

# Modeling vehicle-pedestrian interactions outside of crosswalks

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# Purpose of the project / Basic knowledge

## 1. Purpose of the project

- Analyzing the relationship between pedestrian(allow to cross, jaywalker) and vehicle



## 2. Jaywalking

- A jaywalking event is defined as pedestrian crossing more than 10 ft outside of a marked or unmarked crosswalk at an intersection, or 10 ft outside of a marked midblock crosswalk.

# Data

Place : Two routes on the campus in University of Florida

Drivers : Selected based on age, gender, driving experience, occupation, and vehicle ownership, etc

Time : Every 4:30pm on weekdays (total disturbance time : 1 hour)



Route #1



Route #2

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Total distance

4.7 miles (7.56km)

2.8 miles (4.51km)

Travel time

16 min

20 min

Number of Midblock

17

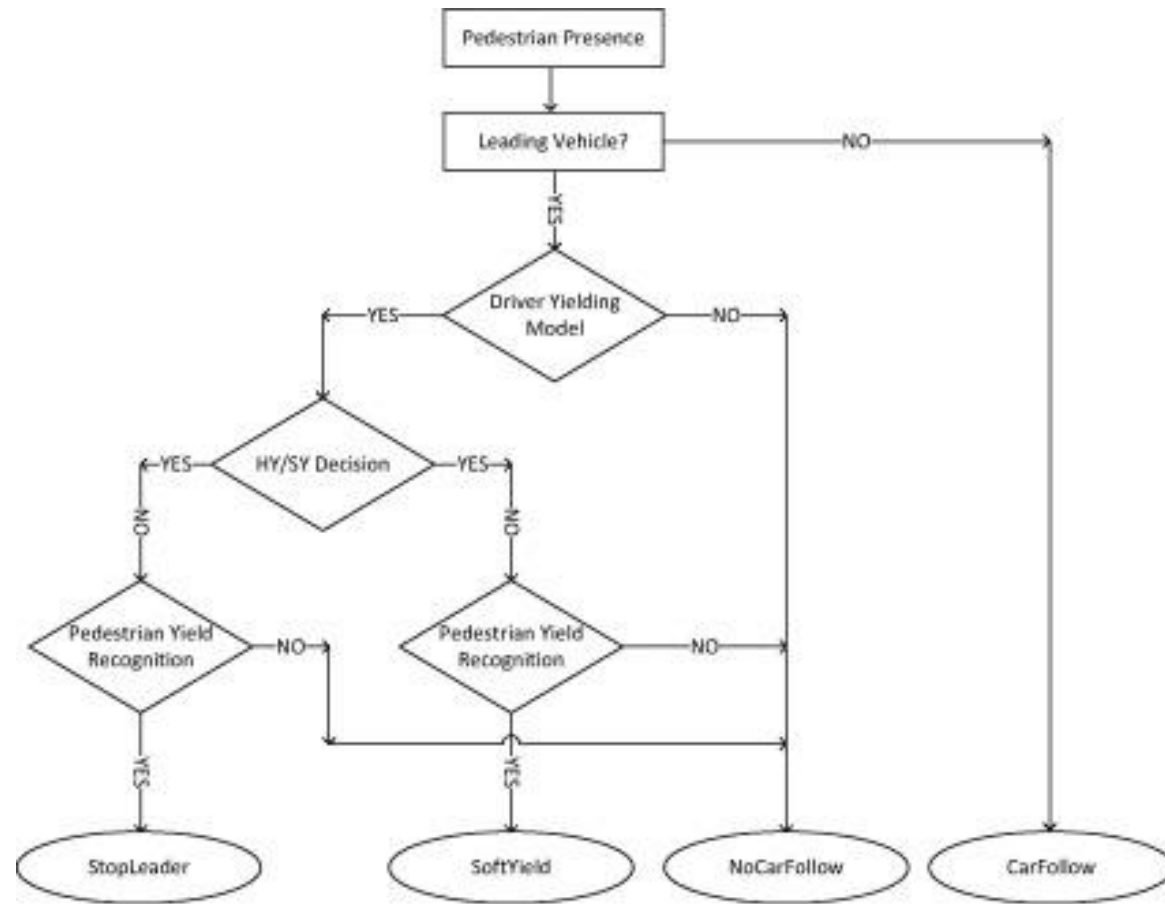
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Number of Signal crossing

