FHWA PedSafe: The San Francisco MTA/UC Berkeley Pedestrian Safety Program

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MTA | Municipal Transportation Agency

In partnership with:

The San Francisco Setting

- **POPULATION: 800,000 in SF and 4.2 million in metro area (vs. Las Vegas 560,000/1.8 million and Miami 410,000/4.9 million – city/metro area)**
- **HIGH PUBLIC TRANSIT USE: 9.5% Transit commuting in metro area (vs. about 4% for both Las Vegas and Miami)**
- **PEDESTRIAN SAFETY INSTITUTIONALIZED by 2000 – fulltime pedestrian safety planning/engineering and outreach staff**
- **OTHER – hills, multi-leg intersections, fog**

Pedestrian Injuries

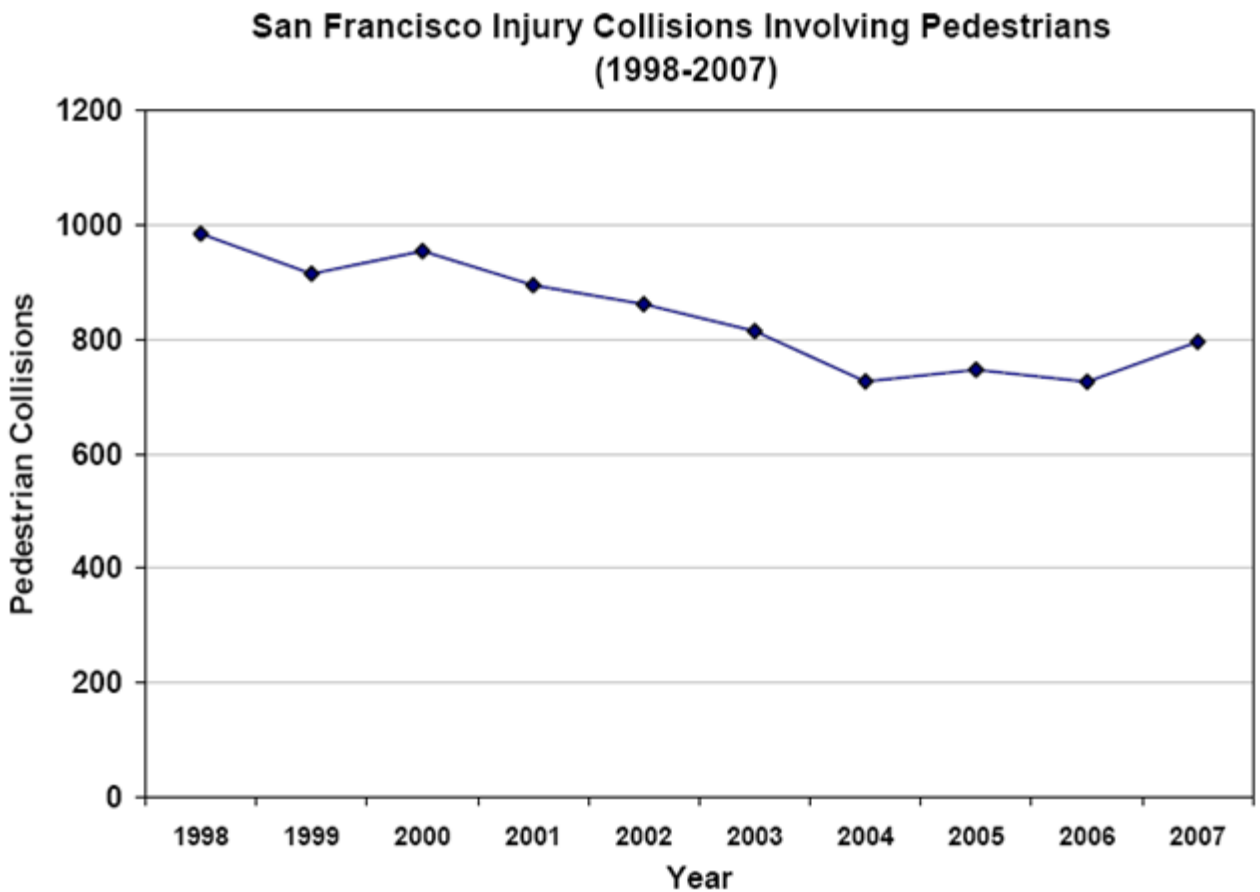

Figure 5
San Francisco Injury Collisions Involving Party Type Pedestrian (1998-2007)

Year	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
Total	985	915	955	895	862	815	727	747	726	796

