

NHTSA's Pedestrian Crash Avoidance Mitigation Research

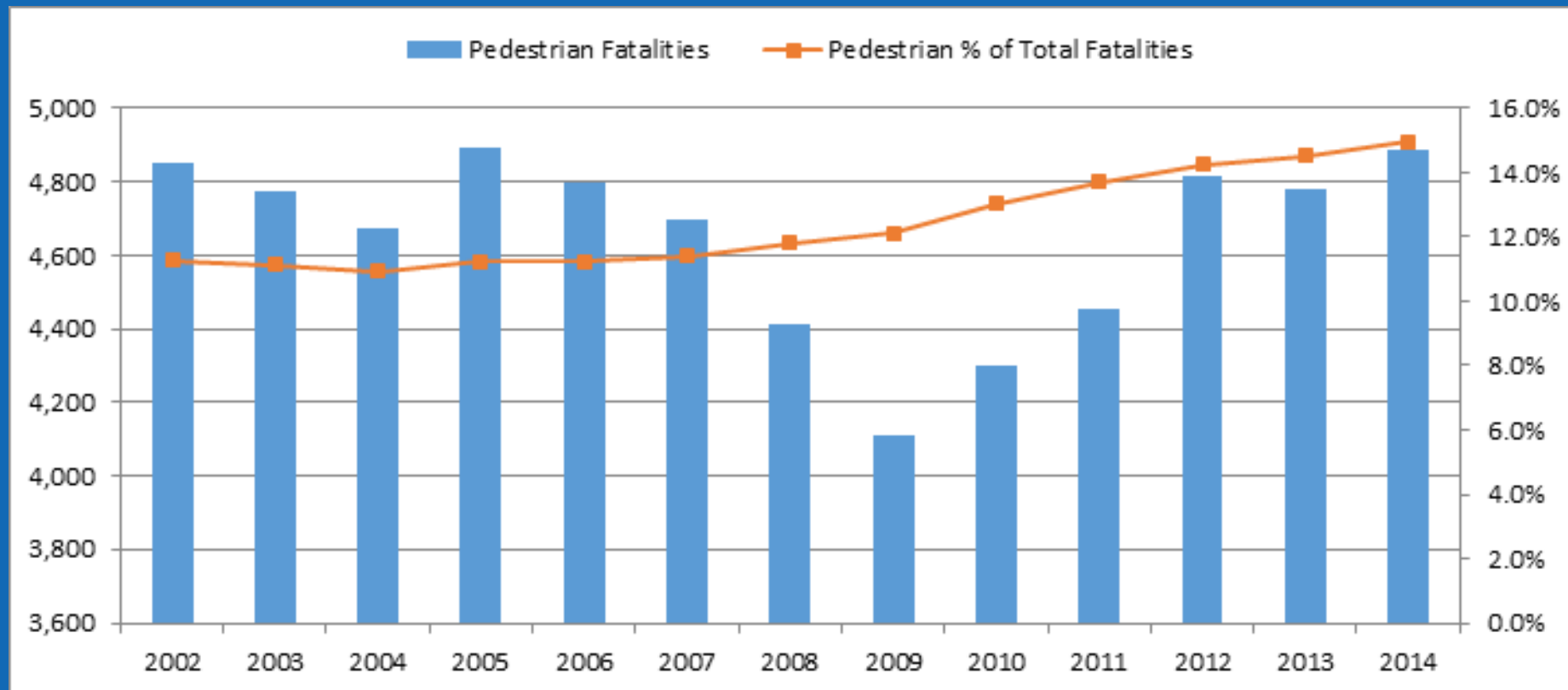
Robert Kreeb
Chief, Intelligent
Technologies Division
5/10/2016

Agenda



- US Pedestrian crashes
- Target Population
- Test Scenarios
- Test Equipment
- Recommendations
- Next Steps

