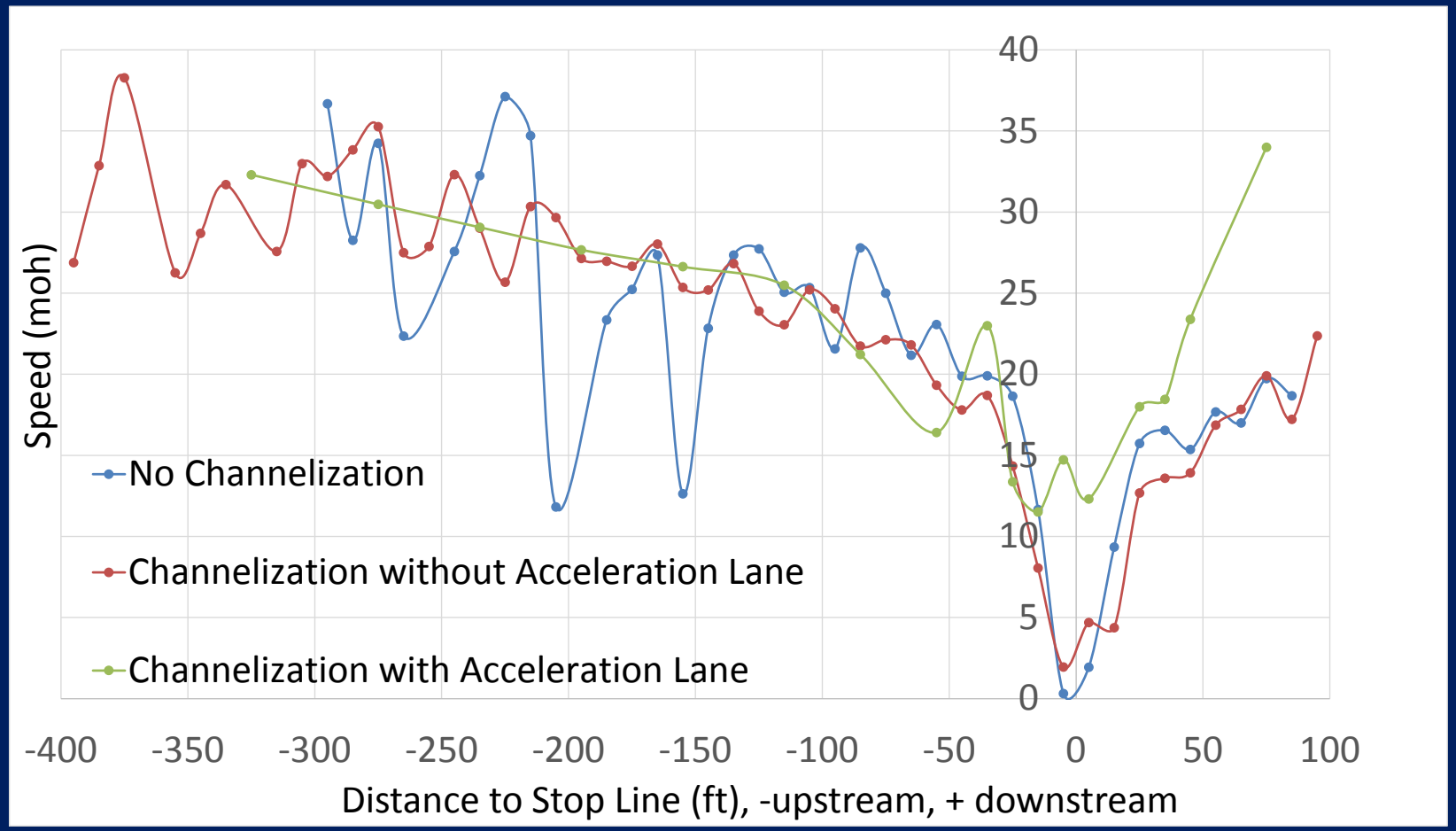
Channelization with acceleration lane



Channelization without acceleration lane

4.Driver Behavior Analysis

❖ Channelization



- For a channelization with acceleration lane, the speed decreases a little near the stop bar, then increases.
- No channelization and channelization without acceleration lane: similar trend---stop then high acceleration

