CMAP March 31, 2016

FLASHING YELLOW ARROWS

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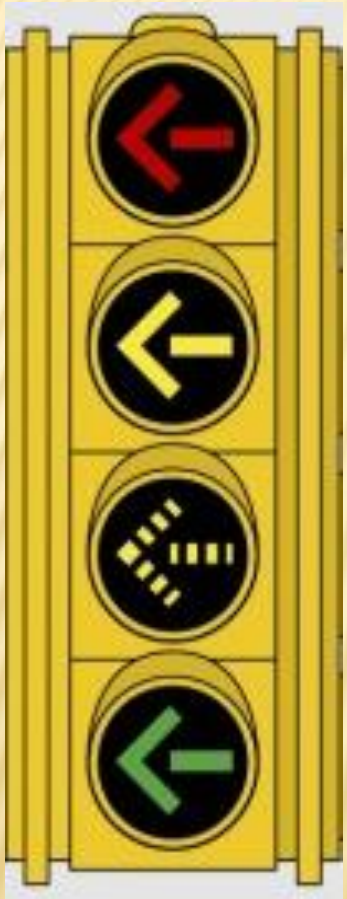


- How did it get started
- Early Research
- Our projects
- Outreach
- Construction
- Our Research
- Next steps

WHAT'S THE PROBLEM ?

- Safety problems with permissive left turn movements at traffic signals.
- High probability for an injury in a left turn crash.
- Circular green for left turns can be confusing.
  - For buried lefts
  - For a vehicle just pulling up.
  - For beginners and the elderly
  - For the distracted

HISTORY OF FYA

- States try various methods to improve the safety of the left turners. FR, FY, FYA, FRA.
  - Michigan – Flashing Circular Red
  - New Jersey and California – Flashing Yellow arrow
  - Peoria, Illinois – Flashing Red Arrow
- FHWA says we can only use one method.

SUMMARY OF THE RESEARCH

- NCHRP 493 (2003) Evaluation of Traffic Signal Displays for Protected/Permissive Left Turn Control
  - In the laboratory
  - On the street
- NCHRP 493 found that displays with exclusive heads were found to offer the higher ratings in terms of safety, operations, human factors, and versatility.
- The FYA was found to be more intuitive and had fewer “false positive” reactions as compared to the green ball.

MORE RESEARCH

- NCHRP Web-Only Document 123 (2007) Evaluation of FYA
- NCHRP Web-Only Document 123 follow-up study indicated significant safety benefits of the FYA.
- FHWA Interim approval for Optional Use of Flashing Yellow Arrow for Permissive Left Turns (March 2006)
- Optional in the 2009 MUTCD

MUTCD REQUIREMENTS

- *"Guidance:*
- 09 *For new or reconstructed signal installations, on an approach with an exclusive turn lane(s) for a left-turn (or U-turn to the left) movement and with opposing vehicular traffic, signal faces that display a CIRCULAR GREEN signal indication should not be post-mounted on the far-side median or mounted overhead above the exclusive turn lane(s) or the extension of the lane(s)."*

MUTCD REQUIREMENTS

- "If a separate left-turn signal face is mounted overhead at the intersection, it is positioned over the extension of the left-turn lane. In a separate left-turn signal face, a flashing left-turn YELLOW ARROW signal indication or a flashing left-turn RED ARROW signal indication is used to control permissive left-turning movements."

WHAT DOES FYA MEAN

A solid red arrow means STOP. Drivers turning left must stop.

A solid yellow arrow indicates this traffic signal will be turning red.

A flashing yellow arrow means turns are permitted, but you must first yield to oncoming traffic and pedestrians, then proceed with caution.

A solid green arrow means turn left. Oncoming traffic must stop.

ADVANTAGES PER NCHRP 493 & 123

- Provides an exclusive display for left turn control
- Reduces Left Turn Crashes
- Eliminates the left turn trap for lagging lefts.
- Better progression using lead - lag lefts.
- Increases capacity
- Can be used for different phasing schemes.
- Promotes nationwide consistency for protected/permissive display

DISTRICT FOUR FYA PROJECT

- Two Major Safety Projects
  - April 2010 Letting
    - IL 40 (Knoxville Ave) & US 150 (War Memorial Drive)
    - $400,000.00
  - June 2010 Letting
    - Rest of the State routes in Peoria, East Peoria, Pekin, Bartonville, Creve Coeur, North Pekin and Morton
    - $500,000.00
- Multiple small projects
- Galesburg, Aledo and Macomb
- Total of 150+ intersections