U.S. Pedestrian Fatalities



The upward trend is continuing in 2015 and 2016

Pedestrian crashes, injuries, fatalities

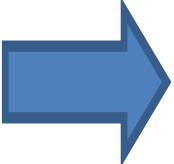


Pedestrian related motor vehicle crashes					
Year	Crashes	Fatalities	Injuries		
			Total	Minor	Serious
2002	71,896	4,851	70,664	55,182	15,482
2003	71,186	4,774	69,949	54,093	15,856
2004	69,515	4,675	67,985	52,421	15,565
2005	65,716	4,892	64,446	48,412	16,034
2006	61,279	4,795	60,924	45,660	15,264
2007	73,744	4,699	70,286	53,485	16,801
2008	70,348	4,414	68,832	55,403	13,429
2009	59,011	4,109	58,647	45,110	13,537
2010	72,110	4,302	70,076	58,203	11,873
2011	70,875	4,457	68,833	56,589	12,244
2012	78,233	4,818	76,128	61,269	14,859
2013	68,933	4,779	66,010	52,724	13,286
2014	68,460	4,884	64,808	52,608	12,200
Avg.	68,930	4,620	66,998	52,898	14,099

- On average, approximately:
 - 70,000 crashes
 - 4,600 fatalities
 - 14,000 serious injuries
 - 67,000 total injuries

Target Population



Target Population 	Pedestrian Struck by Light Vehicle Crashes	Yearly Average 2011 & 2012			
		GES		FARS	
	Pedestrian Stuck in First Event of Crash	63,000	92%	3,337	88%
	Pedestrian Struck in a Later Event	5,000	8%	462	12%
	Total Crashes	68,000	100%	3,799	100%

Test Scenarios



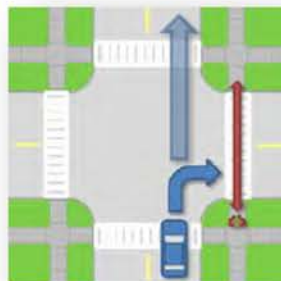
Top 20 pre-crash scenarios by functional years lost (FYL) can be grouped into 4 general scenarios
(N = 139,000 Crashes)

Scenario	Cases	% Total FYL	Fatalities	%Fatalities ** (67% of the top 20 scenarios)
S1	115,000	84%	7,000	88%
S2	2,000	1%	16	<1%
S3	9,000	1%	0	0%
S4	13,000	10%	1,000	12%

