

# The Pedestrian Crossing Experience in Minnesota

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# Outline

- Framing the conversation legally and realistically
- Observation is the key to understanding
- Lessons learned

# Thou shalt yield!!

- Motorists must treat every corner and intersection as a crosswalk, whether it's marked or unmarked, and drivers must stop for crossing pedestrians.
- Pedestrians must obey traffic control devices, and when no traffic control device is present, motorists must stop for crossing pedestrians within a marked crosswalk or at an intersection with no marked crosswalk.



Office of Traffic Safety

A Division of the Minnesota Department of Public Safety

– <https://dps.mn.gov/divisions/ots/laws/Pages/bike-pedestrian.aspx>

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# Let's unpack this a bit.

- Subd. 20. Crosswalk. "Crosswalk" means
  - (1) that portion of a roadway ordinarily included with the prolongation or connection of the lateral lines of sidewalks at intersections;
  - (2) any portion of a roadway distinctly indicated for pedestrian crossing by lines or other markings on the surface.
- Subd. 36. Intersection. "Intersection" means
  - the area embraced within the prolongation or connection of the lateral curb lines or, if none, then
  - the lateral boundary lines of the roadways of two highways which join one another at, or approximately at, right angles or
  - the area within which vehicles traveling upon different highways joining at any other angle may come in conflict.

# Some of the Fine Print.

- Crossing between intersections.
  - (a) Every pedestrian crossing a roadway at any point other than within a marked crosswalk or at an intersection with no marked crosswalk shall yield the right-of-way to all vehicles upon the roadway.
  - (b) Any pedestrian crossing a roadway at a point where a pedestrian tunnel or overhead pedestrian crossing has been provided shall yield the right-of-way to all vehicles upon the roadway.
  - (c) Between adjacent intersections at which traffic-control signals are in operation pedestrians shall not cross at any place except in a marked crosswalk.

# More Fine Print

- Subd. 2. **Rights in absence of signal.**
  - (a) Where traffic-control signals are not in place or in operation, the driver of a vehicle shall stop to yield the right-of-way ....
    - The driver must remain stopped until the pedestrian has passed the lane in which the vehicle is stopped.
  - (b) When any vehicle is stopped at a marked crosswalk or at an intersection with no marked crosswalk to permit a pedestrian to cross the roadway, the driver of any other vehicle approaching from the rear shall not overtake and pass the stopped vehicle.



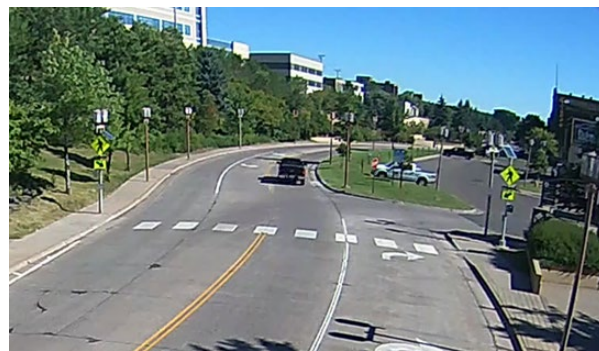
# Some Common Logic

- The driver must first notice the pedestrian in order to yield,
  - and acknowledge the intention to cross.
- The driver must realize that it is a “Pedestrian right-of-way” location.
- Pedestrians, like water, will follow the shortest path.





# An Escalation of Safety Treatments





# The MTO Research

- Observations



# 2010: Pedestrian Experience in Two Modern Urban Roundabouts

## Richfield Yielding Probability

General	41.4% (-4.7% if Bicycle n.s.)
Exiting Roundabout	22.8% (+22.2% if Entering)
Middle Island start	53%
66 <sup>th</sup> St crossings	39.9%
Portland Ave crossings	44.7%



## Minneapolis Yielding Probability

General	83.3% (-1% if Bicycle n.s.)
Exiting Roundabout	81.5% (+3.6% if Entering)
Middle Island start	93.6%

# Summary of Findings

## Yielding Behavior

- Crossing start: Island start = higher yield
- Direction of traffic: Exits = lower yield
- Pedestrian group size: Larger group increases yield chances.
- Distance from vehicle lane: If vehicle is in the lane near the pedestrian then it has higher probability of yielding.
- Vehicle was alone: If the vehicle was alone it had lower probability of yielding

## Pedestrian Delay

- Richfield roundabout
  - Average crossing delay: 2.3 sec overall
  - Average crossing with traffic delay:
    - Non Yielding: 10.6 sec with std of 10 sec
    - Yielding: 3.8 sec with std of 7 sec
- Minneapolis between 1/3 and 1/2 of above.
- Typically, average delay for a signalized intersection would be less than 1/2 of total cycle length. For Richfield ~30sec delay.



