SAE Government Industry Meeting | January 27, 2017

REAL-WORLD PEDESTRIAN CRASHES: INJURY TRENDS AND FATALITY RISKS

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This study examined the following statistical question:

Is the proportion of pedestrians sustaining serious injuries *lower* in collisions with recent generations of passenger vehicles versus older generations?

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50th Anniversary of the U.S. Department of Transportation

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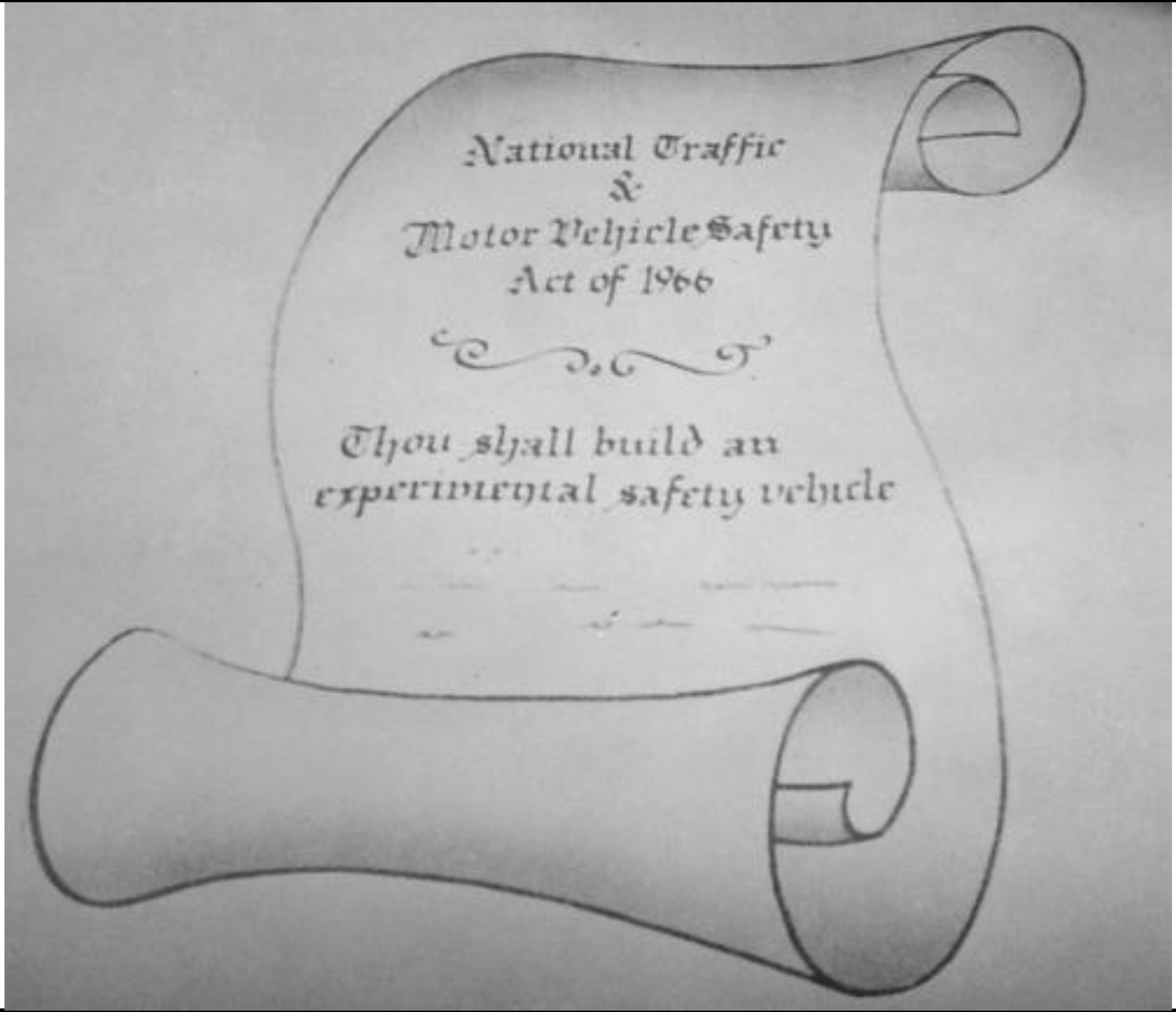
History Lesson: National Traffic and Motor Vehicle Safety Act of 1966