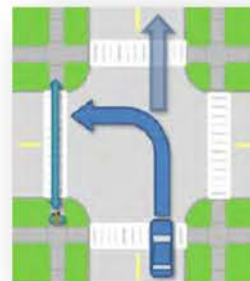
S1



S2



S3

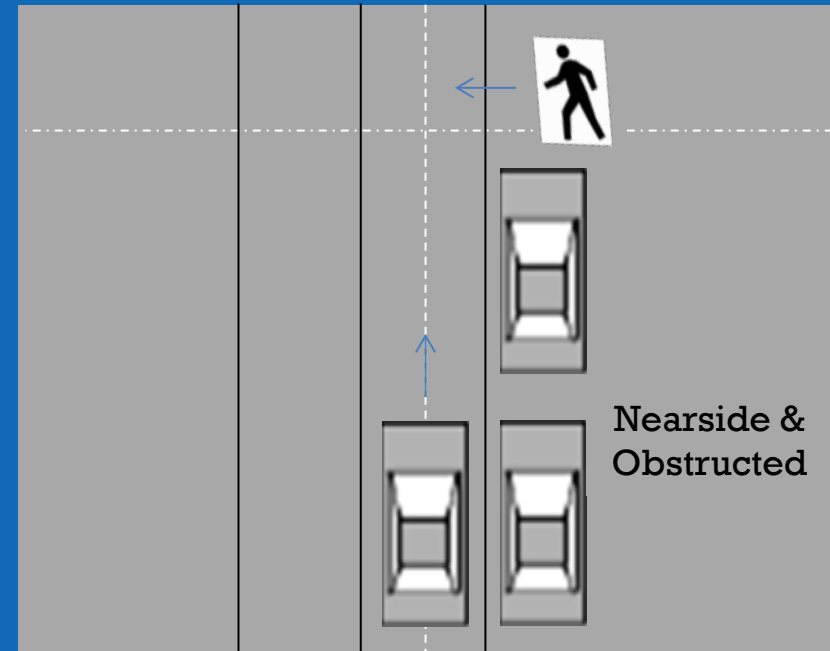
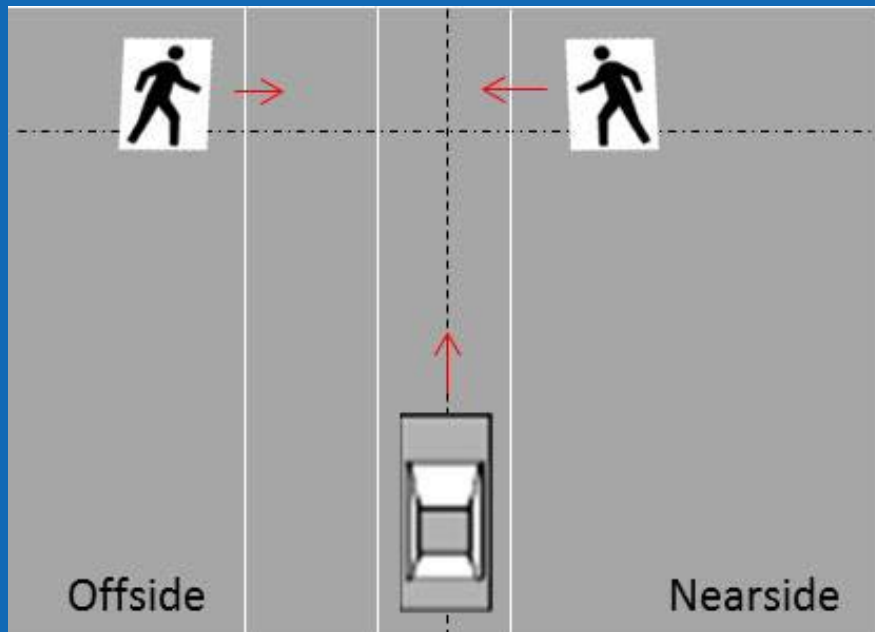


