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Factors Affecting Driver Yielding Compliance on College Campuses:

An Evaluation of 31 Uncontrolled Midblock Crosswalks on Low Speed Roadways in Michigan

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Wednesday, April 19, 2017

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Background - Importance of Pedestrian Safety Assessment

- Recent policy initiatives encourage more pedestrian infrastructure (& ped volumes/exposure)
  - Complete Streets
  - Trails and Greenways
  - TIP/Enhancement Funding
  - Safe Routes to School
  - Transit

- Overrepresentation in pedestrian crashes
  - Pedestrian fatalities **up 21.4%**
  - Traffic fatalities **up 8.3%**
- Identification of risk factors and high risk sites

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Background - Pedestrian Safety Modeling

- The AASHTO Highway Safety Manual (HSM) sets the standard for SPF/CMF development
- Challenges:
  - HSM only provides for Pedestrian SPFs at intersections based on land-use characteristics
  - Research is limited in terms of disaggregate-level studies considering volume, geometry, etc
  - Ped crashes are extremely rare events
  - Are proxy measures available?

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Field Study

- Objective: Compare the relative effectiveness of various existing traffic control devices at uncontrolled crosswalks on low speed streets
  - Medians
  - Marking Types
  - Crossing Widths
  - Enhancement Devices: PHB, RRFB, R1-6
    - In place for > 1 year

- Method
  - Crash evaluation?
  - Conflict (near-crash) analysis?
  - Yielding compliance?

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Site Selection

- 31 sites were selected on low speed streets on/near campuses in Detroit, East Lansing, and Kalamazoo
- Sites were selected to provide broad range of:
  - Vehicle and ped volumes
  - Crosswalk treatment
  - Laneage and widths
  - Divided and undivided
  - One-way and two-way

County	# Ped Crashes 2010-2014	Pedestrian Crashes per 10,000 people
Wayne	3531	19.9
Ingham	430	15.2
Kent	884	14.2
Washtenaw	500	14.1
Kalamazoo	345	13.4

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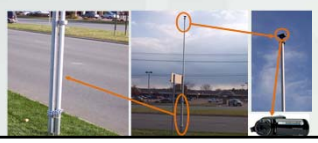
Data Collection

- Neither a crash evaluation nor conflict analysis provided adequate sample sizes
- Yielding compliance from staged pedestrian crossing events was ultimately utilized
- Elevated cameras recorded events and volumes
- Data collection performed weekday mid-day periods (9 AM to 4 PM)



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Staged Pedestrian Crossing

- Trained pedestrian entered into crosswalk when the subject vehicle reached the dilemma zone
  - Based on methods of Van Houten, Fitzpatrick
  - Provides consistency in pedestrian crossing behavior (conspicuity, eye contact, etc.)
- Each event was scored for driver yielding
- Other vehicle variables considered:
  - Vehicle's lane during crossing encounter
  - Position of vehicle in queue

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Staged Crossing Example (Divided)

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Staged Crossing Example (Unmarked)

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Site Summary Statistics

- 1,281 staged ped crossing events
- 62% of drivers yielded to staged pedestrian
- Crossing width:
  - Ranged from 22 ft to 54 ft, with a mean of 35 ft
- Number of lanes:
  - Ranged from 2 to 4, with a median of 2 lanes
- Hourly volumes ranged from:
  - Vehicles: 218 to 1,204 (average of 439)
  - Ped Crossings (naturalistic): 5 to 662 (average of 86)
  - Bicycles: 0 to 31 (average of 9)

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Analysis

- Binary logistic regression with mixed effects
  - Good for analyzing dichotomous outcomes, i.e. "yielded" or "did not yield"

$$\ln\left[\frac{p_i}{1-p_i}\right] = \alpha_j + \beta' X_i$$

- where
  - p_i = response probability of a driver yielding
  - α_j = intercept term
  - β' is a vector of estimable parameters
  - X_i is a vector of predictor variables (e.g., crosswalk treatment, pedestrian/vehicular volumes, etc.).

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Binary Logistic Regression Results

Variable	Level or Unit	Coefficient Estimate	t-stat	Odds Ratio
Constant		-3.416	0.005	N/A
Crosswalk Treatment	Unmarked	baseline		
	Standard only	1.01445	0.0044	2.8
	Continental only	1.24722	<0.0001	3.5
	In-Street R1-6 Sign	2.83458	<0.0001	17
	PHB	2.93714	<0.0001	18.9
Crossing Width	ln ft	0.54656	0.0822	1.7
Pedestrian Volume	ln ped/hr	0.18541	0.0099	1.2
Vehicle Lane Position	Near (curb) lane	baseline		
	Other lane	0.83107	<0.0001	2.3
Vehicle Position in Queue	Unqueued vehicle	baseline		
	Queue leader	0.45534	0.0011	1.6
	Queue follower	-0.35329	0.0411	0.7
Cross-Section	Undivided	baseline		
	Divided	-0.34902	0.0032	0.7

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Yielding Compliance by Treatment

Crosswalk Treatment	Number of Locations	Number of Observations	Percent of Drivers Yielding
Unmarked	5	261	28.7%
Standard only	3	88	50.0%
Continental only	17	744	66.3%
In-Street Sign (R1-6)	3	101	95.0%
PHB	2	51	98.0%
RRFB	1	36	100.0%
ALL	31	1,281	62.0%

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Yielding Compliance by Lane Position & Cross-Section or Treatment

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Conclusions

- Type of crosswalk treatment has a strong influence on driver yielding compliance
  - Enhancement Devices > Markings Only > Unmarked
  - Results agreed with prior research
  - Crosswalk enhancement devices showed improvements over prior Michigan studies
    - Familiarity?
- Yielding compliance showed little sensitivity to lane position at sites with crosswalk enhancements
  - Crosswalks without enhancement devices were highly affected by driver lane position
    - Vulnerability? Conspicuity?

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Recommendations

- Providing marked crosswalks at uncontrolled locations with light to moderate vehicle volumes will improve yielding compliance vs. no markings
  - Additional enhancement treatments are not necessary unless special circumstances (school, hospital, etc.) exist.
- Where high vehicle and/or ped volumes exist, utilize low-cost treatments such as R1-6 signs
  - Particularly at multilane crossings
- RRFBs and especially PHBs, should only be installed at select locations with high ped and vehicular volumes, particularly where other treatments have proven to be ineffective.

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Limitations

- Results are limited to low speed locations only
  - Yielding compliance is likely different on higher speed roadways, as pedestrian activity is typically less frequent
- All sites selected in this study were on or near public universities in the Midwest during the early fall when school was in session
  - Younger demographic than general population
  - Larger than typical ped volumes at most locations
  - Driver unfamiliarity may also be an issue
  - Pedestrian invincibility

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Questions?

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