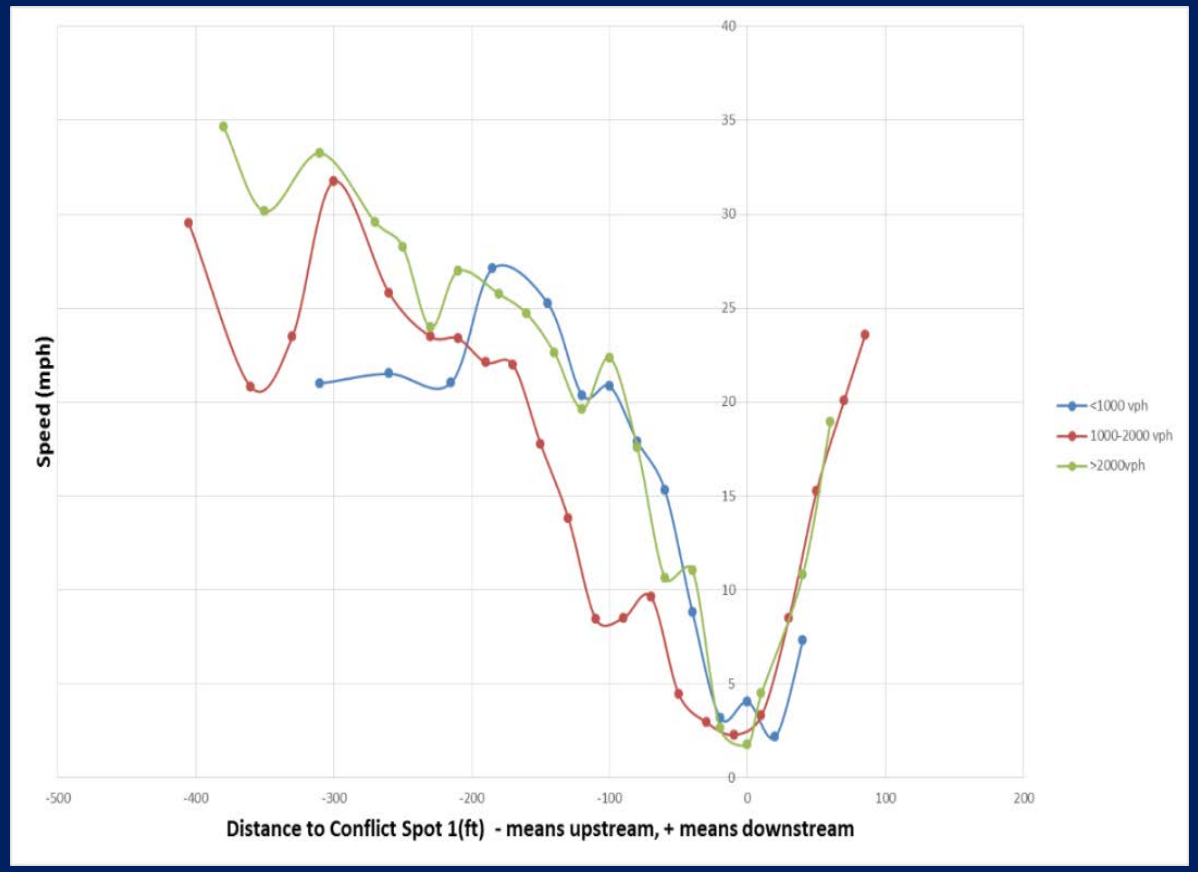
4.Driver Behavior Analysis

❖ Influence of Pedestrians

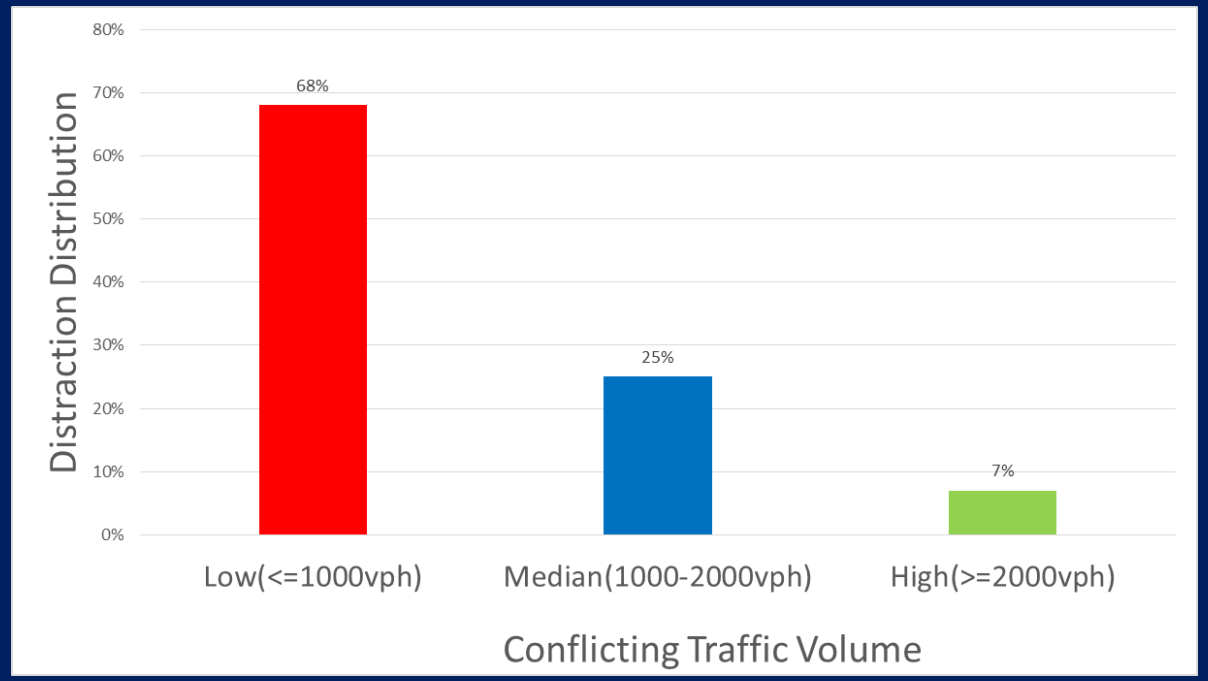
- Drivers slowed down, or stopped more for crossing pedestrians when a group of pedestrians, rather than an individual, attempted to cross the road.
  (Limited Events by reviewing front videos)