S4



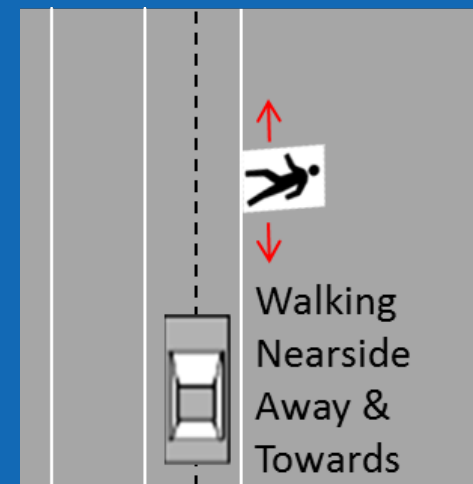
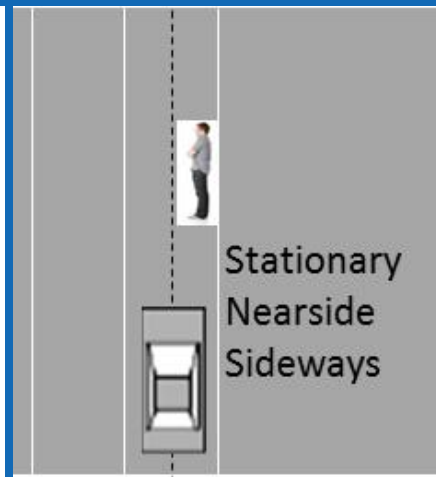
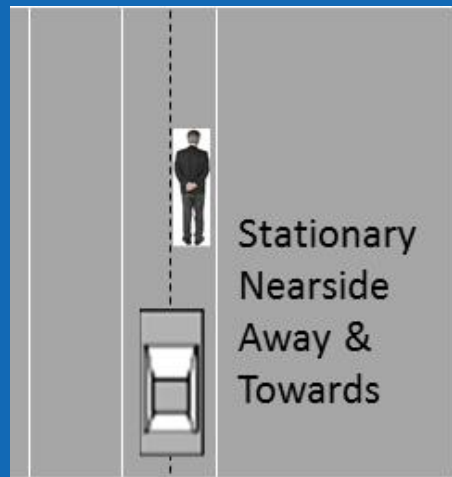
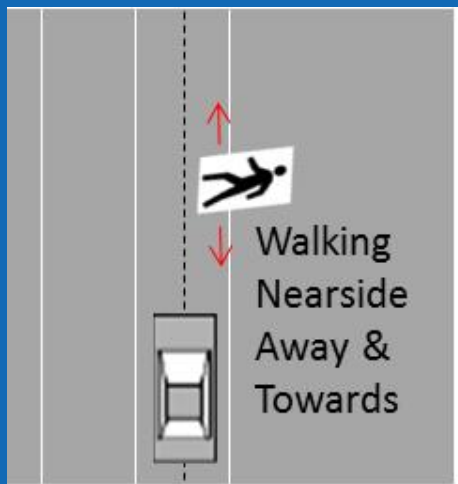
** Note: Top 20 Scenarios represent 67% of estimated pedestrian fatalities

S1 Scenario Test Conditions



- **Pedestrian:** Adult and Child
- **Pedestrian Speed:** 5 kmh to 8 kph (walking & running)
- **Conditions:** Day and Night
- **Overlap (location where mannequin will impact vehicle w/o the technology):** stop short; pass-by: 25/50/75 % overlap with front of car
- **Obstructions:** Yes (child only) and No
- **Vehicle Speeds:** variable: 15 km/h to 60 km/h

S4 Scenario Test Conditions



- **Pedestrian:** Adult
- **Pedestrian Speed:** Stationary and Walking
- **Conditions:** Day and Day-to-night.
- **Overlap (location where mannequin will impact vehicle w/o the technology):** 25% and out-of-path
- **Obstructions:** No
- **Vehicle Test Speeds:** variable: 15 km/h to 60 km/h

Test Vehicle Descriptions



2014 Test Track Work

Year	Make	Model	Sensor Technology	Description	Warning type	Braking Capability
2015	Subaru	Outback	Stereo Vision	EyeSight® Driver Assist	Visual and Audible	Up to full auto braking
2013	Lexus	LS460	Stereo Vision and Radar	Active Pedestrian Detection System	Visual and Audible	Up to full auto braking
2012	Volvo	S60	Mono Vision RADAR LIDAR	Pedestrian Detection System	Visual and Audible	Up to full auto braking

2015 Test Track Work

Year	Make	Model	Sensor Technology	Description	Warning type	Braking Capability
2015	Subaru	Legacy	Stereo Vision	EyeSight® Driver Assist	Visual and Audible	Up to full auto braking
2015	Lexus	LS460L	Stereo Vision and Radar	Active Pedestrian Detection System	Visual and Audible	Up to full auto braking
2015	Mercedes	C300	Mono Vision and Radar	PRE-SAFE Brake with Pedestrian Recognition	Visual and Audible	Up to full auto braking

Posable Test Mannequins



Cover	Adult Male	Child Male
Trousers	Royal-Blue	Royal-Blue
Top	Silver or Black	Tweed Red or Black
Hair	Black	Black
Shoes	Black	Black
Skin	Sand	Sand
Version	SB43 V2/V2	SB25 V2/V2