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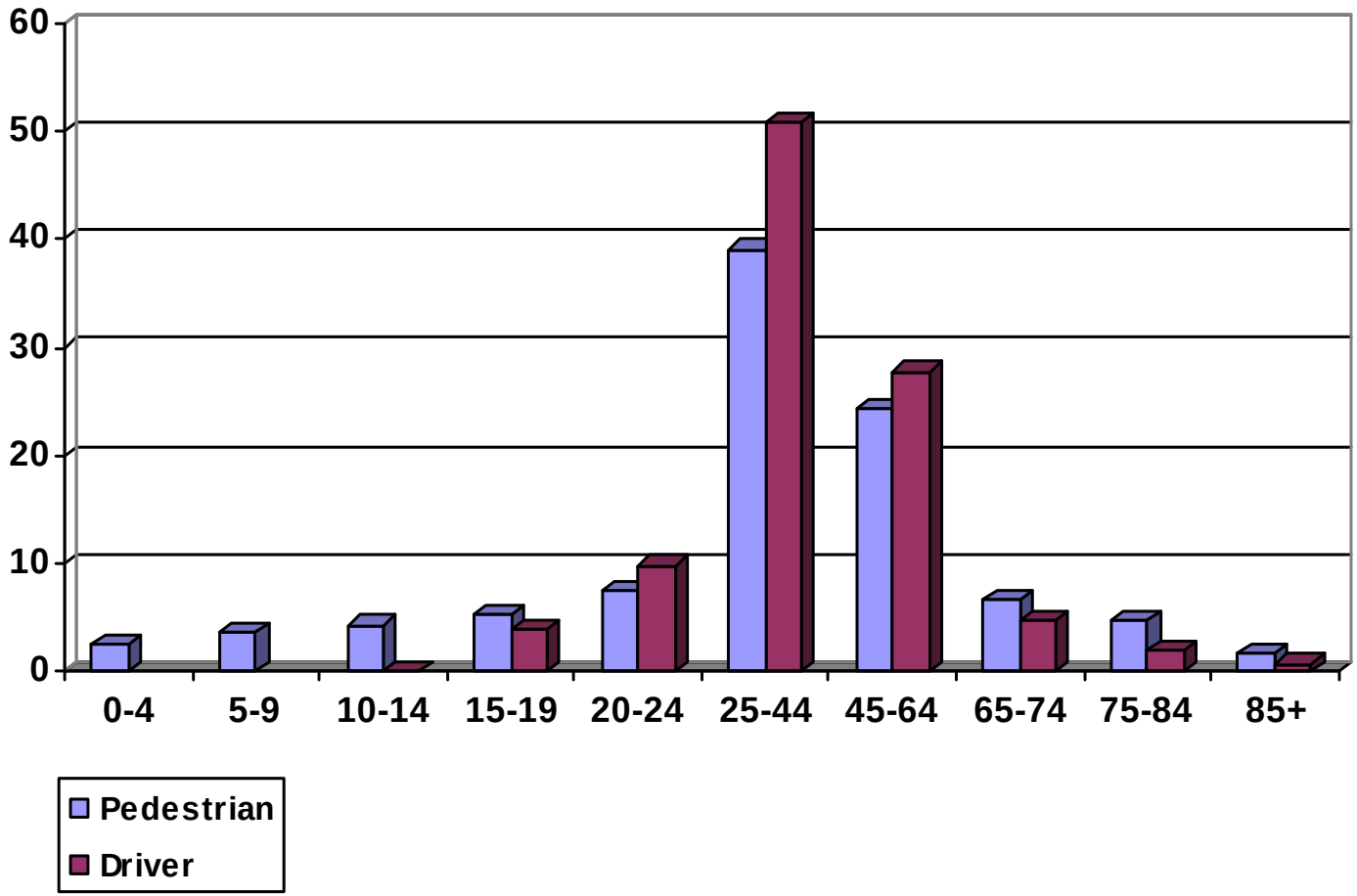
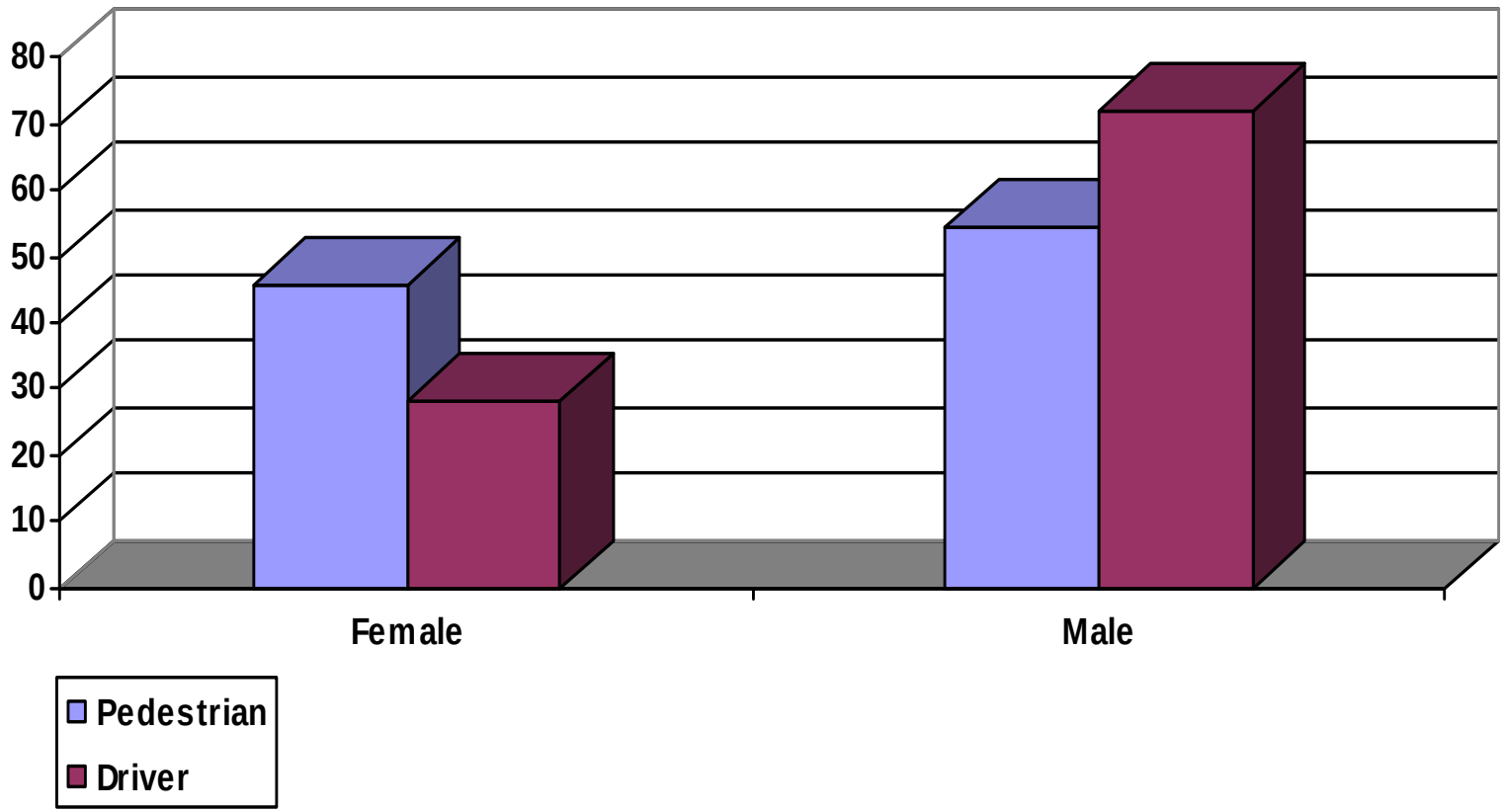
Pedestrian Injury Patterns - Age