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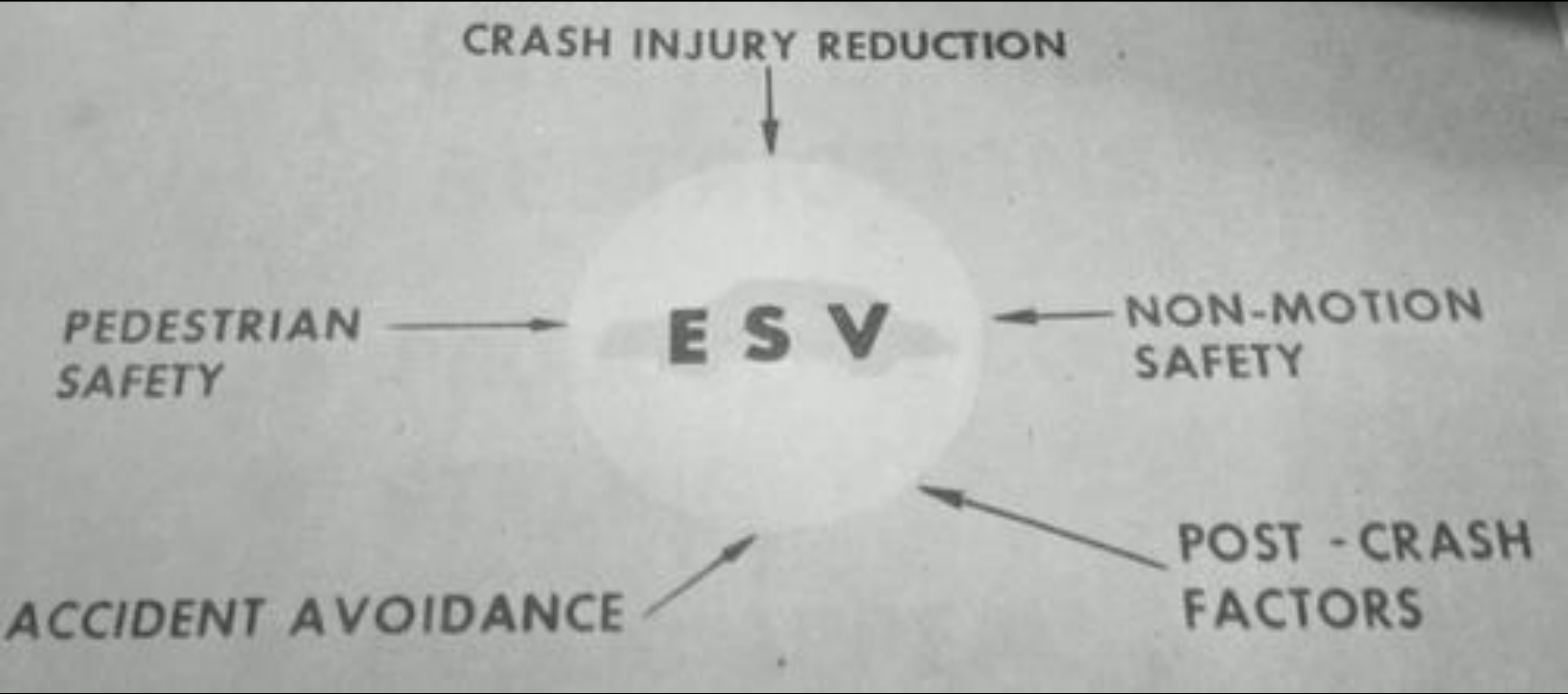
Original Requirements for ESV Safety Features