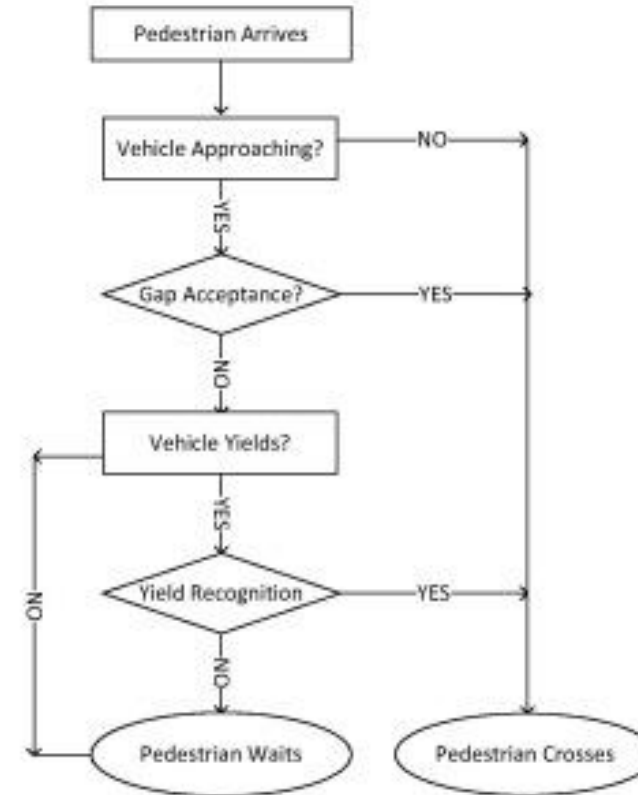
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# Data Framework



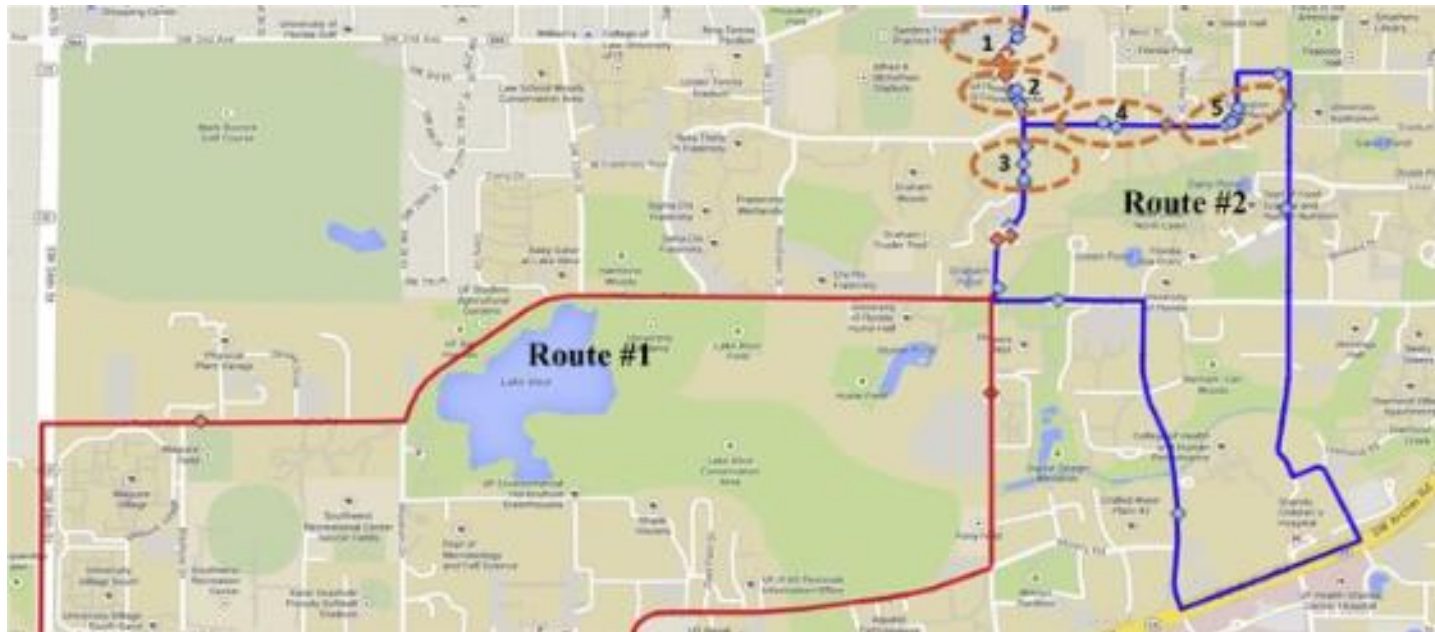
(a) Vehicle Process Flow



(b) Pedestrian Process Flow

# Data observation results

	Location 1	Location 2	Location 3	Location 4	Location 5
Jaywalker volume (/min)	1.467	0.733	2.933	1.667	4.033
Average pedestrian volume	1.800	2.333	2.550	3.233	5.633
Average traffic volume (/min)	6.100	5.000	5.583	1.367	2.95
Crossing distance (ft)	40.0	45.0	35.5	40.0	38.5
Nearby bus stops	1	0	1	2	2
Distance between crosswalks on either side of this location (ft)	360	444	1023	747	487