# 2019: Assessing the Impact of Pedestrian Activated Crossing Systems

- 31 sites selected
  - 19 RRFB sites (1 before/after)
  - 6 LED sites (6 before/after)
  - 4 HAWK sites
  - 2 standard signal sites





# Site Selection

- Factors considered:
  - Treatment type
  - Speed limit
  - Vehicle volume (AADT)
  - Lanes crossed
  - Traffic islands
  - Intersection type (4-way, T, midblock, free right turn)
  - Surroundings (urban, rural, school zone, etc.)



# Project Questions

- How does a Flashing LED Ped sign impact the rate of vehicles yielding to pedestrians at free right turns?
- How does a delayed activation impact the compliance of pedestrians in waiting to cross a street?
- How do refuge islands impact yielding to pedestrians?
- How do traffic islands impact wait times for pedestrians?
- How does the number of lanes affects yielding?
- How do yield rates differ per lane on multilane road crossings?
- Does the presence/type of the PAC affect the yield rate of far lanes on multilane roads?
- Which system is more effective at midblock crossings?
- Which system results in the lowest pedestrian delay?
- How often were HAWKs used properly by pedestrians? ....by drivers?
- Which system performed best at busy intersections?
- What was the rate of vehicles yielding to pedestrians by type of intersection (right turn, midblock, three-way, four-way)?
- What was the rate of vehicles yielding to pedestrians by treatment type?
- What was the rate of vehicles yielding to pedestrians by traffic volume?
- What was the rate of vehicles yielding to pedestrians on bikes?
- What was the rate of vehicles yielding to pedestrians by speed limit?
- What was the rate of vehicles yielding to pedestrians by conflict direction (left turn, right turn, near side through, far side through, etc.)?
- What was the rate of vehicles yielding to pedestrians by environment (school zone, rural, residential, commercial, etc)?
- What were pedestrian wait and crossing times?
- What was the rate of pedestrians using the crossing system?
- If not all vehicles yield to a pedestrian, how many vehicles did not yield to pedestrian by system?

# Data Analysis – HAWKs

Site	Island Destination	Lanes Crossed	All Driver Yield Rate	
			Activated	Not Activated
10	No	3	94.5%	58.3%
10	Yes	3	64.2%	62.1%
6	n/a	2	81.2%	75.0%
7	n/a	2	88.5%	56.5%
9	No	2	93.0%	100%
9	Yes	2	66.2%	42.8%

- Yield rate is higher when ped is crossing **from an island** than when crossing **to an island**
- Yield rate higher when HAWK is activated

Site	Lanes Crossed	Avg. Delay in seconds (Std. Dev.)	
		Activated	Not Activated
10	3	14 (7)	12 (15)
6	2	16 (5)	11 (10)
7	2	15 (4)	5 (8)
9	2	15 (7)	17 (14)

- The **avg. delay** is higher when the HAWK is activated but the **Std. dev. of delay** is lower