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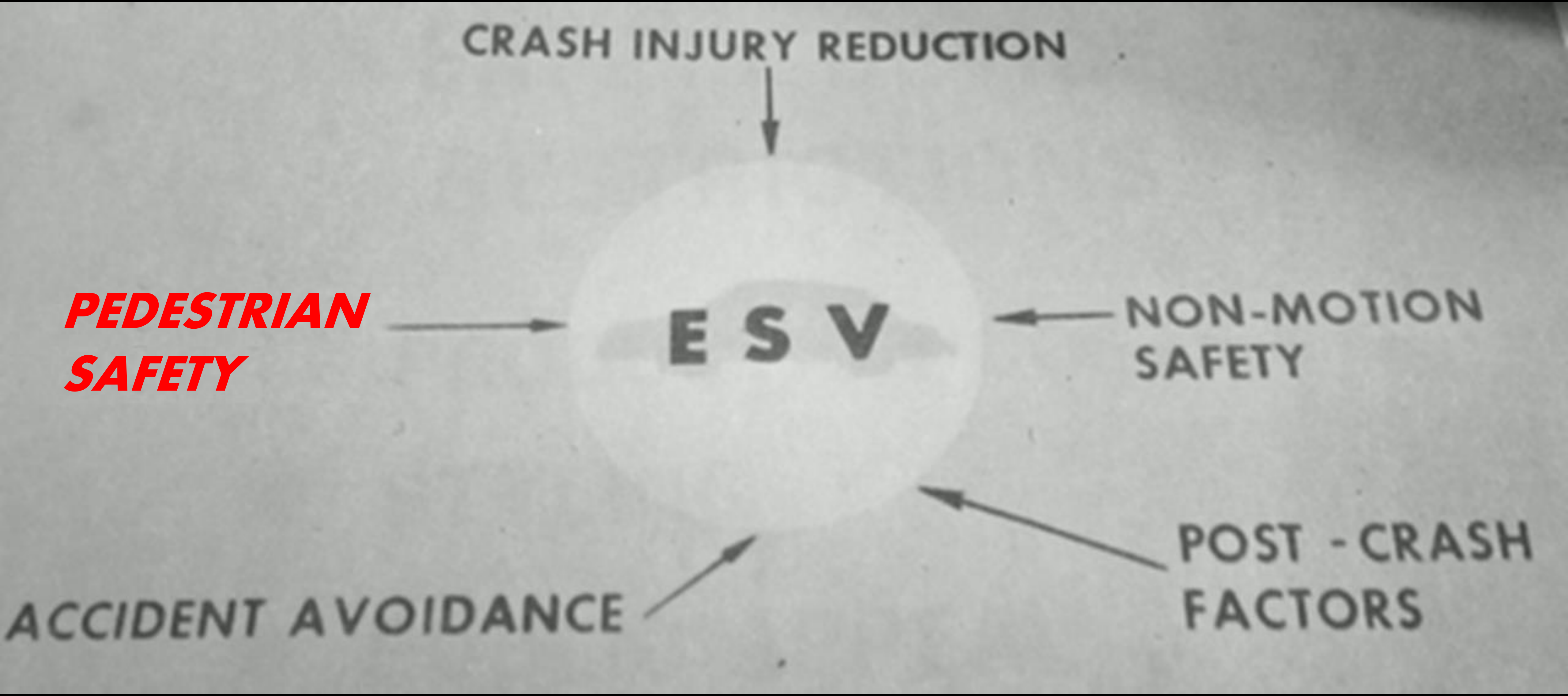
Original Requirements for ESV Safety Features