Pedestrian Injury Patterns - Gender



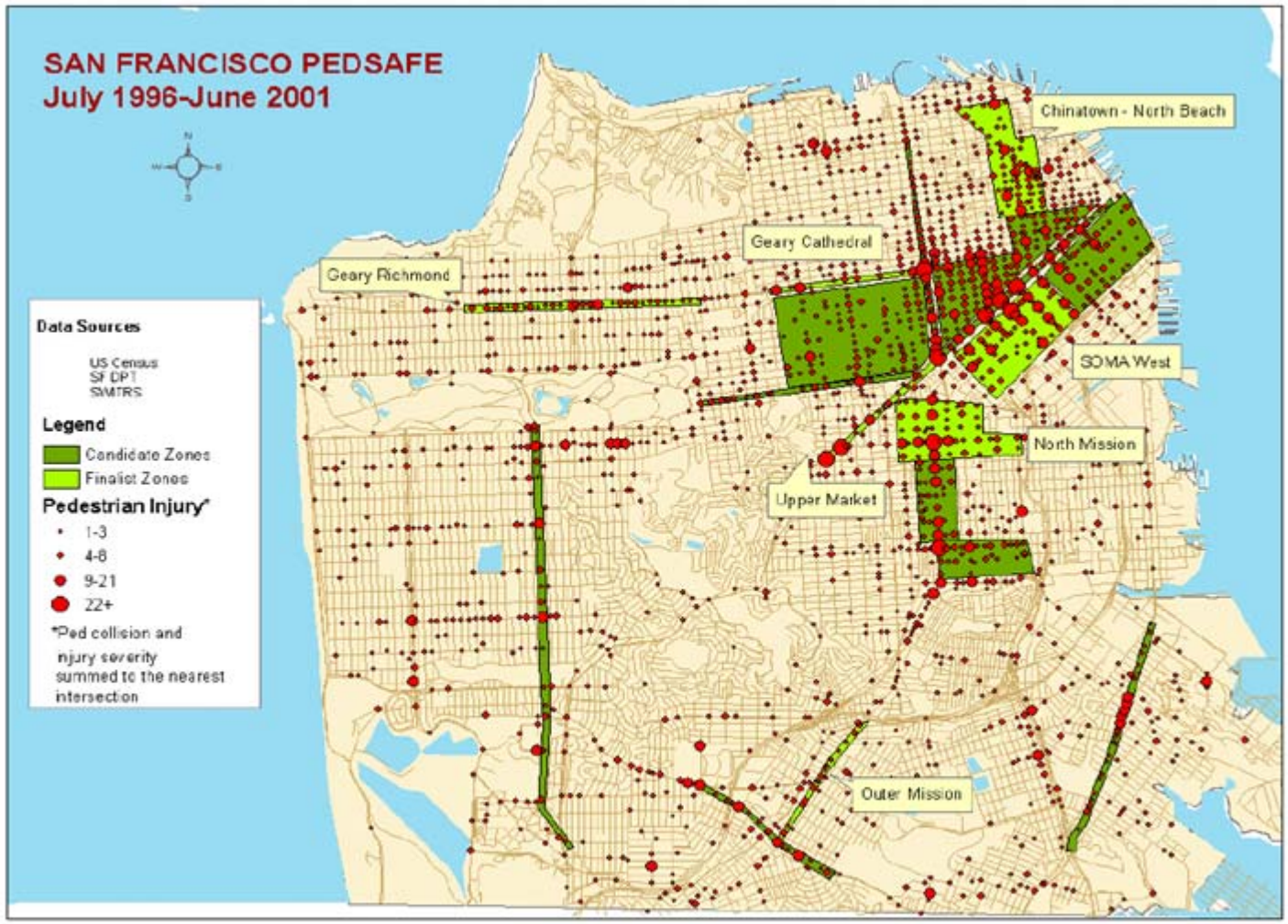
Pedestrian Injury Patterns: Primary Violations

- **Driver Failed to Yield to Pedestrian in Crosswalk 35%**
  - **At Signalized Crosswalk On Left Turn 16%**

- **Pedestrian Failed to Yield, not Jaywalking 13%**
- **Pedestrian Failed to Yield, Jaywalking 9%**
  (between signalized intersections)

- **Unsafe Speed 7%**
- **Pedestrian Running in Crosswalk in front of vehicle 7%**
- **Red Light Running 3%**

PedSafe Zones



*Only finalist zones are labeled by name

Phase 1 – Planning: Recommended Countermeasures - 1

Pedestrian Safety Engineering Countermeasures

- **ADA Curb ramps and detectable warnings**
- **Advance limit lines and red curb program**
- **Distribution of retroreflective materials**
- **Impactable and roadside "Yield to Pedestrian" signs**
- **Median refuge island improvements**
- **Pavement stencils ('Look both ways')**
- **Pedestrian scramble phasing (exclusive pedestrian phasing)**
- **Modified signal timing (increased pedestrian crossing time)**
- **"Pedestrian head start" (leading pedestrian intervals)**

Phase 1 – Planning: Recommended Countermeasures - 2

Intelligent Transportation Systems (ITS) Technologies

- **Animated eyes/countdown pedestrian signals**
- **Automated detection of pedestrians to extend crossing time**
- **Flashing beacons (both automated detection and push button-actuated)**
- **Pedestrian countdown signals (mostly replacing conventional pedestrian signals)**
- **Portable radar speed trailer**
- **Radar speed display sign**
- **"Smart lighting" or other street lighting improvements**

Phase 1 – Planning: Recommended Countermeasures - 3

Education and Outreach Program:

- **In-person education in schools and in senior centers**
- **Device-specific tips, including education at countermeasure sites**
- **Grassroots media campaign**

Phase 2 – Implementation: Refining Countermeasures Plan

Refining Countermeasure List

- **Vendor interest in experimental measures**
- **Cost considerations**
- **Interagency negotiations**

Assigning Countermeasures to Locations**:**

- **Primarily pedestrian or driver behavior problem?**
- **Vehicle movement most frequently problem?**
- **Type of violation?**
- **Special opportunities?**

Results- Flashing Beacon with Automated Detection

Cost ($62,000 installation cost)	**High**
Changes in MOES (pre vs. post-installation)	
Intersection	**1**
Ped. Delay	**4.2 to 2.9 sec.**
Ped. Look Before Crossing	87 to 95%
Diverted Crossing	19 to 5%

Vehicle Yield	**81 to 94%**
Vehicle/Ped Conflict	**6 to 3%**
Pedestrian Trapped	**4 to 0%**

Results- Impactable Yield Sign

Cost	**Low ($1,800)**
Intersection	**4**
Ped. Delay	5.1 to 4.6 sec. (NS)
Ped. Crossing Time	11.0 to 11.0 sec.
Ped. Look Before Crossing	98.7 to 92.3%
Ped. Look at Midpoint	70.3 to 56.0%
Diverted Crossings	14.6 to 16.0%
Vehicle Yield	**52.6 to 67.6%**
Vehicle/Ped. Conflict	7.2 to 6.8% (NS)
Pedestrian Trapped	3.7 to 4.3% (NS)

Results- Ped Head Start (LPI)

Cost	**Low ($2,600)**
Intersection	**4**
Ped. Delay	8.3 to 9.2 sec.
Ped. Start Crossing	
% Red Hand Last 4 Sec	**10.2 to 7.5**
% Walk	**66.0 to 71.5**
% Flashing Red Hand	**16.9 to 18.2**
% Red Hand	**6.2 to 5.9**
% Veh turned Left in front of Ped.	6.2 to 5.4 (NS)
% Veh turned right in front of Ped.	6.6 to 5.7 (NS)
% Veh turned in Front of Ped (3 intersections)	**6.2 to 4.0**