Site	Activation rate when vehicles were present
10	70%
6	66%
7	92%
9	91%

- Activation rate is similar to non-HAWK sites



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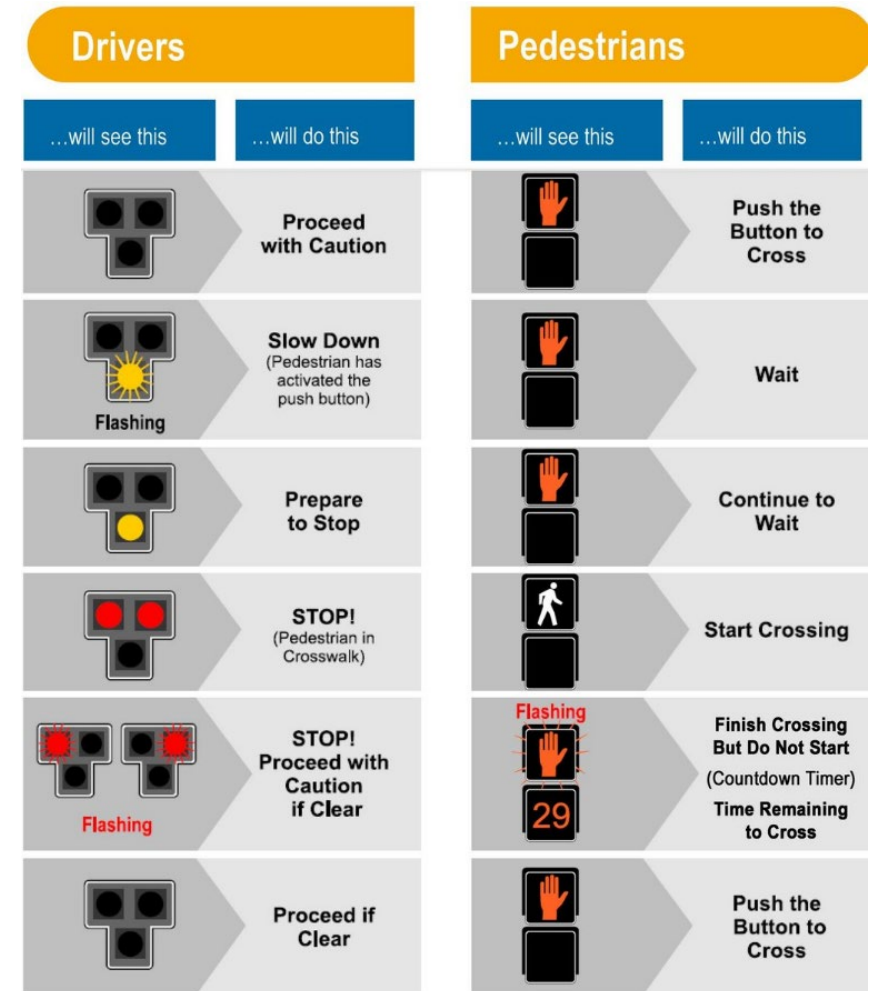


# Data Analysis – HAWKs

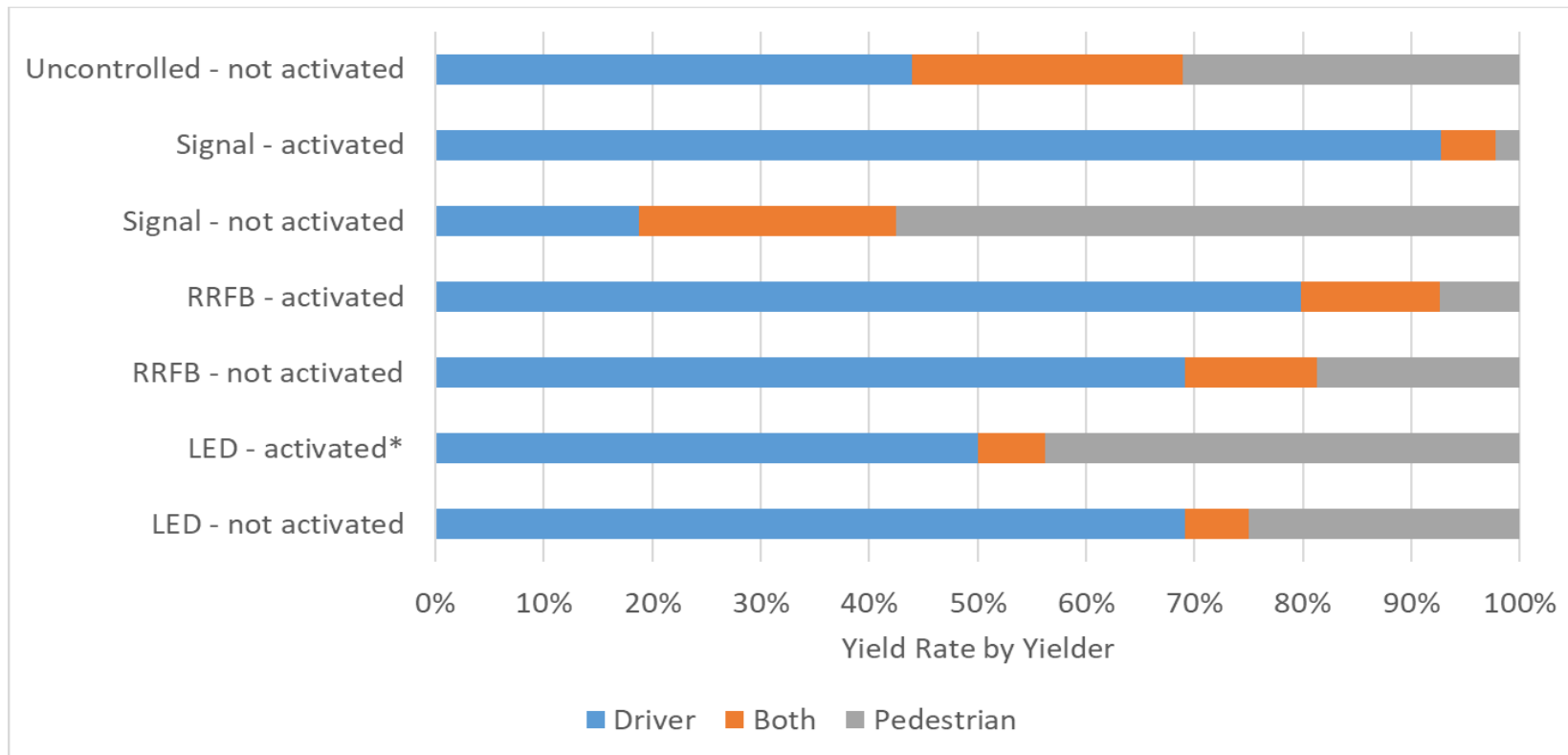
Site	Avg. number of vehicles not stopping (per event)	
	Yellow Phases	Red Phases
10	0.367	0.113
6	0.576	0.011
9	0.816	0.154
7	1.440	0.236