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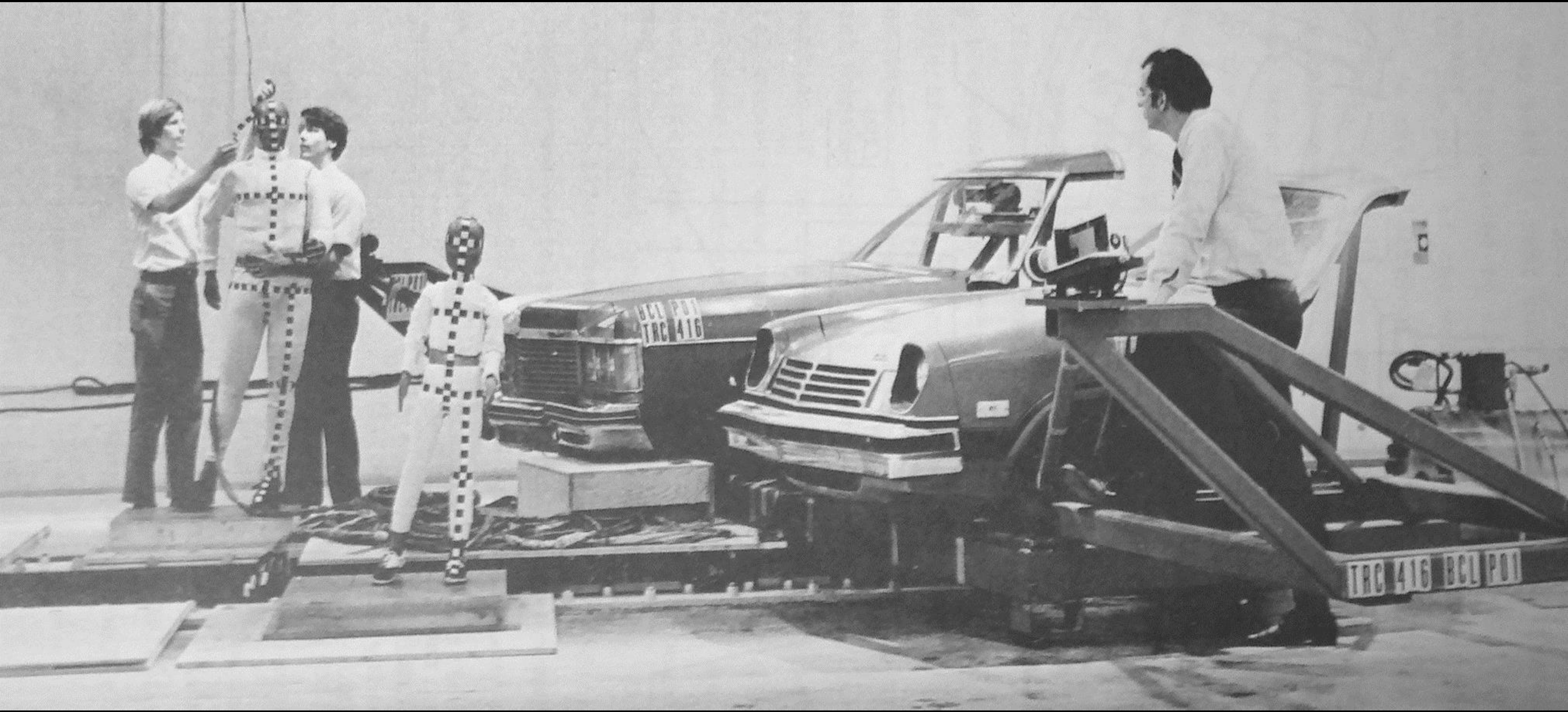
Vehicle Crashworthiness for Pedestrian Safety: Early Research at NHTSA



