DRIVER YIELDING MODELS FOR MIDBLOCK PEDESTRIAN CROSSINGS

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OBJECTIVE

Using Statistical Models:

- Describe driver yielding behavior toward pedestrian(s) based on vehicle/driver and pedestrian variables

To address this objective, **observational studies** were conducted at midblock locations with clearly marked crosswalks.

FRAMEWORK

An interaction event between pedestrians and drivers begins at the moment a pedestrian reaches the crosswalk influence area while a driver is on the approach.
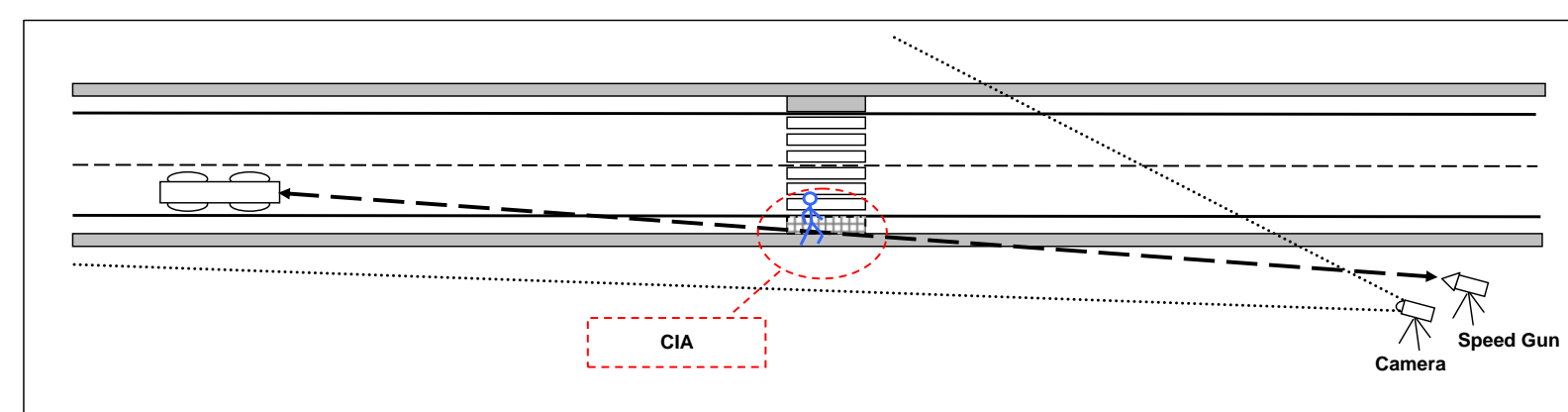
Both the pedestrian and the driver have decisions to make. The pedestrian may decide to accept a gap or wait for a vehicle to yield, while the driver must decide if they will, or if they even can, yield.
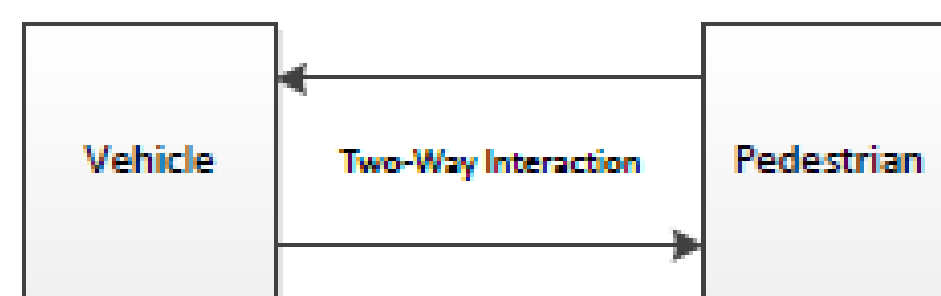
METHODOLOGY

Data Collection Process:

- Real-time observations by trained observer on a tally sheet
- Video recording of the crosswalk
- Lidar speed measurements of approaching vehicles

Validation:

- Pull one representative dataset from each state before creating models
- Determine which model gives better results