Occur percent of jaywalk (72.5%)

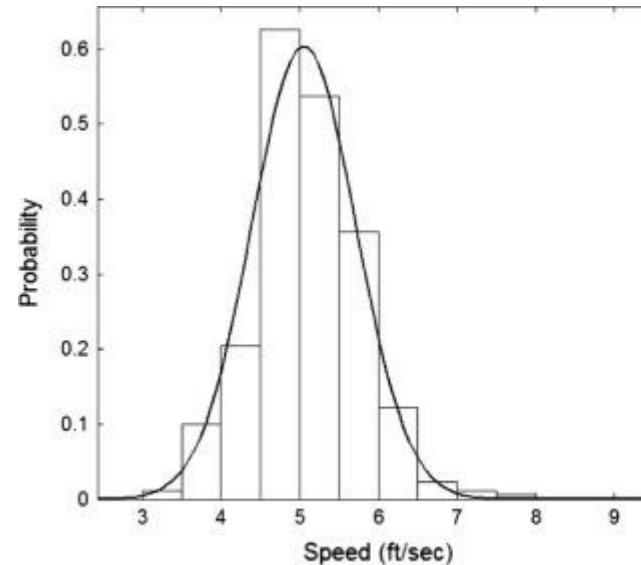
- Location 1 : 13.33%
- Location 2 : 16.67%
- Location 3 : 30.00%
- Location 4 : 20.00%
- **Location 5 : 53.33%**

Fig. 2. Observed Jaywalking Locations.

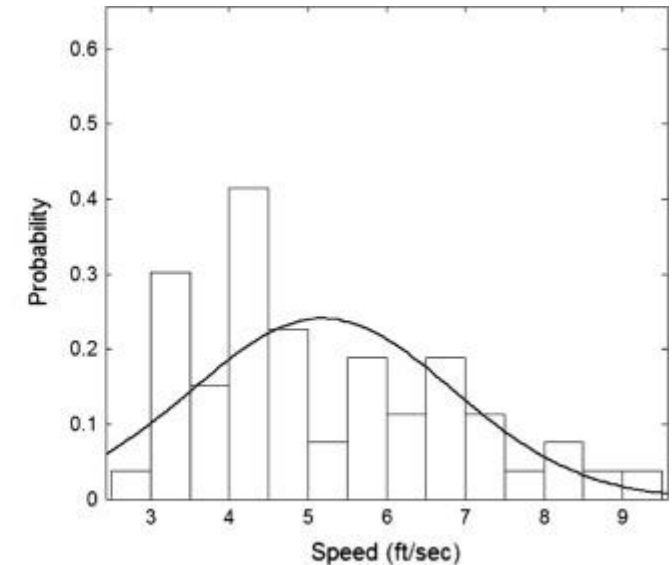
# Analysis result of pedestrian speed in and out of crosswalks

## In Crosswalk

1. Permissible crossing (343 people were observed)
  - average permissible crossing speed on campus is 5.05 ft/s
  - Standard deviation is 0.66
2. Jaywalker (487 people were observed)
  - average jaywalking speed on campus is 5.18 ft/s
  - Standard deviation is 1.65



(a) Permissible Crossings



(b) Jaywalkers

## Outside of Crosswalk

- Vehicles yield or during shorter gaps against vehicle pedestrian prefer to walk faster else walk slow