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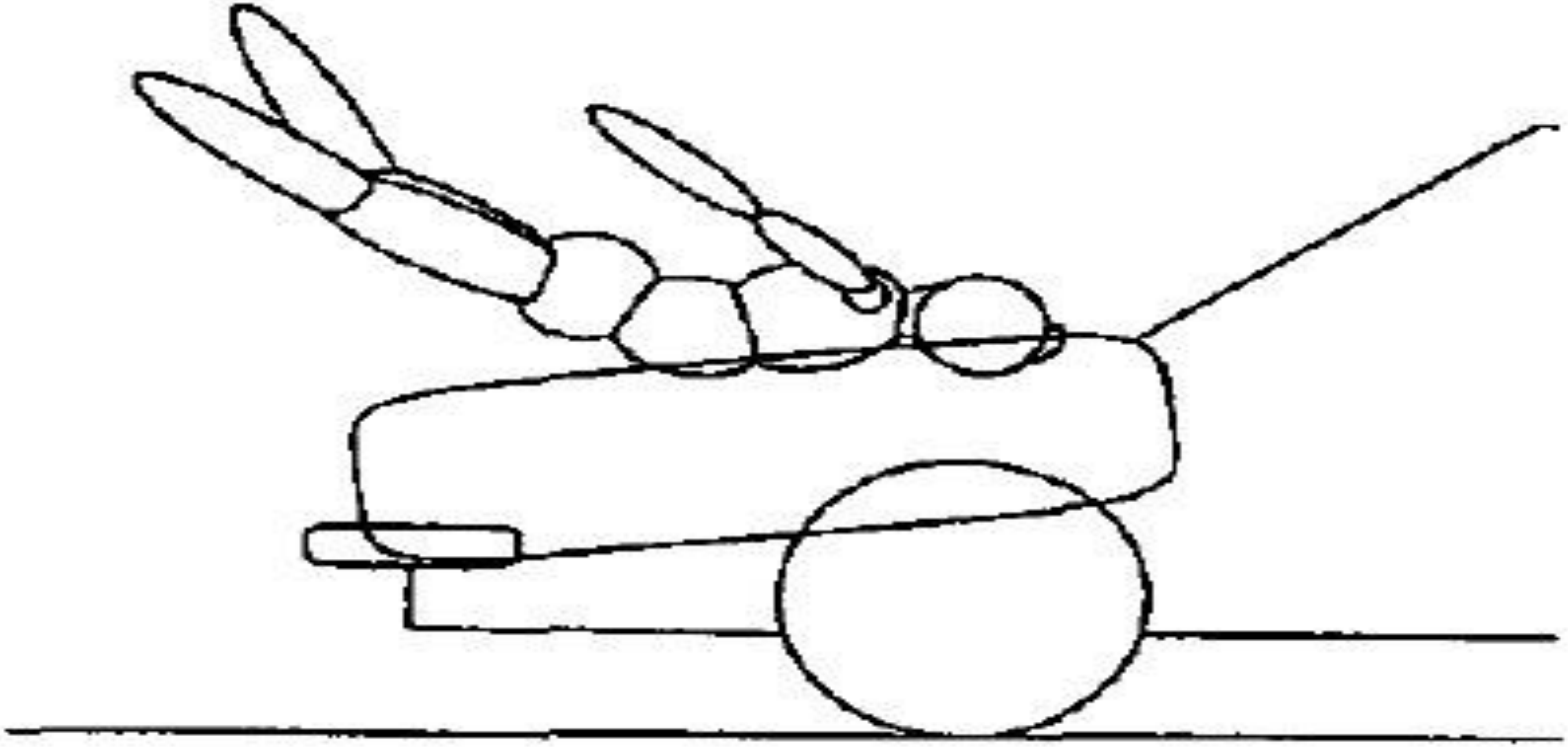

150 ms

International Pedestrian Safety Regulations and Assessments

International Regulatory Requirements

EEVC ISO IHRA UNECE

------ Standards Development Activities -----

EUROPEAN COMMISSION

Directive Issued

EUROPEAN COMMISSION

Japan MLIT

Stage 1 goes in force

1997

2000

2003

2005

2007

EURO NCAP

FOR SAFER CARS

www.euroncap.com

ANCAP

Crash testing for safety

JNCAP

Japan New Car Assessment Program

KNCAP

International NCAP Assessments

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International Pedestrian Safety Regulations and Assessments