OUTREACH

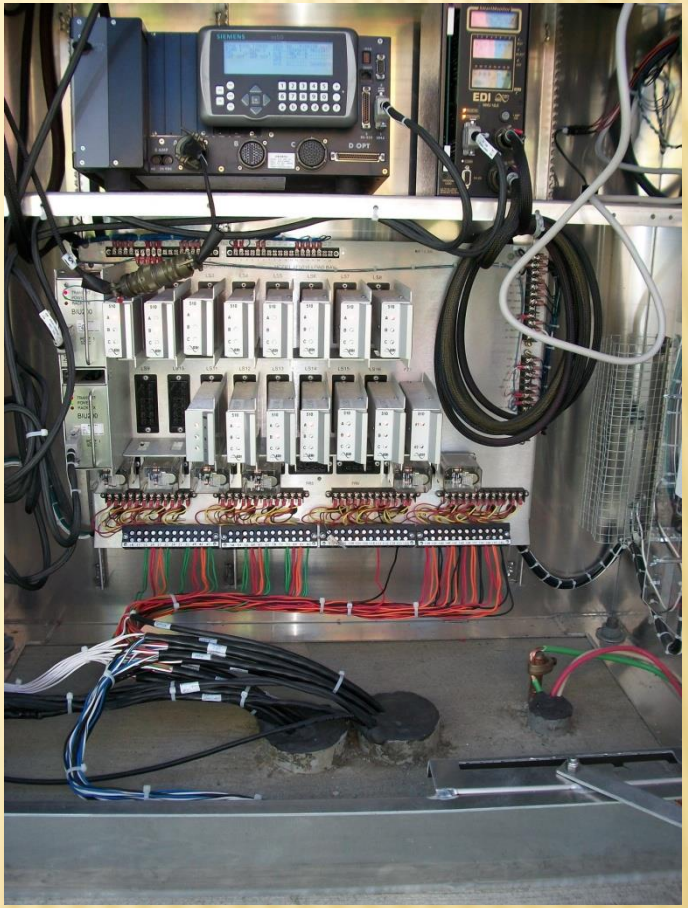
- Support from the cities
- Presentations
- Brochures
- You Tube
- Attempted Press Conference
- Television News Stories
- News Paper Articles

WHAT DID THE CHANGE TO FYA INVOLVE?

- New signal heads
- Additional cable
- New controller – Maybe
- New cabinet – Maybe
- Rewire cabinet
- Reprogram Controller
- New MMU

ECONOLITE

EAGLE



CHALLENGES

CHALLENGES

- Software
- MMU
- Conduit
- Training
- Signs

SIGNS


LEFT TURN
YIELD
ON
FLASHING


LEFT TURN
YIELD
ON
FLASHING
YELLOW
ARROW

PASADENA CALIFORNIA

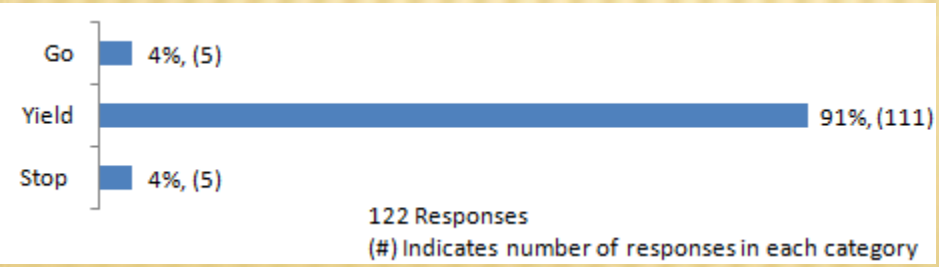
BRADLEY RESEARCH

- Literature Review
- Driver Survey
- Gap Acceptance
- Red Light Running
- Crash Analysis

COMPARATIVE SURVEY RESULTS

- If you want to turn left, and you see the traffic signal shown below, what would you do?

PHASE 1



PHASE 2

COMPARATIVE SURVEY RESULTS

- If you want to turn left, and you see the traffic signal shown below, what would you do?