DATA COLLECTION

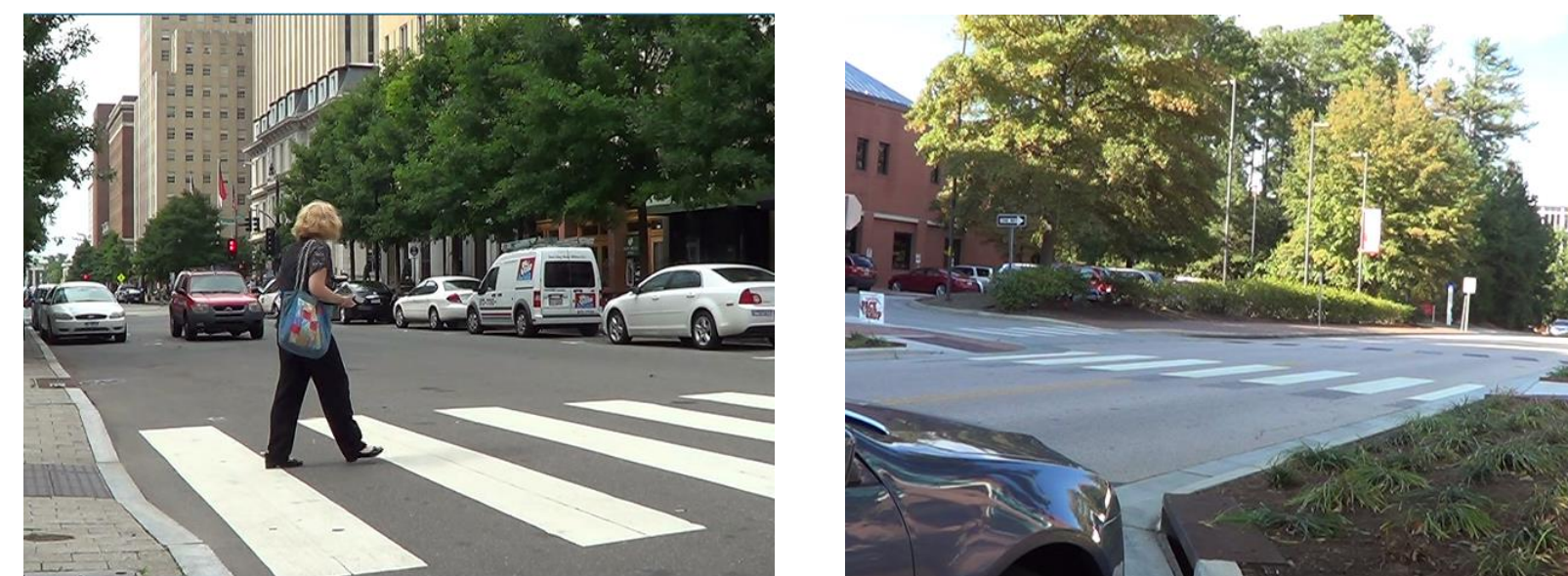**Characteristics of Sites and Pedestrian Population:**

- On-campus and off-campus
- Geometry: single- or multi-lane with/without turn lanes, single- or two-stage crossing
- Land use: education, public office, parking
- User types: age, attire, gender, behavior

Equipment Used:

- Video camera and tripod
- Laser speed gun

Study Sites:

City	State	On/Off Campus
Raleigh	NC	3 On, 3 Off
Greensboro	NC	2 Off
Tuscaloosa	AL	4 On
Birmingham	AL	3 Off
Gainesville	FL	4 On, 6 Off

Factor	Description	Value
SPD	The speed of the first vehicle (mph), at the time the pedestrian arrives at crosswalk influence area (waiting location), recorded from speed gun	Mph
ADJDIST	Vehicle position at the time of pedestrian arrival in crosswalk influence area measured in feet using a LIDAR speed measurement device; ADJDIST is calculated from measured distance, speed, distance delay and Distance to Crosswalk; ADJDIST=DIST+SPD*1.467*DIST_DEL-Distance to Crosswalk	Ft
YIELD	Whether the first vehicle yielded and if it was a hard or soft yield	No=NY, Soft= SY, Hard=HY
NEAR	Whether the vehicle for which speed and distance was recorded (first vehicle) was in the lane nearest or farthest from the pedestrian	Near=1, Far=0
ADJ	Whether there was a yield on the other side of the road (opposite direction) or a yield in an adjacent lane (same direction)	Adj. Yield=1
PLT	If the first vehicle was in a platoon or had a close follower	Platoon=1
HGV	First vehicle type: passenger car or heavy vehicle (bus or truck)	Heavy Vehicle=1
MUP	If there were other pedestrians present near the crosswalk; if any pedestrian is at either sides of the street or the splitter island and intends to cross	Multiple Pedestrian=1
MED	Whether the pedestrian crossed from the median or the curb	Median=1, Curb=0
CTRL	Whether the crossing pedestrian was controlled (researcher) or random (observational study)	Controlled=1, Random=0
IN_CW	Whether the pedestrian stopped in the crosswalk or at the curb. This variable shows the behavior of the pedestrian. A passive pedestrian is defined to wait at the curb for a crossing opportunity however an assertive pedestrian is defined to be waiting in the crosswalk or walking toward the crosswalk	Crosswalk=1, Curb=0
TTC	Time until vehicle would theoretically arrive at the crosswalk; TTC is calculated from the measured speed and distance at the time pedestrian arrives in the crosswalk influence area; TTC=ADJDIST/(SPD*1.467)	Seconds
DECEL	Deceleration rate necessary to come to a full stop prior to crosswalk; DECEL is calculated from measured speed and adjusted distance; DECEL=(SPD*SPD)/(2*ADJDIST)	Ft/s²
STUDENT	Researcher's estimate of the pedestrian's age group	Student=1, Adult=0
DISTR	Whether the pedestrian was distracted by an outside source, such as a cell phone	Yes=1, No=0
BUSINESS	Researcher's observation of the pedestrian's attire or clothing	Business=1, Casual=0
FEMALE	Pedestrian's gender	Female=1, Male=0