International Regulatory Requirements

EUROPEAN COMMISSION Japan MLIT

Phase-in of Domestic Requirements

UNECE

EUROPEAN COMMISSION Japan MLIT Korea MOLIT

Full Reg. No. 127 Phase-in

2009	2010	2011	2012	2013	2019
New (Pass. Cars)			New Cars (all)	New (Pass. Cars)	New Cars (all)
20%	30%	40%	60%		

Pedestrian Score needed,

★ ★ ★ ★ ★

Overall

FOR SAFER CARS EURO NCAP www.euroncap.com

New Headform Protocol, Flex-GTR Leg

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Improvements in Euro NCAP scores.
Case study: Ford Focus.

Ford Focus, 2nd Generation

Production:
U.S. 2007-2010 (MY2008-MY2011)
E.U. 2004-2010, Ford C1 platform

Score: 15 of 36 points
(n/a on headform, legform scores)

Tested by EuroNCAP in 2004
5 door hatch, Trend 1.6, 1248 kg

Ford Focus, 3rd Generation

Production: 2011-present, Ford global C-car platform.
U.S. Debut: MY2012
E.U. Debut: MY2011

Score: 26 of 36 points
(16 pts headform, 6 pt ULF, 4 pts LLF)

Tested by EuroNCAP in 2012
Small Family, 1.6 TDCI Trend, 1344 kg

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Ford Focus – 2nd vs. 3rd Generation

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Ford Focus – 2nd vs. 3rd Generation

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Ford Focus – 2nd vs. 3rd Generation

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Do better pedestrian assessment scores lead to injury reductions in *the real world?*

bast
Federal Highway Research Institute

Correlation between pedestrian injury severity in real-life crashes and Euro NCAP pedestrian test results

Claus Pastor
Federal Highway Research Institute (BASt)
Germany
Paper Number 13-0308

ABSTRACT

In Germany the number of casualties in passenger

identified comparing diesel and gasoline cars. Higher engine displacements are associated with a lower injury risk for pedestrians. The most relevant parameter has been "time of accident", whereas

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2013 BASt study:
Euro NCAP pedestrian scores vs. GIDAS real-world pedestrian injury rates.

Make-Model	Score (36 pt. max)	Ped. Crash incidence	No. of Serious Injuries	No. of Fatalities
2003 Audi A3	8	188	N_{s1}	N_{f1}
2004 BMW 5	2	62	N_{s2}	N_{f2}
.	.	.	.	.
.	.	.	.	.
.	.	.	.	.
2006 VW Touran	19	270	N_{s203}	N_{f203}