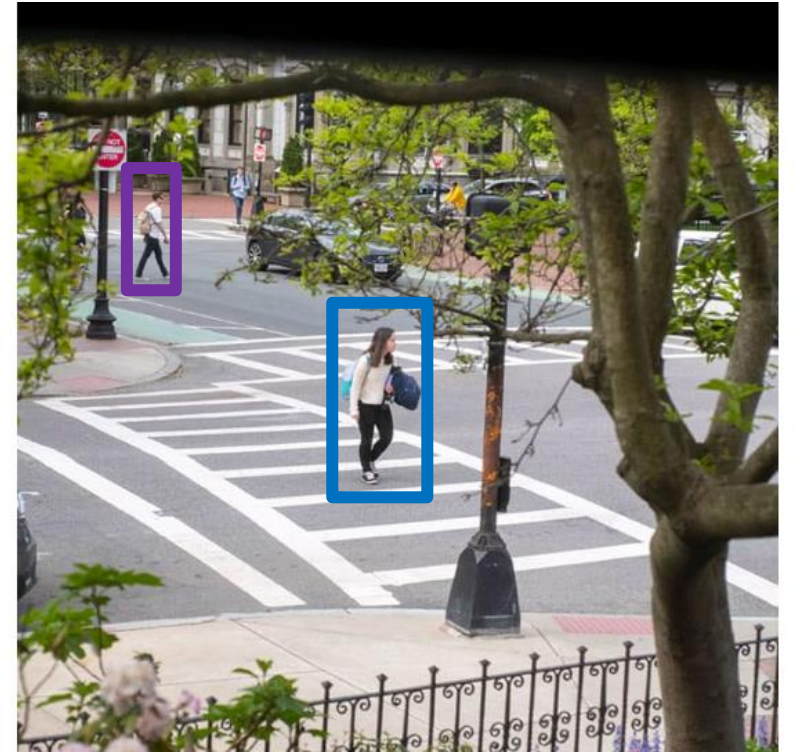


# Yield acceptance rate, curb wait time about vehicle and pedestrian

- NY : No-Yield
- SY : Soft-Yield (Slowing down for pedestrian without a full stop)
- HY : Hard-Yield (Slowing down until complete stop for pedestrian)

## Pedestrian Admission

1. Permissible crossing
  - Will accept 100% of yield to the vehicle
  - Delay at the curb about pedestrian : 3.65 s
2. Jaywalking
  - Low percent of being yield to the vehicle (= Don't expect drivers to yield)
  - Prefer to cross during larger gap between car rather than during yields
  - Delay at the curb about pedestrian : 0.87 s → looking for gap while walking



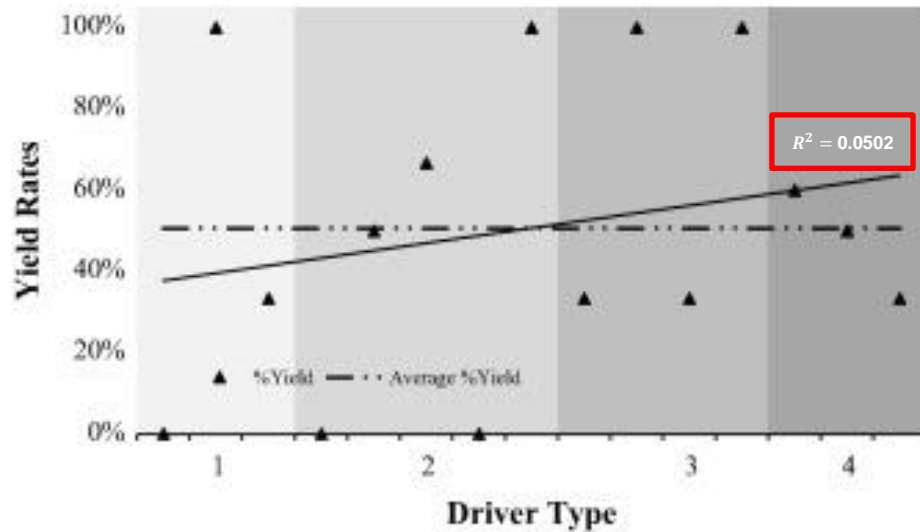
## About Vehicle

1. Rate of yielding to permissible crossing : 72.66%
2. Rate of yielding to jaywalkers : 50.67%

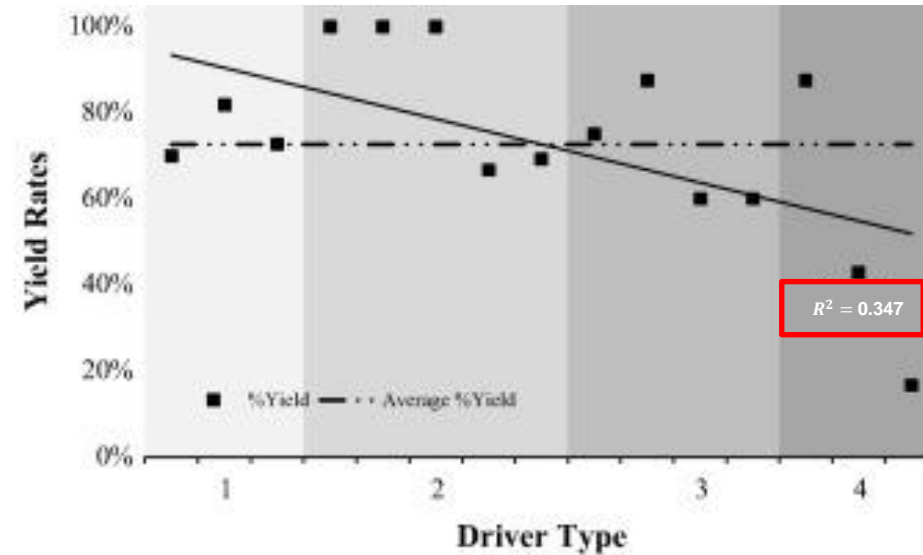


# Analysis based on driver type

- Using Linear regression, the rate of yielding about permissible crossings and jaywalkers seems to be random among all driver groups  
→ No clear relationship between driver type and yield