Results- Portable Speed Trailer

Cost	**Medium ($40,200)**
Intersection	**4**
Ped. Delay	6.4 to 6.9 sec. (NS)
Ped. Crossing	14.0 to 13.9 sec. (NS)
Vehicle Yield	**68.4 to 83.3%**
Vehicle/Ped. Conflict	5.7 to 10.0 (NS)
Veh. Speed Reduction	Reduced 1 to 6 MPH

Results- Automated Video Detection of Pedestrians to Extend Crossing Time

Cost	**High ($17,000 + Previously purchased equipment)**
Intersection	**1**
% Peds. Finishing Crossing on Red	14 to 12 (NS)
% Late Crossing Peds Detected	**100**
% Extensions > 1 sec.	14
Extensions In Error (due to vehicle encroachment)	**5 in 30 minutes**

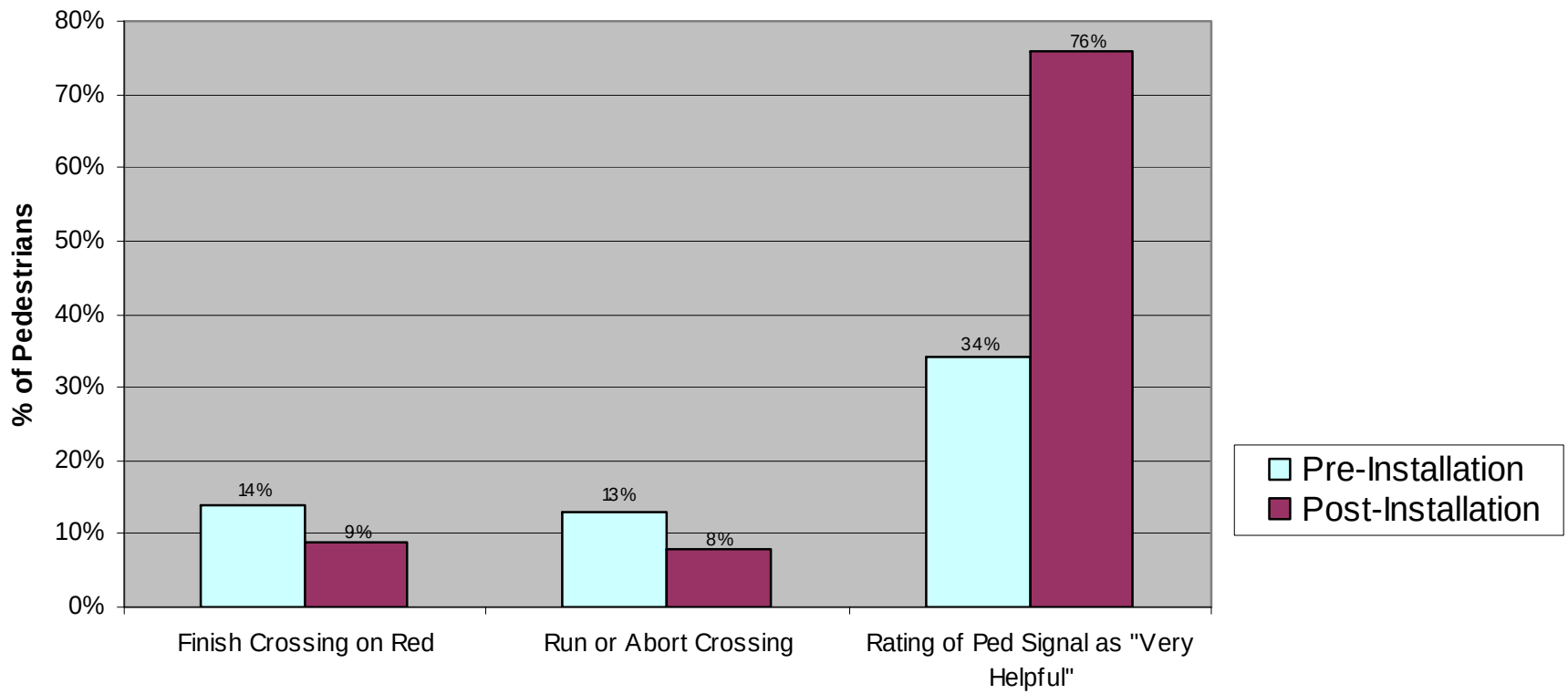
Countdown Signals Program

- **Pilot -** Countdown signals initially installed at 14 test locations
- **Full-scale Replacement -** City eventually replaced most pedestrian signals with Countdown Signals (over 800 intersections)
- **More energy-efficient:** electricity savings paying for LED device installation (over several years)

Countdown Signals Impacts Summary:

- **Injuries -** Citywide installation – about 22% drop in injuries at countdown locations vs. 2% rise at intersections without pedestrian signals but with traffic signals.
- **Pedestrians finishing crossing on red –** significant reduction
- **Pedestrians starting to cross** at the beginning of the clearance interval – no significant reduction
- **Red light running –** no increase
- **Additional information** on how much time left to cross the street liked by pedestrians.

Countdown Behavioral Impacts



Note: All differences statistically significant, p<0.01

Conclusions- Overview of most successful CMs

* Reported by SFMTA
Flashing Beacons
Impactable Yield Signs
Pedestrian Head Start
Portable Speed Trailer
Yield to Pedestrian Sign
Automatic Video Detection with Signal Extension*

Overview of Data Collection and Analysis

- Thirteen Countermeasures
- 29 Intersections
- >300 Hours of video
- Intercept Surveys
- Protocols Developed
- Tools Used
- Statistical Analysis
- Inter-rater Reliability

FLASHING BEACON PROTOCOL – BASELINE

At the beginning of the clip, fill in the following variable names in the columns below the video screen (the numbers in front of each variable name correspond to the numbered instructions below):

Each independent pedestrian is counted separately (i.e., there are no groups). People being pushed in wheelchairs, strollers, etc. or small children accompanied by an adult are NOT independent. If the pedestrian starts across the street and then turns back, they are not to be counted. When the person being observed arrives at the intersection intending to cross, press the **"New Initial Event" 1** button. A new row will begin and a time stamp will appear in the "Initial" column.