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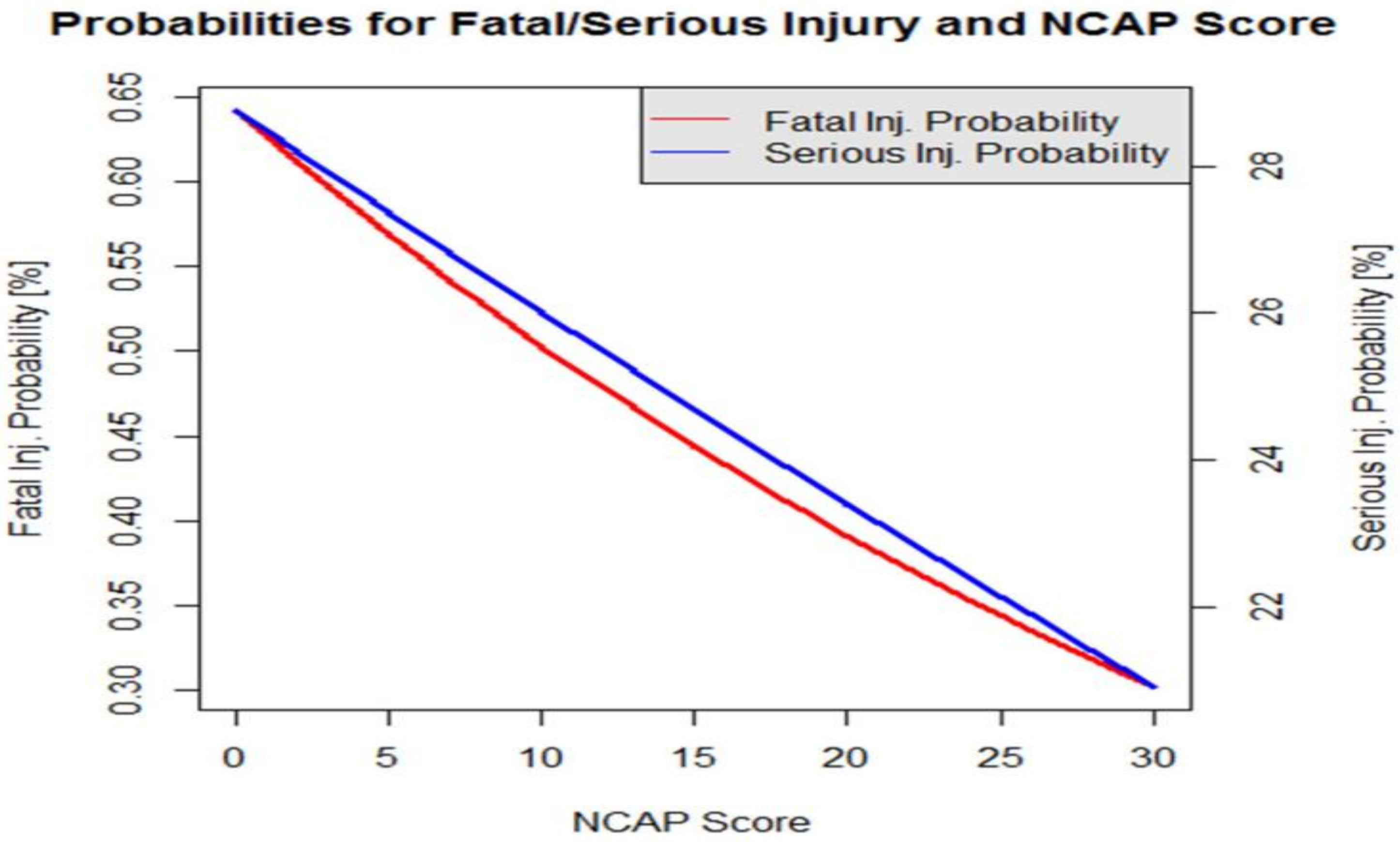
2013 BASt study: Euro NCAP pedestrian scores vs. GIDAS real-world pedestrian injury rates.



Finding: Each point in NCAP score reduces fatalities by 2.5% and serious injuries by 1%.

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2013 BASt study:
Euro NCAP pedestrian scores vs. GIDAS real-world pedestrian injury rates.

Demonstrates that a good pedestrian assessment will lead to reductions in pedestrian injuries in *EUROPE.*

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2013 BASt study:
Euro NCAP pedestrian scores vs. GIDAS real-world pedestrian injury rates.

Says nothing about the situation in the U.S.A.