Site	Percent of events where vehicles moved during blinking red phase
6	25%
10	41%
7	47%
9	76%

- With the exception of **Site 7**, driver compliance on yellow and solid red is high
- Varying compliance on flashing red

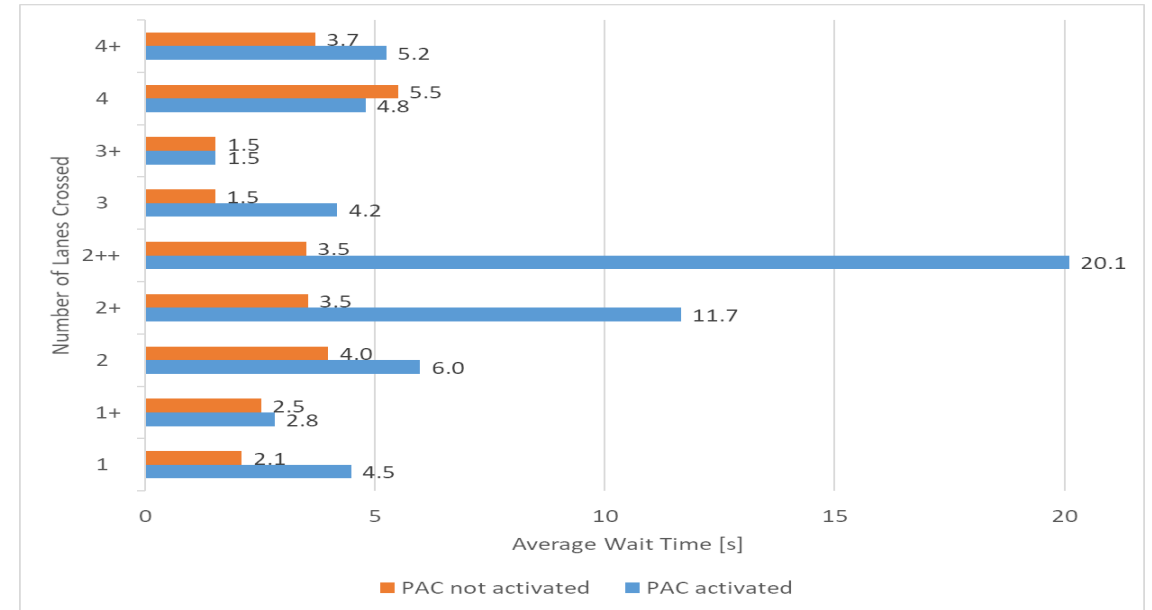
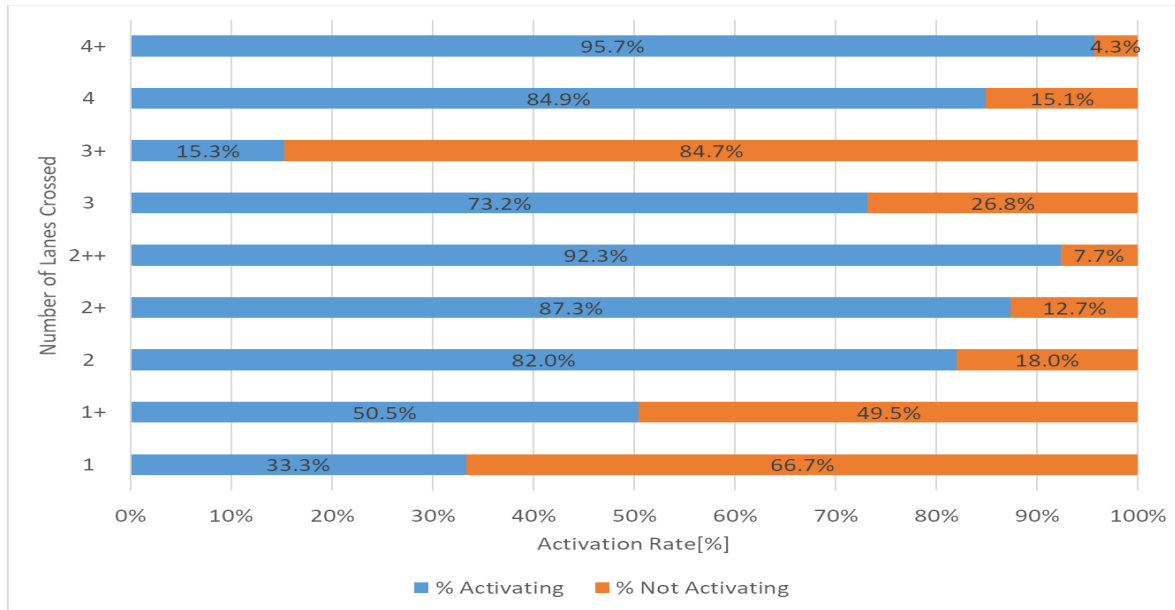