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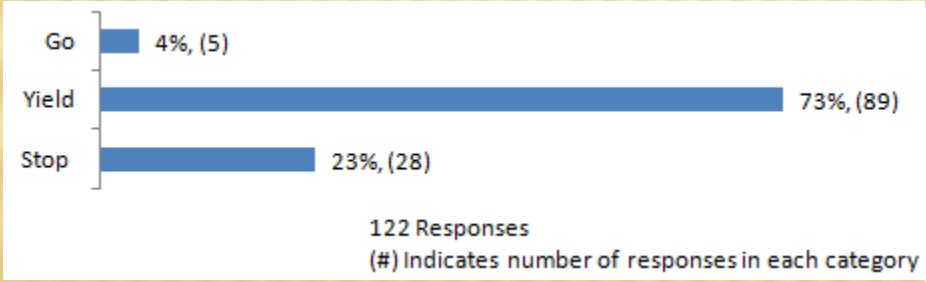
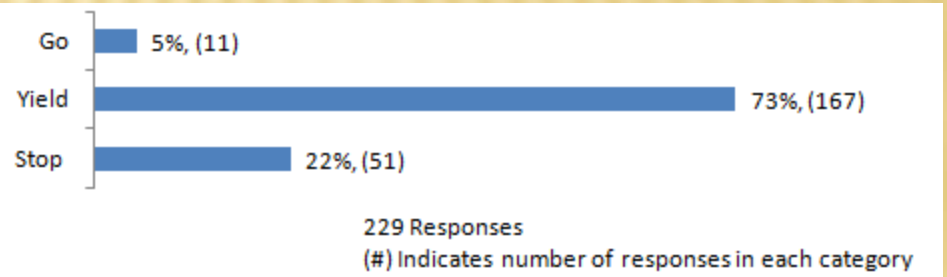


PHASE 2



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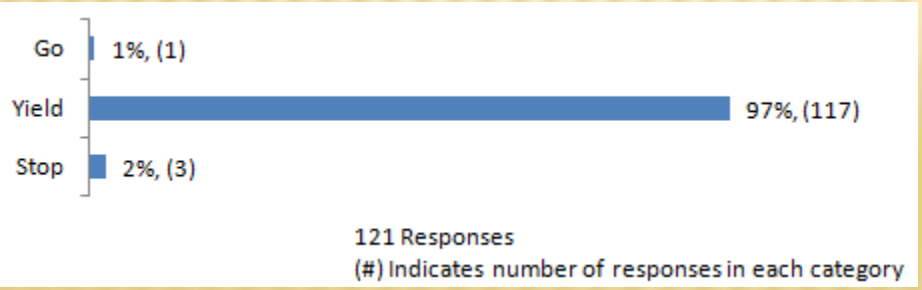
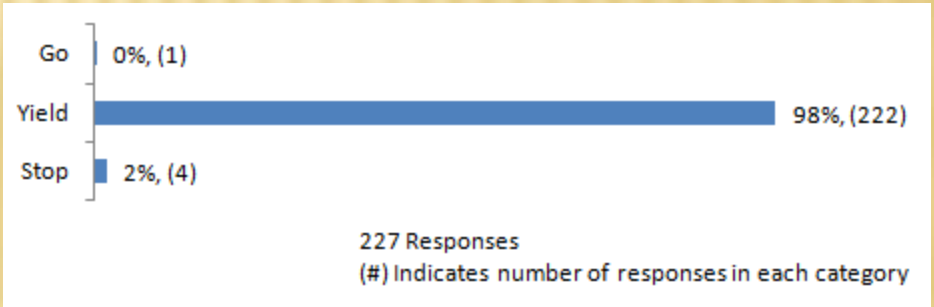


PHASE 2



B&A CRASH FREQUENCY RESULTS

- 92 FYA approaches with supplemental signage

	FINAL RESULTS			
Crash Type	Before	After	% Reduction	Significant?*
Total crash frequency	182	166.67	8.40%	No
Injury crash frequency	55.33	46.33	16.30%	No
LT related crash frequency	72.33	50.00	**30.90%**	**Yes**
LTOT crash frequency	49.67	35.33	**28.90%**	**Yes**

*Based on Poisson test at 95% LOC
Data Through June 2014

B&A CRASH FREQUENCY RESULTS

- 72 FYA approaches without supplemental signage

	FINAL RESULTS			
Crash Type	Before	After	% Reduction	Significant?*
Total crash frequency	146.67	159.00	-8.40%	No
Injury crash frequency	41.67	40.00	4.00%	No
LT related crash frequency	52.67	46.67	11.40%	No
LTOT crash frequency	40.67	34.00	16.40%	No

*Based on Poisson test at 95% LOC
Data Through June 2014

INTERSECTION

Crash Type	B&A - Intersection				EB - Intersection			
	Before	After	% Reduction	Significant?*	Expected	Actual	% Reduction	Significant?*
Total crash frequency	554	548.33	1.02%	No	560.74	548.33	2.21%	No
Injury crash frequency	154.33	139	9.94%	No	161.5	139	**13.93%**	**Yes**
LT related crash frequency	158.33	123	**22.32%**	**Yes**	159.27	123	**22.77%**	**Yes**
LTOT crash frequency	99.67	78	**21.74%**	**Yes**	99.05	79	**20.25%**	**Yes**