4.Driver Behavior Analysis

❖ **Conflicting Traffic Volume**



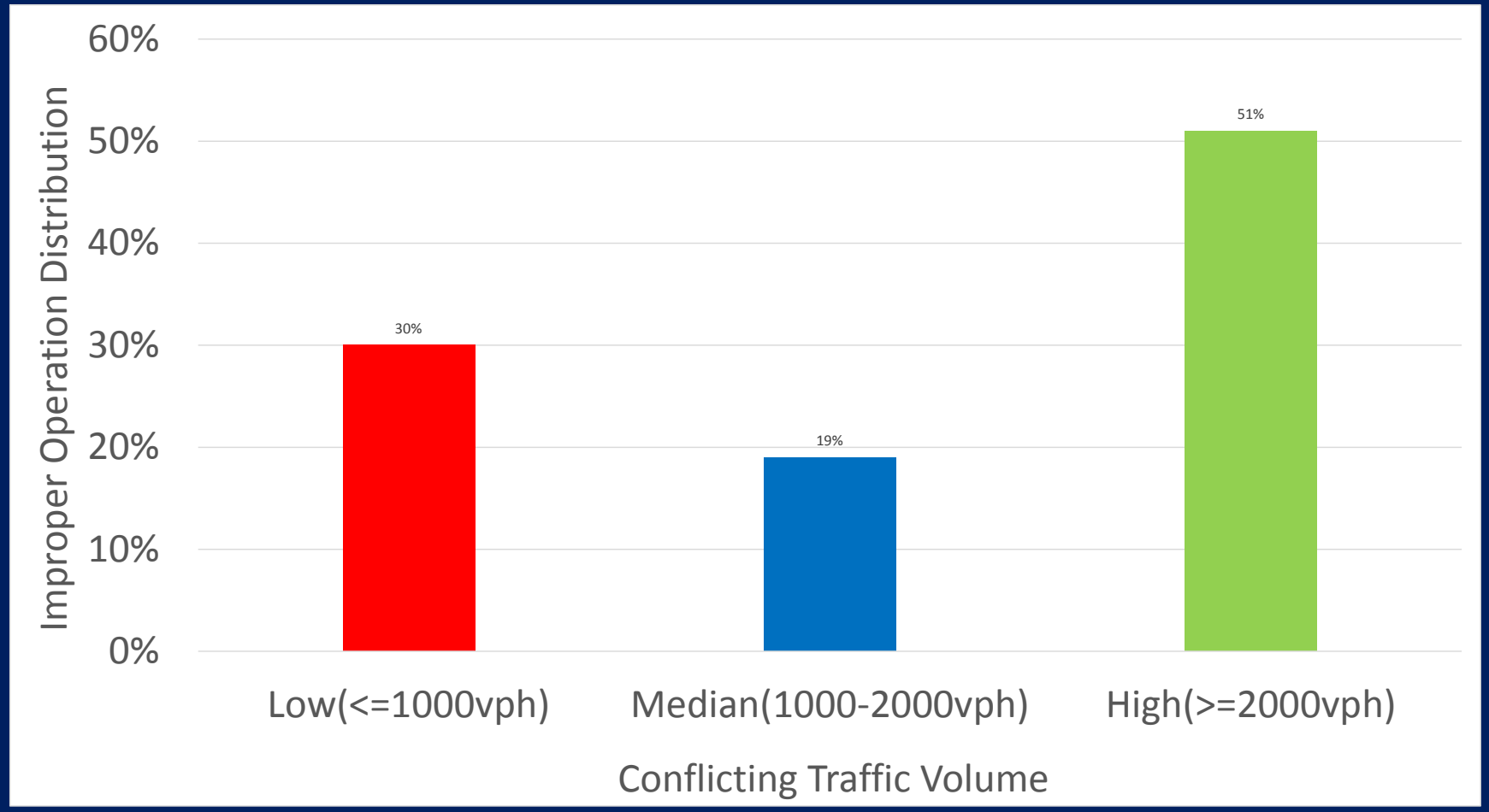
No obvious difference



- The frequency of distraction behavior will decrease as conflicting traffic volume increases.

4.Driver Behavior Analysis

❖ Conflicting Traffic Volume



- The frequency of improper operation increases when conflicting traffic volume is very low or very high.

5. Conclusions and Limitations

❖ **Conclusions**

- Optimizing traffic signal timing can be used to increase the possibility of green signals when right turn vehicles reach stop bar or NO Right Turn on Red.
- Channelization with acceleration lane can be used to reduce traffic delay and increase traffic safety at intersections with high right-turn volume.
- The frequency of distraction decreases when conflicting traffic volume increases.
- The frequency of improper operation increases when conflicting traffic volume is very low or very high.

5. Conclusions and Limitations

❖ **Limitations**

- The analysis on pedestrian involved crashes was limited because of limited data in the database.
- Face videos were not available in this research. This was a limitation on analyzing detailed driver observation behavior.
- The latitude and longitude of intersections were also not available in this research. The NDS data and RID data could not be linked.
- Driver factors (such as driver age, gender) and vehicle factors (such as vehicle type) on driver behavior were not analyzed in this research.
- The number of events was limited. More data are still needed to evaluate the findings of this research.

References

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Thank you!

Suggestions and Questions?