Ped Sweep

1. Ped Arrival	2. Ped Start	3. Gender	4. Age	5. % in Xwalk	6. Angle I/O	7. Ped Look

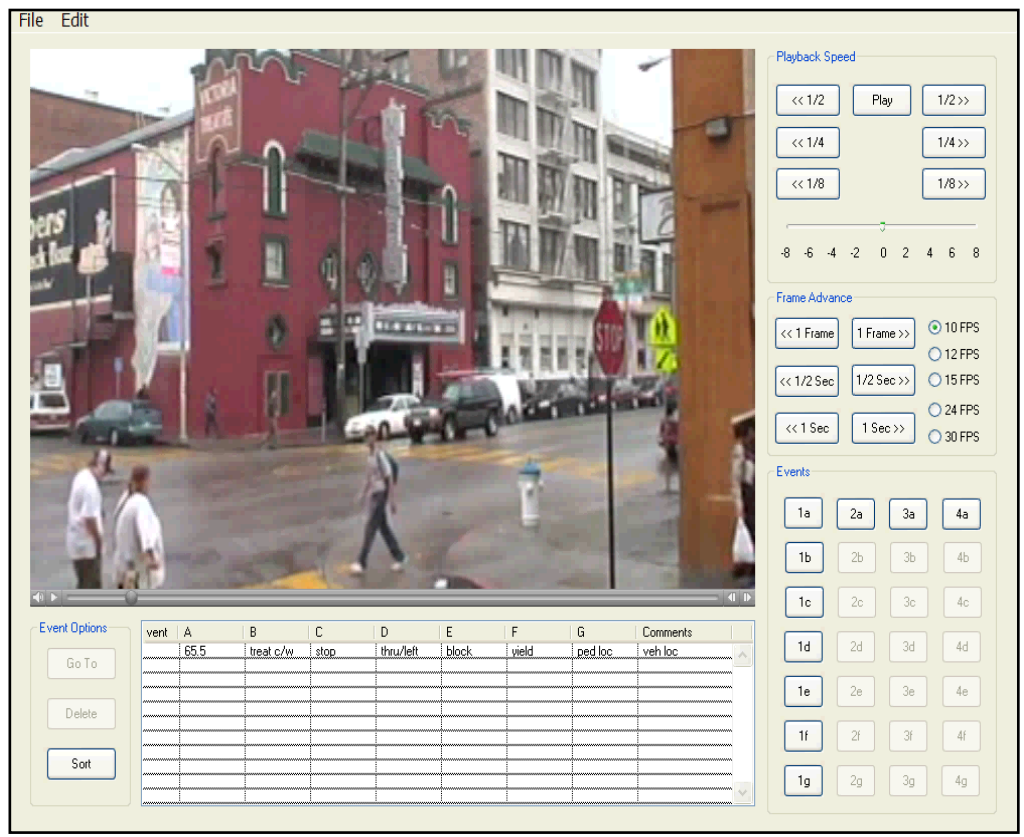
1. When the pedestrian arrives at the corner of the crosswalk, press "Event" 1 button.
2. When the pedestrian starts to cross the street, press the "Event" 2 button. (This is when the pedestrian steps into the traffic lane. Stepping off curb into a parking lane does not count as "start to cross" unless the person does not pause in the parking lane.)
3. Record the gender of the pedestrian. Enter a "9" if gender cannot be determined.
4. Age ("Y" for youth – less than 21, "A" for adult – 21 to 60, or "E" for elderly – greater than 60). Enter a "9" if age cannot be determined.
5. Record the percentage of time the pedestrian walks in the crosswalk while crossing the street. (Use ONLY 25%, 50%, 75%, or 100% increments.)
6. If the pedestrian is not in the crosswalk 100% of the time, record if that person angled Into (I) the crosswalk as they began to cross or angled Out (O) of the crosswalk as they finished crossing. If that person did both, record IO.
7. Record if pedestrian looked for traffic before starting to cross ("1 if yes, "0" if no)

METHODS

- **Use of Video Analysis**
- **Signal Timing Linkage**
- **Defining Operational Concepts (Interaction/Yielding/Conflicts)**
- **Automated Analysis**

Use of Surrogate Measures & Video Observation

- Limited time frame
- Lack of collision data
- Large amount of CMs vs. limited amount of intersections
- Workload
- The Playback Tool



Lessons Learned- Video Analysis

Advantages

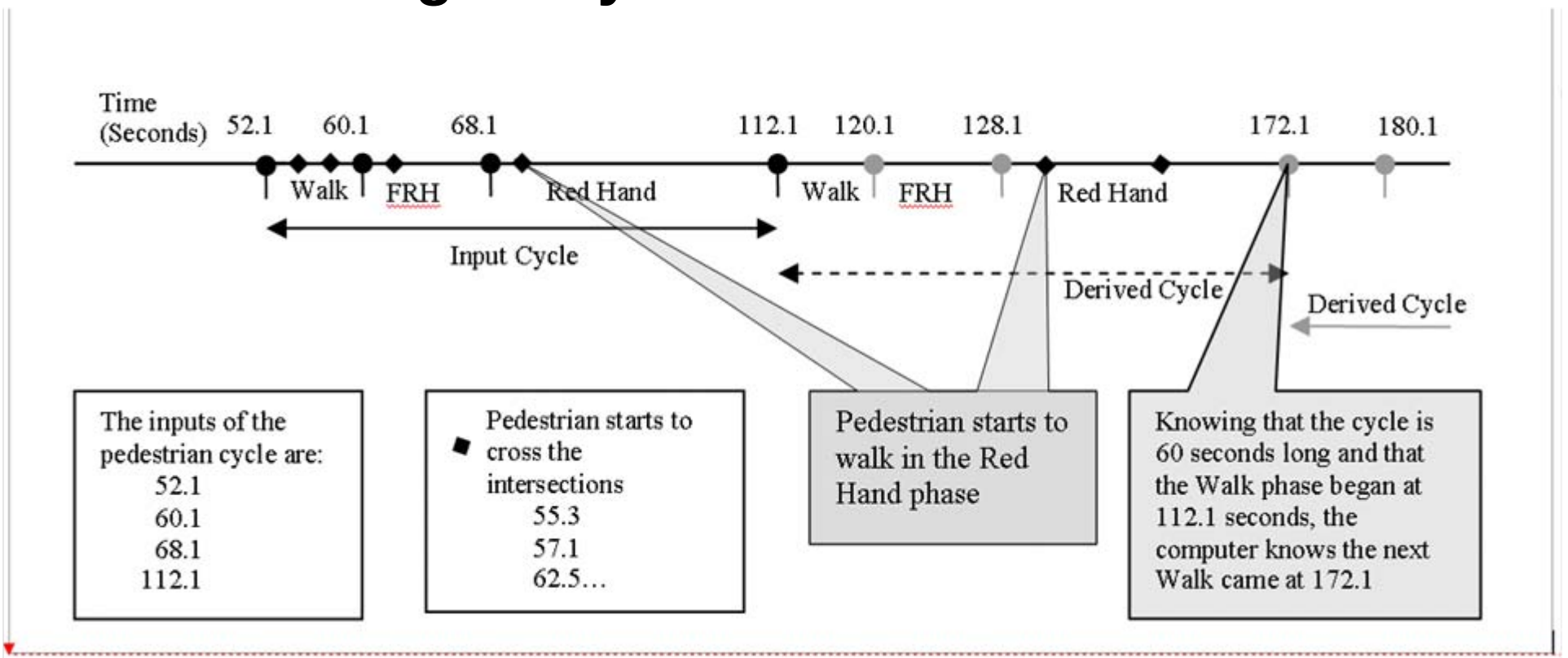
- Repeated observations
- Precise time stamping of events
- Flexibility