# Data Analysis – Non-HAWKs



- Signal clearly gives right-of-way
- RRFBs and LEDs still work as passive signs when not activated

# Data Analysis – Non-HAWKs



- Activation rate increases with number of lanes crossed
- Activation rate higher at two-phase crossings (+)
  - especially when there is also a signal (++)
- No correlation between lanes crossed and delay

# Data Analysis – Non-HAWKs

Treatment	Lanes Crossed	All Driver Yield Rate		Speed Limit (mph)	Lanes Crossed	# of Conflicts	Treatment	Overhead RRFB?	All Driver Yield Rate	
		Activated	Not Activated						Activated	Not Activated
RRFB	1	72.3%	66.2%	30	3	5	RRFB	Yes	91.30%	66.67%
RRFB	2	78.0%	60.4%	30	3	5	RRFB	No	78.00%	53.33%
RRFB	3	79.1%	59.2%	30	2	2	RRFB	Yes	72.01%	50.79%
RRFB	4	60.5%	34.8%	30	2	2	RRFB	No	88.70%	82.93%
Signal	2	75.9%	60.5%	50	2	4	RRFB	Yes	92.80%	66.67%
Site	Activated	Four-Way	Not Activated	50	4	3	Treatment	Lanes Crossed	Intersection Type	All Driver Yield Rate
U4	100.0% (30)	Midblock	93.1% (175)	30	1	RRFB 1	RRFB	2	Four-Way	52.1%
46	93.5% (185)	Midblock	66.7% (3)	30	2	RRFB 2	RRFB	3	Four-Way	51.1%
27	81.0% (100)	Island-Intersection	60.0% (30)	30	3	RRFB 4	RRFB	4	Four-Way	58.6%
23	65.9% (44)	Island-Intersection	29.4% (34)	30	2	RRFB 2	RRFB	2	Four-Way	66.9%
U1	44.7% (76)	Island-Intersection	12.5% (8)	50	3	RRFB 4	RRFB	4	Four-Way	27.3%
RRFB	1	No	69.4%	55	2	2	RRFB	2	Four-Way	69.6%
RRFB	2	Yes	80.8%	55	3	3	RRFB	2	Four-Way	68.4%
RRFB	25	73.1% (130)	85.4%	55	2	2	RRFB	1	Midblock	68.4%
RRFB	U2a	72.1% (172)	63.2%	55	2	2	RRFB	2	Midblock	42.9%
RRFB	U2b	68.7% (198)	78.0%	55	2	2	RRFB	2	Midblock	53.3%
RRFB	4	81.8% (22)	59.1%	50	2	2	RRFB	2	Midblock	70.6%
Signal	11	98.0% (151)	83.9%	14.7% (61)	2	2	Signal	2	Midblock	25.0%



# Summary Findings

- PACs are most effective at sites...
  - without good sight distances and/or advance warning
  - with a high number of movements conflicting with the crosswalk
- Speed limit is not a good predictor of effectiveness
- Yield rates are generally higher with overhead RRFBs (even when not activated)

# Questions

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The logo for the Minnesota Traffic Observatory (MTO) features the letters 'MTO' in a bold, blue, sans-serif font. The 'M' and 'T' are connected, and the 'O' is a simple circle.

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