Posable Test Mannequins Evaluated during 2014 Test Season

Mannequin	Adult Male Dimensions	Child Male Dimensions
Height	71"	46.5"
Chest	40"	21"
Waist	38"	21"
Hips	38"	21"
Weight	11.4 lb	4.1 lb



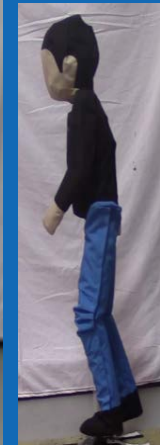
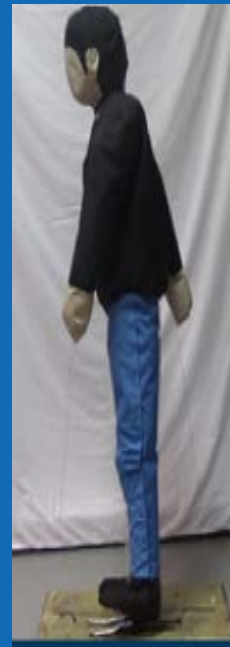
Articulated Test Mannequins



Mannequin	Shoulders	Hips	Elbows	Knees
TASI Adult	Active	Active	Passive	Active
TASI Child	Active	Active	Passive	Passive
4a Adult	Posable	Active	Fixed	Passive
4a Child	Posable	Active	Fixed	Passive
NHTSA	Active	Active	Fixed	Fixed

Articulated Test Mannequins Evaluated during 2015 Test Season

Mannequin	Weight (lbs.)	RADAR Cross Section
TASI Adult	22	Known
TASI Child	13	Known
4a Adult	15.4	Tuned
4a Child	8.8	Tuned
NHTSA	~17.7	Unknown



Test Apparatus (ABD Spring 2016)

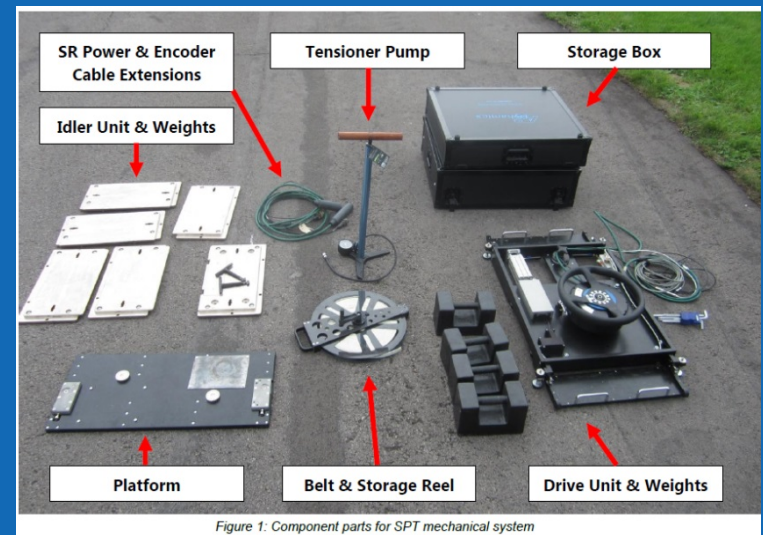


Figure 1: Component parts for SPT mechanical system

Adult Crossing from Offside



Vehicle encounters a crossing adult pedestrian running from the offside



Adult Walking Away



Vehicle encounters an adult pedestrian walking on the nearside of the road away from the vehicle



Adult Crossing from Nearside



Vehicle encounters a crossing adult pedestrian walking from the nearside



Child Running from Behind



Vehicle encounters a crossing child pedestrian running from behind parked vehicles from the nearside



Next Steps



- Public Report on draft test procedures later this summer
 - Seek public feedback
- Test Procedure Refinement
 - ABD Motion Base Testing
 - Development of final performance criteria
 - Night Testing
 - Additional False Positive Testing
- Benefits Estimates
 - Volpe Report on details of target population and benefits estimates by end of CY16

Questions