Limitations

- Labor-intensive
- Storage requirement
- Hardware requirement
- Cost

Signal Timing Linkage

Takes timestamps (from Play-Back Tool) and links actions to signal cycle



Signal Timing Linkage

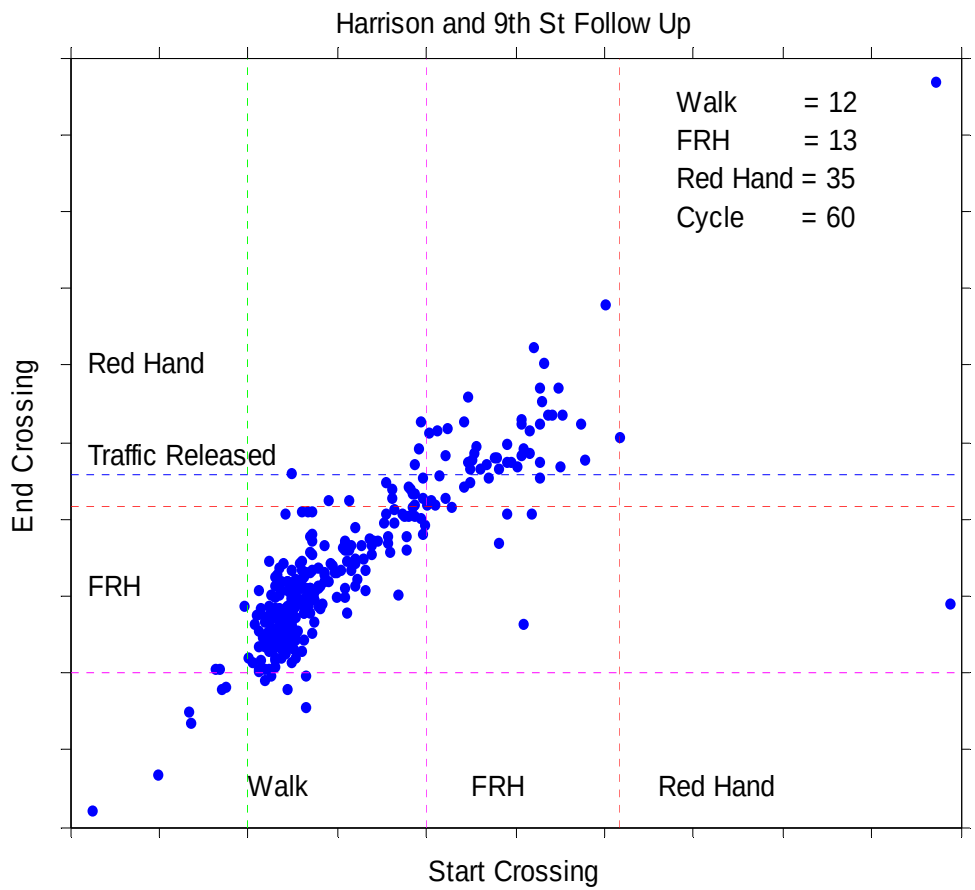
Output:

Howard_8.txt

Howard and 8 Baseline	Start Crossing			End Crossing	
Red Hand-Last 4 Seconds	37	11.5%	Red Hand-Last 4 Seconds	0	0.0%
Walk	184	57.3%	Walk	4	1.2%
FRH	69	21.5%	FRH	176	54.8%
Red Hand-First 4 Seconds	1	0.3%	Red Hand-First 3.5 Seconds	41	12.8%
Red Hand-Up to the Last 4 Seconds	30	9.3%	Red Hand-3.5 to 4.5 Seconds	13	4.0%
Total	321	100.0%	Red Hand-Up to the Last 4 Seconds	69	21.5%
			Red Hand-Last 4 Seconds (Next Cycle)	1	0.3%
			Walk (Next Cycle)	17	5.3%
			Total	321	100.0%