(a) Yield Rates to Jaywalkers

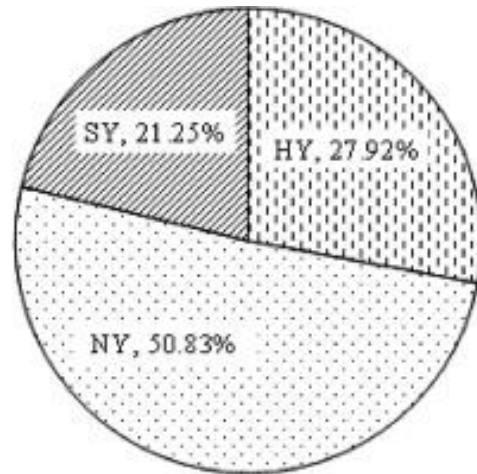


(b) Yield Rates to Permissible Crossings

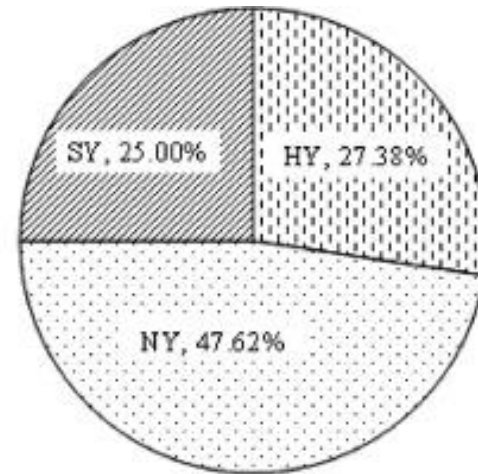
Existing conditions and environment(speed, distance, jaywalker volume) rather than the driver attitudes

# Analysis based on reportable or not

- Compared to Jaywalker-Reported Drivers and Unreported Driver NY, SY, HY are seen to have similar trends about yielding  
→ No relationship between report and yield



**(a) Jaywalker-Reported Drivers**



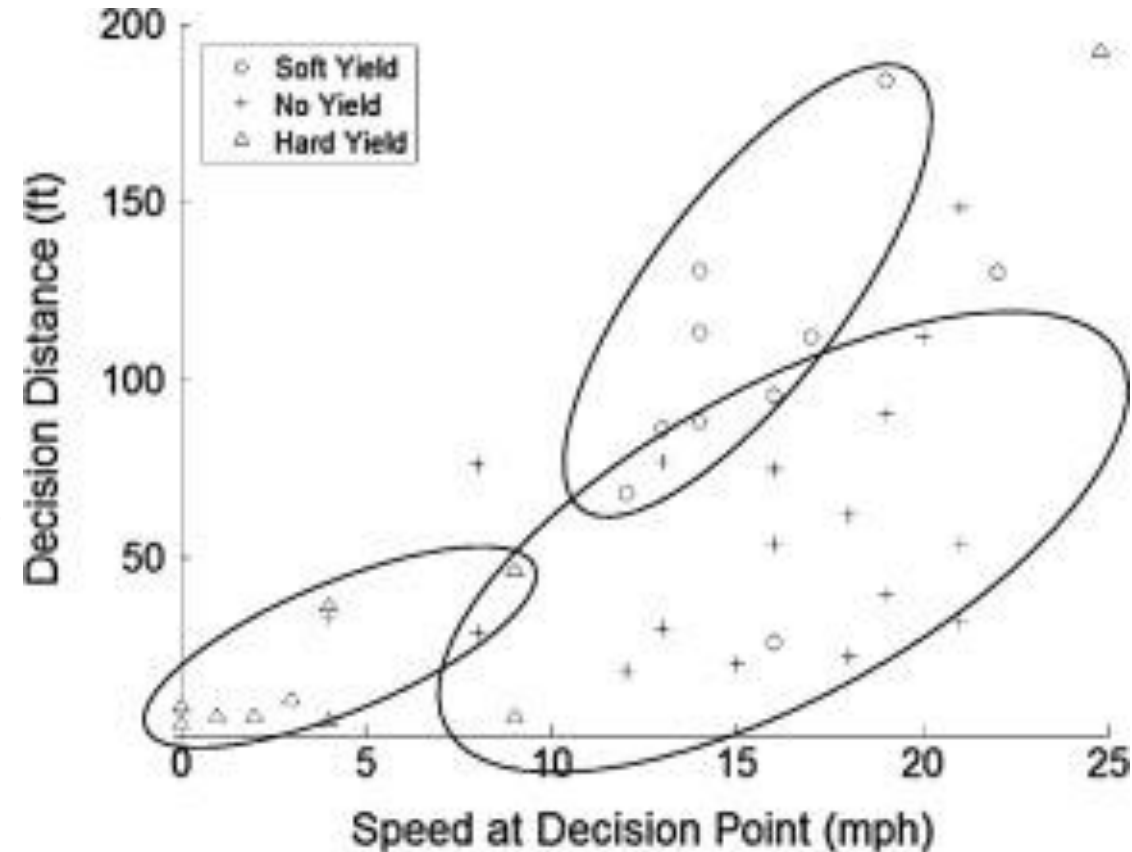
**(b) Jaywalker-Unreported Drivers**

# Analysis based on speed at decision point

- Average distance for permissible crossing : 132.37 ft
- Average distance between driver decision point and jaywalker : 85.81 ft