MODEL DEVELOPMENT

Model Development:

- Use observation data to create models
- Model types being considered:
  - Binary logit – Single choice between Y and NY
  - Pseudo nested logit – After Y is selected, single choice between HY and SY
  - "Flip-of-a-coin" based on group probabilities (not included in sample results)

SAMPLE RESULTS

Full Binary Logit Model

Analysis of Maximum Likelihood Estimates					
Parameter	DF	Estimate	Standard Error	Wald Chi-Square	Pr > ChiSq
Intercept	1	1.8820	0.6443	8.5328	0.0035
SPD	1	-0.1846	0.0296	38.9600	<.0001
ADJDIST	1	0.0107	0.00364	8.5578	0.0034
NEAR	1	0.5844	0.2121	7.5951	0.0059
ADJ	1	1.0466	0.2983	12.3087	0.0005
PLT	1	0.2567	0.1622	2.5037	0.1136
HGV	1	-0.7799	0.3489	4.9960	0.0254
MUP	1	1.0254	0.2346	19.1008	<.0001
MED	1	1.4558	0.2614	31.0254	<.0001
CTRL	1	-0.3252	0.2072	2.4646	0.1164
TTC	1	-0.2036	0.0991	4.2207	0.0399
DECEL	1	-0.00168	0.0335	0.0025	0.9601
STUDENT	1	0.5377	0.2315	5.3961	0.0202
DISTR	1	0.2498	0.7270	0.1181	0.7311
BUSINESS	1	-0.9817	0.3753	6.8441	0.0089
FEMALE	1	-0.0104	0.1601	0.0042	0.9483

- Sample Size: 432 Yields, 543 Non-Yields
- Significant: SPD (-), ADJDIST (+), NEAR (+), ADJ (+), HGV (-), MUP (+), MED (+), TTC (-), STUDENT (+), BUSINESS (-)
- Forward selection and backward elimination models showed same variables to be significant

Recommended Binary Logit Model

Analysis of Maximum Likelihood Estimates					
Parameter	DF	Estimate	Standard Error	Wald Chi-Square	Pr > ChiSq
Intercept	1	0.9432	0.3894	5.8656	0.0154
SPD	1	-0.1435	0.0150	92.0423	<.0001
ADJDIST	1	0.00418	0.00119	12.3099	0.0005
NEAR	1	0.4824	0.1943	6.1651	0.0130
ADJ	1	1.0006	0.2937	11.6085	0.0007
HGV	1	-0.7919	0.3464	5.2261	0.0223
MUP	1	1.1661	0.2117	30.3435	<.0001
MED	1	1.3593	0.2449	30.8101	<.0001
STUDENT	1	0.4905	0.2218	4.8912	0.0270
BUSINESS	1	-0.8579	0.3707	5.3558	0.0207

- Removed TTC since this variable was intercorrelated with ADJDIST
- STUDENT and BUSINESS have opposite sign, may show difference in driver behavior by location

Pseudo Nested Logit Model

Analysis of Maximum Likelihood Estimates					
Parameter	DF	Estimate	Standard Error	Wald Chi-Square	Pr > ChiSq
Intercept	1	-0.0760	0.4074	0.0348	0.8520
ADJDIST	1	-0.0126	0.00236	28.6614	<.0001
NEAR	1	-0.7733	0.2381	10.5463	0.0012
ADJ	1	0.9601	0.3192	9.0454	0.0026
MUP	1	1.3988	0.2542	30.2834	<.0001
DECEL	1	0.3686	0.0816	20.3974	<.0001