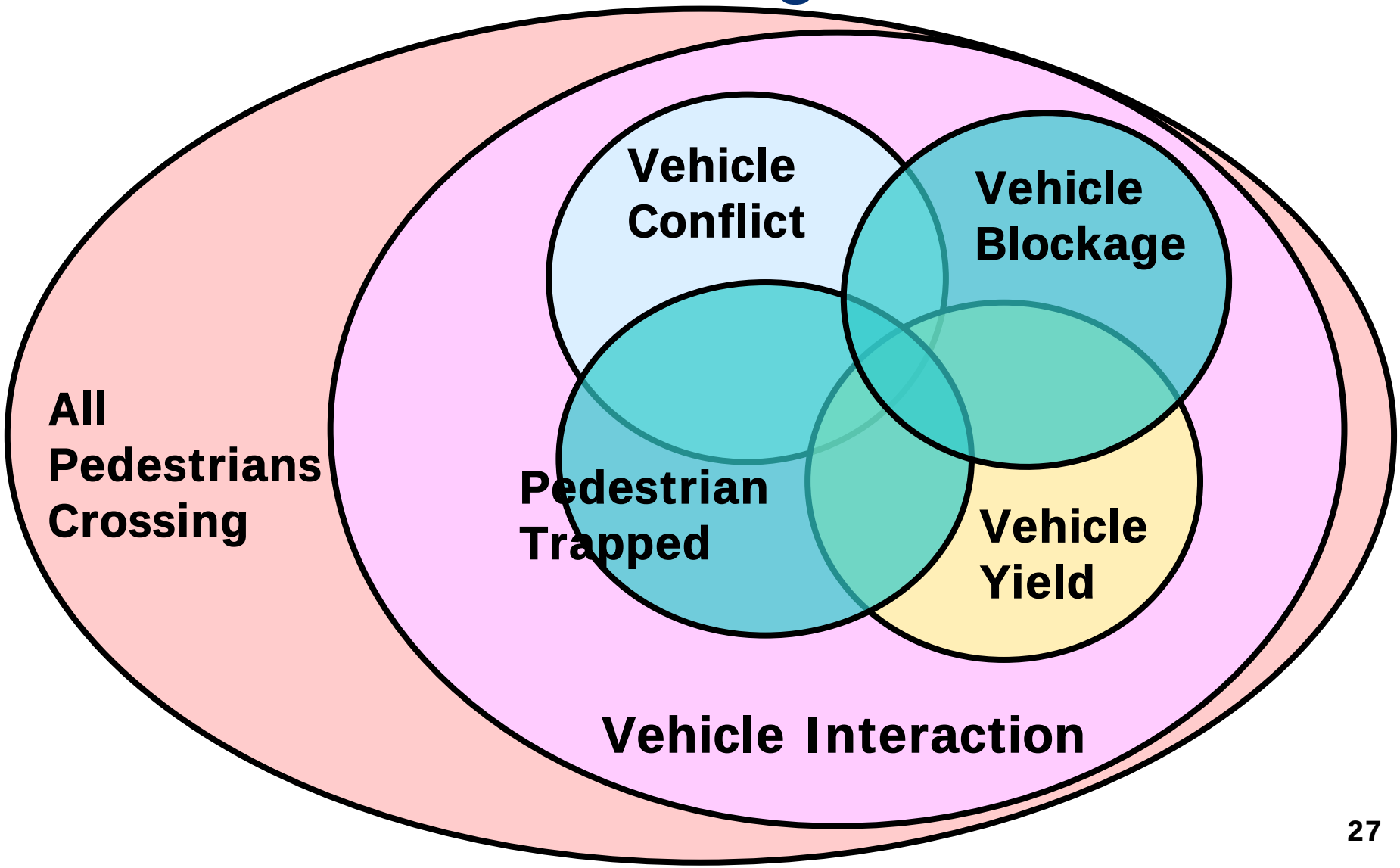
Howard and 8 Follow Up 1	Start Crossing			End Crossing	
Red Hand-Last 4 Seconds	37	11.3%	Red Hand-Last 4 Seconds	0	0.0%
Walk	182	55.5%	Walk	6	1.8%
FRH	73	22.3%	FRH	177	54.0%
Red Hand-First 4 Seconds	2	0.6%	Red Hand-First 3.5 Seconds	48	14.6%
Red Hand-Up to the Last 4 Seconds	34	10.4%	Red Hand-3.5 to 4.5 Seconds	9	2.7%
Total	328	100.0%	Red Hand-Up to the Last 4 Seconds	67	20.4%
			Red Hand-Last 4 Seconds (Next Cycle)	5	1.5%
			Walk (Next Cycle)	16	4.9%
			Total	328	100.0%

Statistics: Percentages for each phase



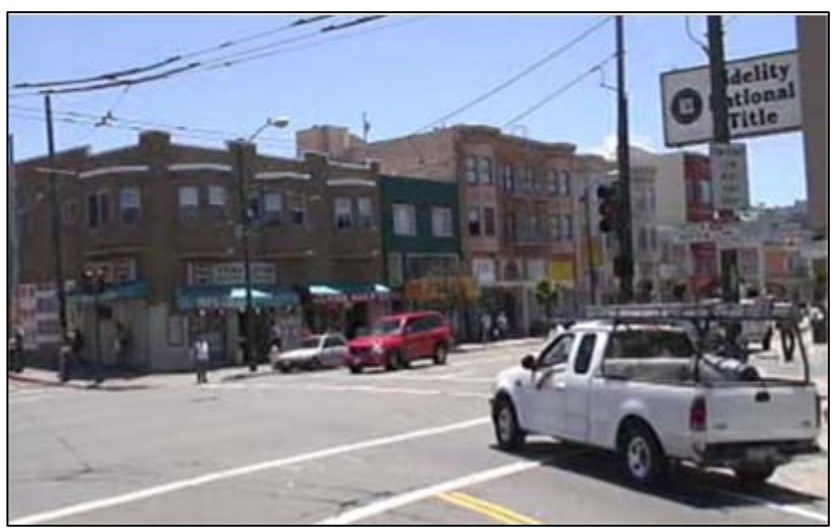
Graphs

Video Observation Categories



Vehicle/Pedestrian Interaction

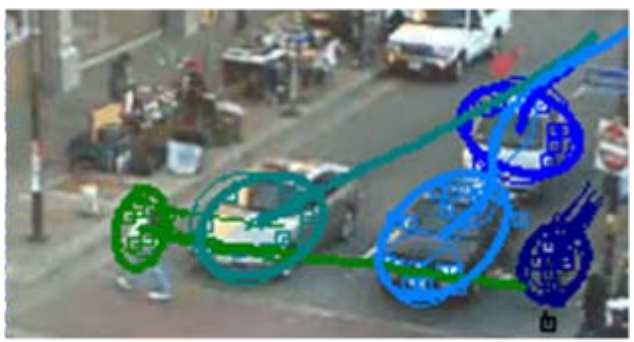
Vehicle Yielding

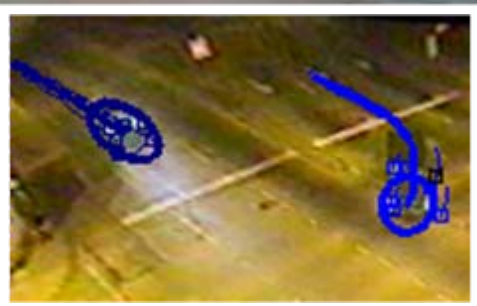


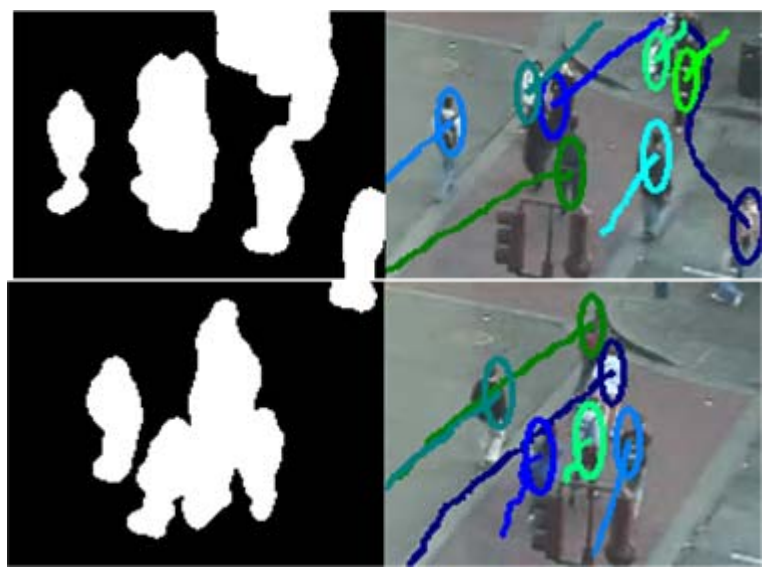
Vehicle/Pedestrian Conflict

Berkeley Traffic Scene Analysis System

- **Advanced algorithm combining background subtraction and feature tracking**
- **Pedestrian/vehicle detection and tracking**