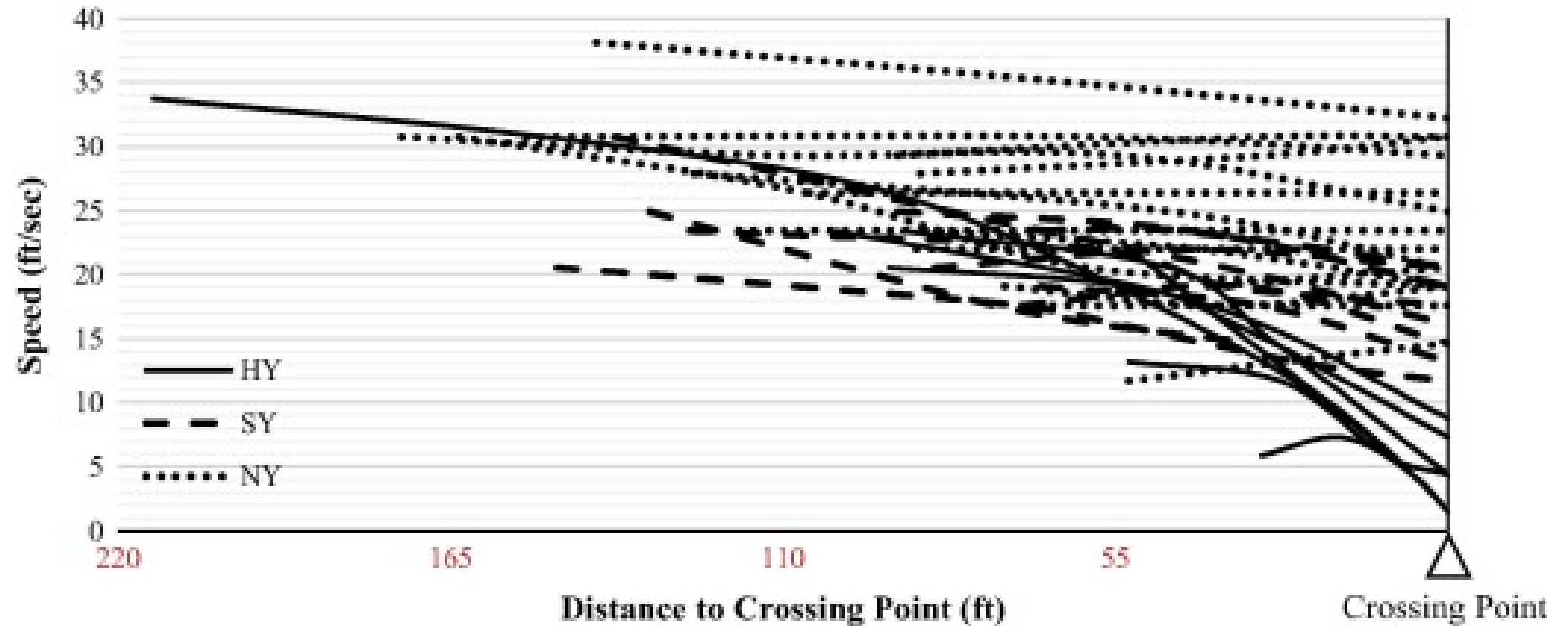
## Inference

1. The drivers are more likely to do hard yield to jaywalkers if their **speed is low** and they are quite close to the crossing point
2. Drivers with **higher approaching speed** decide to soft yield to jaywalkers if they are far away from the crossing point, otherwise they cannot stop and choose not to yield when the decision distance is short