- Significant: ADJDIST (-), NEAR (-), ADJ (+), MUP (+), DECEL (+)

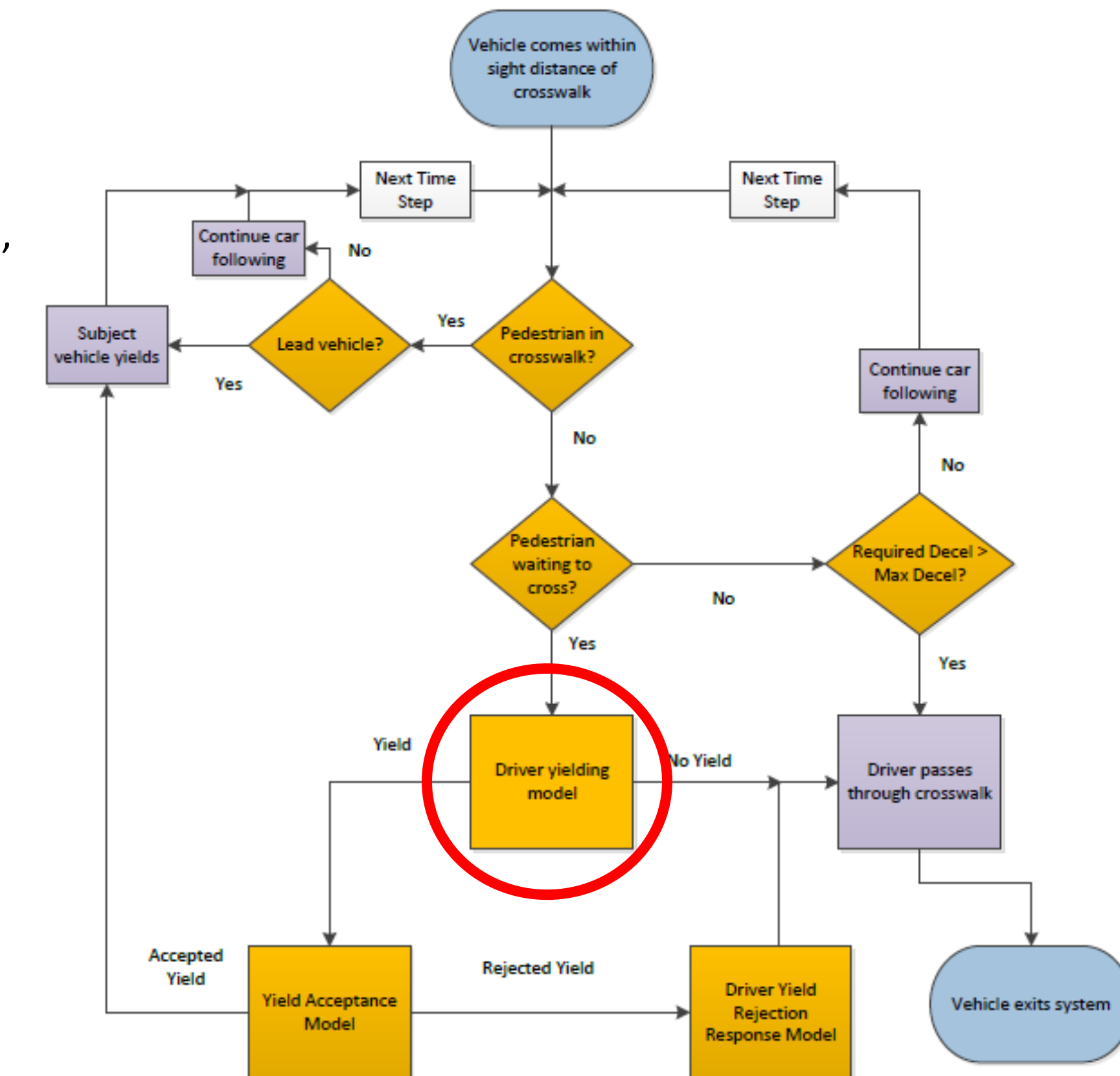- All Max-rescaled R² values between 0.33 and 0.35

NEXT STEPS

Next steps include:

- Validate model
- Determine if model needs further editing
- Choose final yielding model
- Compile discussion of modeling process for final report

IMPLEMENTATION

The driver yielding model, as well as a gap acceptance model, will be incorporated in algorithms ready to be implemented in microscopic traffic simulation tools to assure successful technology transfer.

Vehicle Process Flow:

ACKNOWLEDGEMENTS