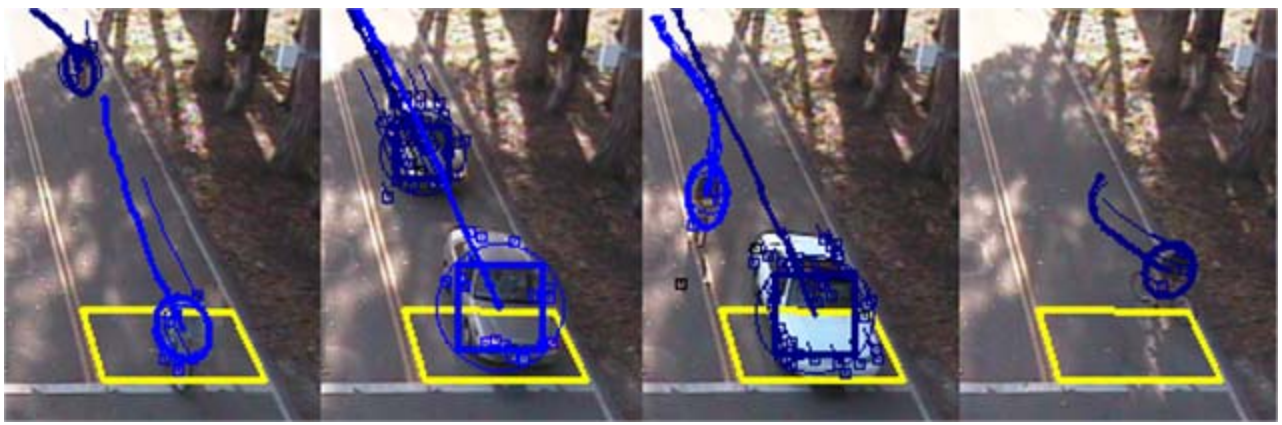






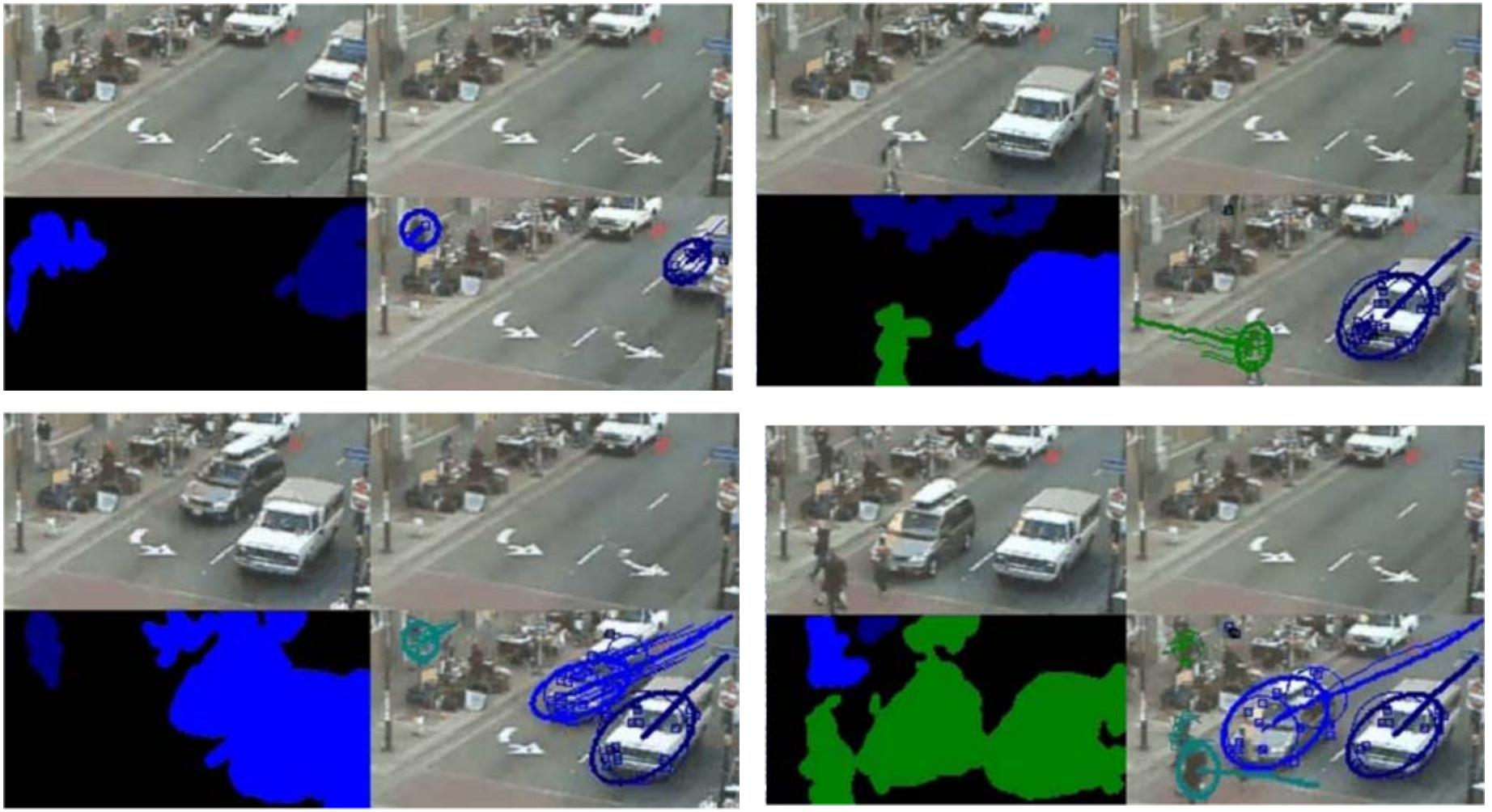
Berkeley Traffic Scene Analysis System (Continue)

- **Vehicle/non-vehicle classification**



- **User-assisted system was also developed to obtain perfect result**

Berkeley Traffic Scene Analysis System (Continue)



Next Steps: Additional Research

- ITE Committee Preparing Information Report **on Automated Detection Technologies**
- **Surveying Effectiveness of Different Devices, but also:**
  - **Costs**
  - **Maintenance**
  - **Liability Issues**
- Timely **with MUTCD Changes**
  - **Especially extended crossing time**
- **More Concrete Definitions**
- **Automated Pedestrian Counting**

Questions?