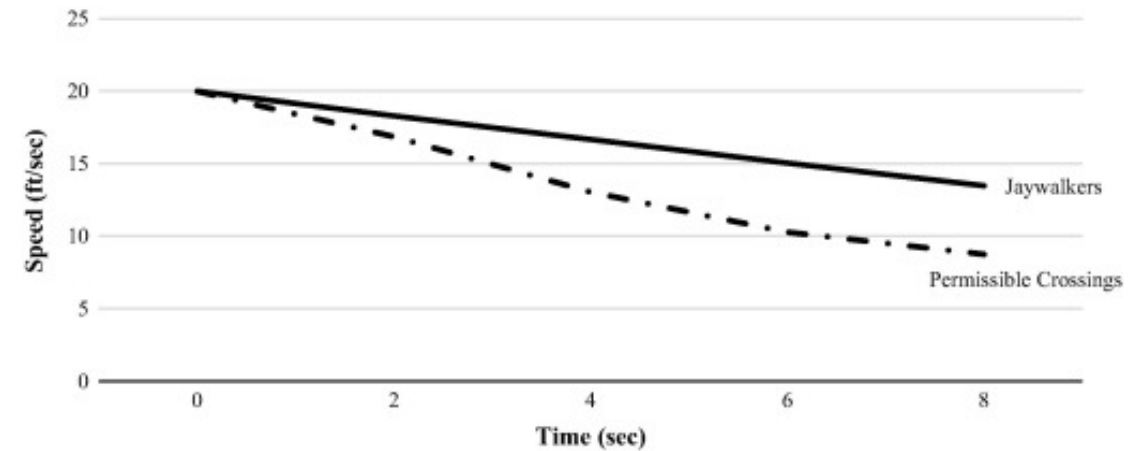
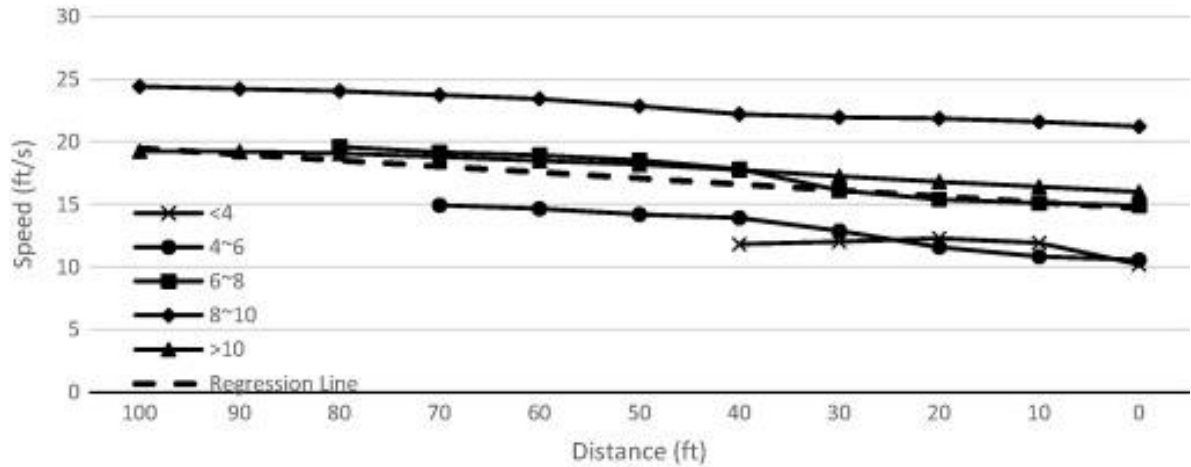
⊗ Decision point : Location where the driver starts to react to the presence of pedestrians (Data collected by GPS)

# Jaywalkers only Speed variation based on HY,SY,NY related distance



# SY : Compare speeds in TTC & Speed variation over time

- NY vehicles seems to have no large difference between VPI (Vehicle Pedestrian Interaction) and VJI (Vehicle Jaywalker Interaction).
- Regarding to Soft Yield analyzed distance of 100 ft, cause the average of driver decision point for jaywalking events is 85.81 ft