APPROACH

Crash Type	B&A - Approach				EB - Approach			
	Before	After	% Reduction	Significant?*	Expected	Actual	% Reduction	Significant?*
Total crash frequency	328	324	1.20%	No	327.66	342	1.12%	No
Injury crash frequency	97	86	11.30%	No	97.23	86	11.55%	No
LT related crash frequency	125	96	**23.20%**	**Yes**	125.16	96	**23.30%**	**Yes**
LTOT crash frequency	90.33	68.67	**24.00%**	**Yes**	91.34	68.67	**24.82%**	**Yes**

*Based on Poisson test at 95% LOC
Data Through June 2014

YOUNGER DRIVER

Table 7.4 Younger Driver Analysis Results

Crash Type	Aggregated on an Intersection-Level				Aggregated on an FYA Approach-Level			
	Avg. Annual Before Crashes	Avg. Annual After Crashes	% Reduction	Significant?* (p-value)	Avg. Annual Before Crashes	Avg. Annual After Crashes	% Reduction	Significant?* (p-value)
Total crashes	160.33	139.67	**12.9%**	**Yes (0.05)**	98.67	82.33	**16.6%**	**Yes (0.05)**
Injury crashes	43.33	28.67	**33.9%**	**Yes (0.02)**	31.00	18.00	**41.9%**	**Yes (0.01)**
LT related crashes	52.00	34.33	**34.0%**	**Yes (0.01)**	43.33	26.67	**38.5%**	**Yes (0.01)**
LTOT crashes	35.33	25.00	**29.3%**	**Yes (0.05)**	32.33	20.67	**36.1%**	**Yes (0.03)**

* Based on Poisson Test of crash frequencies at 95% LOC and significance level $\alpha = 0.05$

BENEFIT COST RATIO

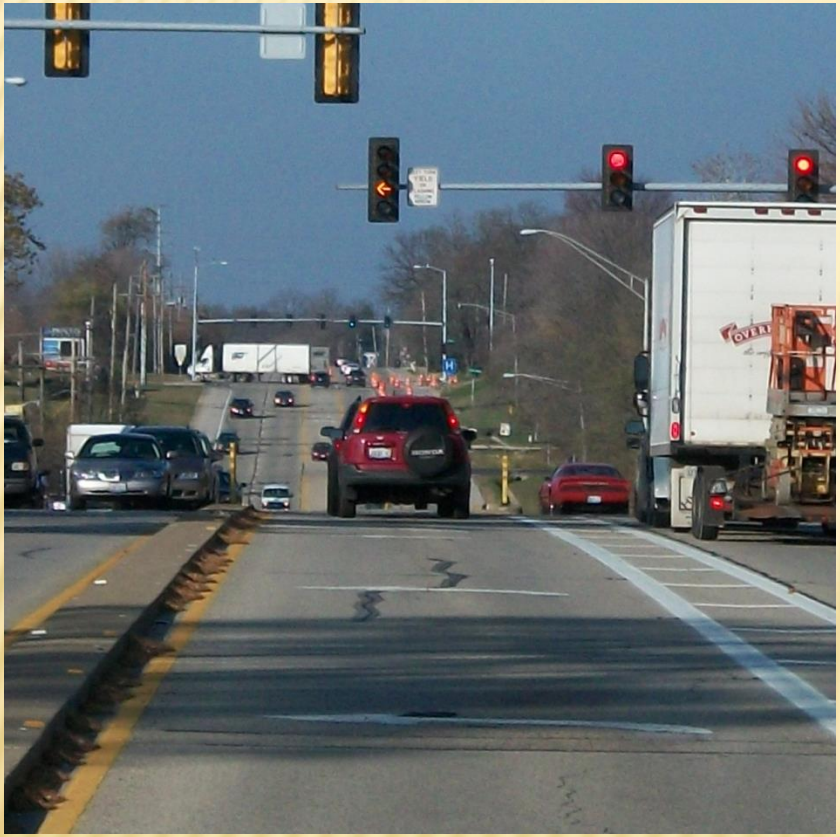
Table 8-3. Resulting Annual Benefits and Costs of FYA

FYA EUAB	$1,630,060
FYA EUAC	$82,460
B/C Ratio	19.8

LEFT TURN TRAP

- Lead - Lag Lefts
  - Progression – Great results
  - Crashes - Lake St. Left Turn crashes 3 to 14
    - Louvers?
    - Patience?
    - Left turn sight distance?

LEFT TURN BAY TREATMENTS



NEXT STEPS

- Change the Illinois Vehicle Code - Complete
- Study the Results - Complete
  - Bradley University
  - Illinois Center for Transportation
- Macomb and the rest of the District - Complete
- Get the entire State interested – Springfield is started.

QUESTIONS

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- Illinois Department of Transportation
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- Randall.Laninga@illinois.gov