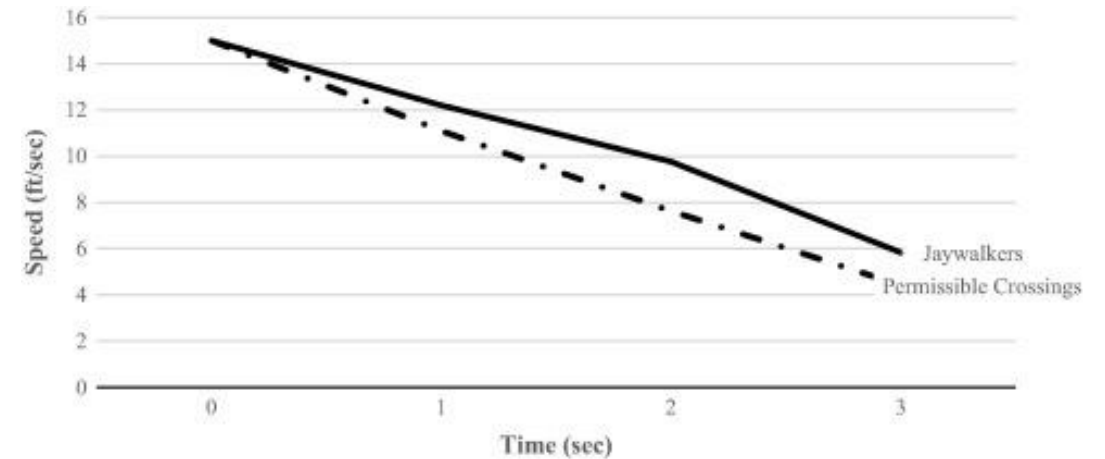
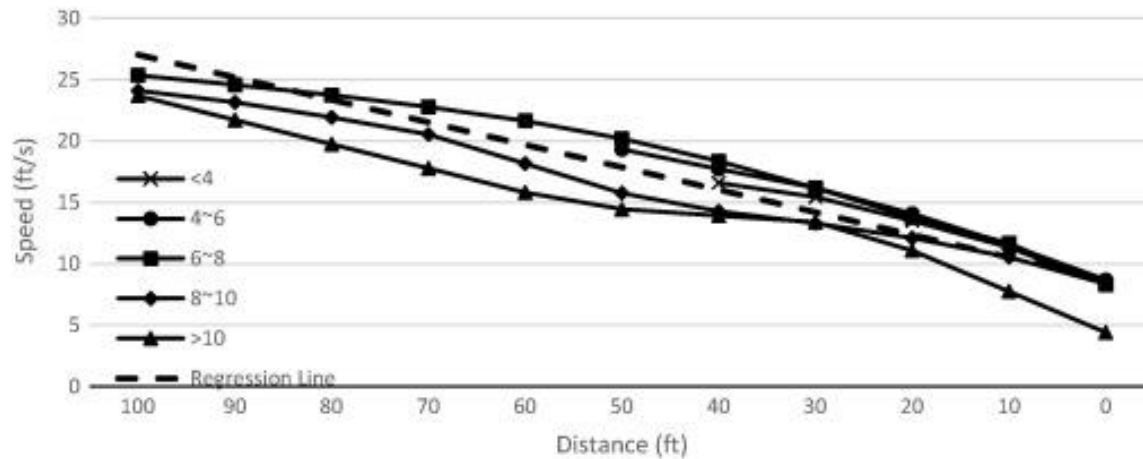


- Each graph are drawn by TTC (Time to Conflict :  $\frac{\text{the distance to crossing point}}{\text{the speed at that moment}}$  ) ※ Low price of TTC mean far away from crossing point or the speed at that moment is slow

## Inference

- According to TTC graph drivers who chose SY mostly have a similar deceleration rate
- The slope of the graph appears to be gentle
- According to regression line the average of deceleration rate to pedestrian who permissible crossing is  $-1.3 \text{ ft/sec}^2$  and to jaywalker is  $-0.818 \text{ ft/sec}^2$
- Drivers tend to slow down more to permissible crossings than to jaywalkers

# HY : Compare speeds in TTC & Speed variation over time



## Inference

- According to TTC graph, drivers who chose HY mostly have a similar deceleration rate
- Compared to SY, both graph slope seems to be steep
- According to regression line the average of deceleration rate to pedestrian who permissible crossing is  $-3.27 \text{ ft/sec}^2$  and to jaywalker is  $-3.4 \text{ ft/sec}^2$



# Conclusion

## Conclusion to driver reaction to jaywalkers

- Driver yielding rates are higher for pedestrians in permissive crossings (72.66%) compared to jaywalking events (50.67%)
- The average yield rate to jaywalkers on campus is about 51% and does not differ between drivers who mentioned the presence of jaywalking in the survey (“jaywalking-reported”) and those that did not (“jaywalking-unreported”); Moreover, drivers’ yield-to-jaywalker behaviors are not influenced by their driver type as classified based on level of aggressiveness
- Speed and distance at the driver decision point highly correlate to driver’s yield choice to jaywalkers. The decision point determines the start (time) location of vehicle–jaywalker interactions. It is shown that the decision point for reacting to jaywalkers is approximately 85.81 ft, while the average distance for permissible crossings is 132.37 ft.

# To my project

- The most exposed danger to pedestrians is when crossing at a crosswalk, of which jaywalkers are most exposed to danger. Based on this knowledge, I think it would be better to analyze the car reaction when jaywalker occur and compare to the pedestrian who are allowed to cross.

# End of slide

[https://www.sciencedirect.com/science/article/pii/S1569190X15001197?casa\\_token=ot3mWa7pCl8AAAAA:dAs\\_2Y1cOkf3tDP1\\_cFWrJAXTSr3wNQtmZrzwO8ph4Hh9npzQ0J8FYygjo4kMDw1BMqNclXynfo](https://www.sciencedirect.com/science/article/pii/S1569190X15001197?casa_token=ot3mWa7pCl8AAAAA:dAs_2Y1cOkf3tDP1_cFWrJAXTSr3wNQtmZrzwO8ph4Hh9npzQ0J8FYygjo4kMDw1BMqNclXynfo)