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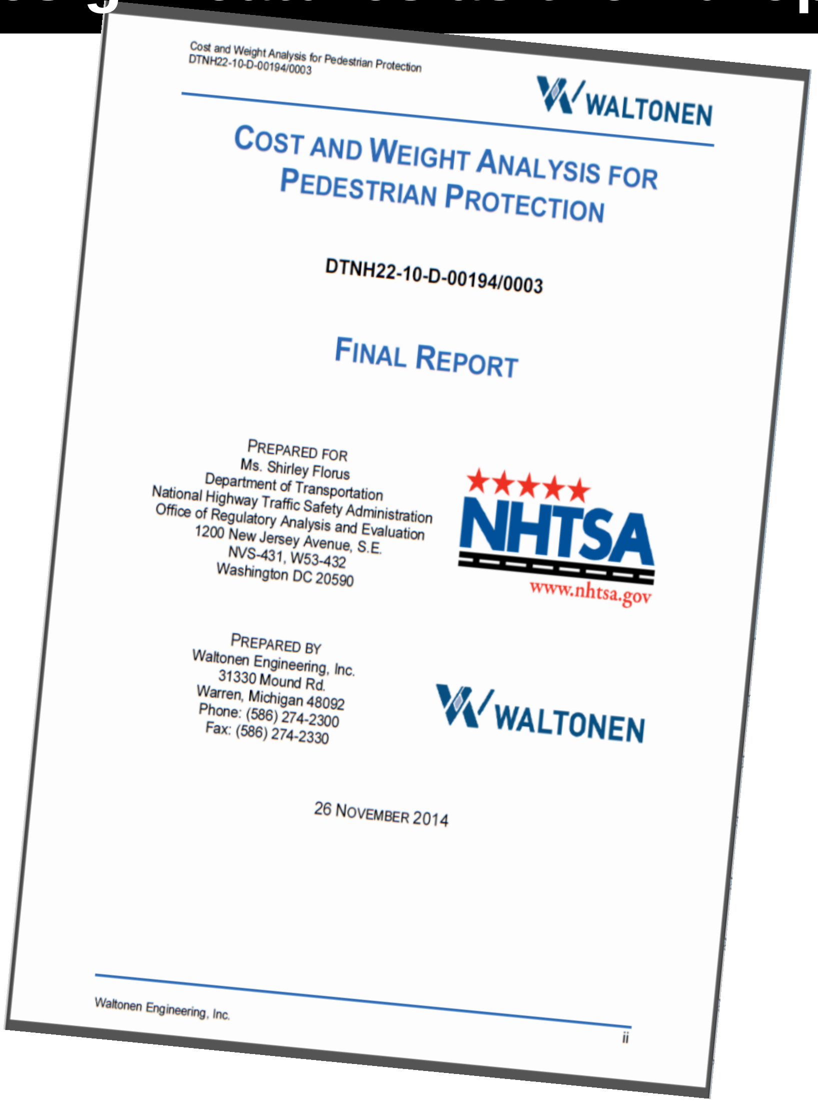
Does the U.S. variant of a make/model offer the same pedestrian safety design features as the European variant?



Cost and Weight Analysis for Pedestrian Protection
DTNH22-10-D-00194/0003

WALTONEN

COST AND WEIGHT ANALYSIS FOR PEDESTRIAN PROTECTION

DTNH22-10-D-00194/0003

FINAL REPORT

PREPARED FOR
Ms. Shirley Florus
Department of Transportation
National Highway Traffic Safety Administration
Office of Regulatory Analysis and Evaluation
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WALTONEN

26 NOVEMBER 2014

Waltonen Engineering, Inc.

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Cost and Weight Analysis for Pedestrian Protection

November 2014

See: www.regulations.gov

Docket No. NHTSA-2011-0066-0090

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Teardown Study of 3rd Generation Ford Focus U.S. vs. European variants

2012 European Ford Focus

2012 U.S. Ford Focus

- **Both are built on Ford Global 1 platform**
- **Tear down of E.U. vs. U.S. variants**
- **Part-by-part comparison**

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Teardown Study of 3rd Generation Ford Focus U.S. vs. European variants

Same parts: The majority of the parts are the same or very similar, with carryover part numbers, including the hood, hinges, and latches.

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Teardown Study of 3rd Generation Ford Focus U.S. vs. European variants

Different parts:

Wiper blades

Fender-to-pillar bracket

Bumper cross member and energy absorber

Grille – air deflector members

Lower valence/air deflector

NOTE: Basic shape of all parts is virtually the same!

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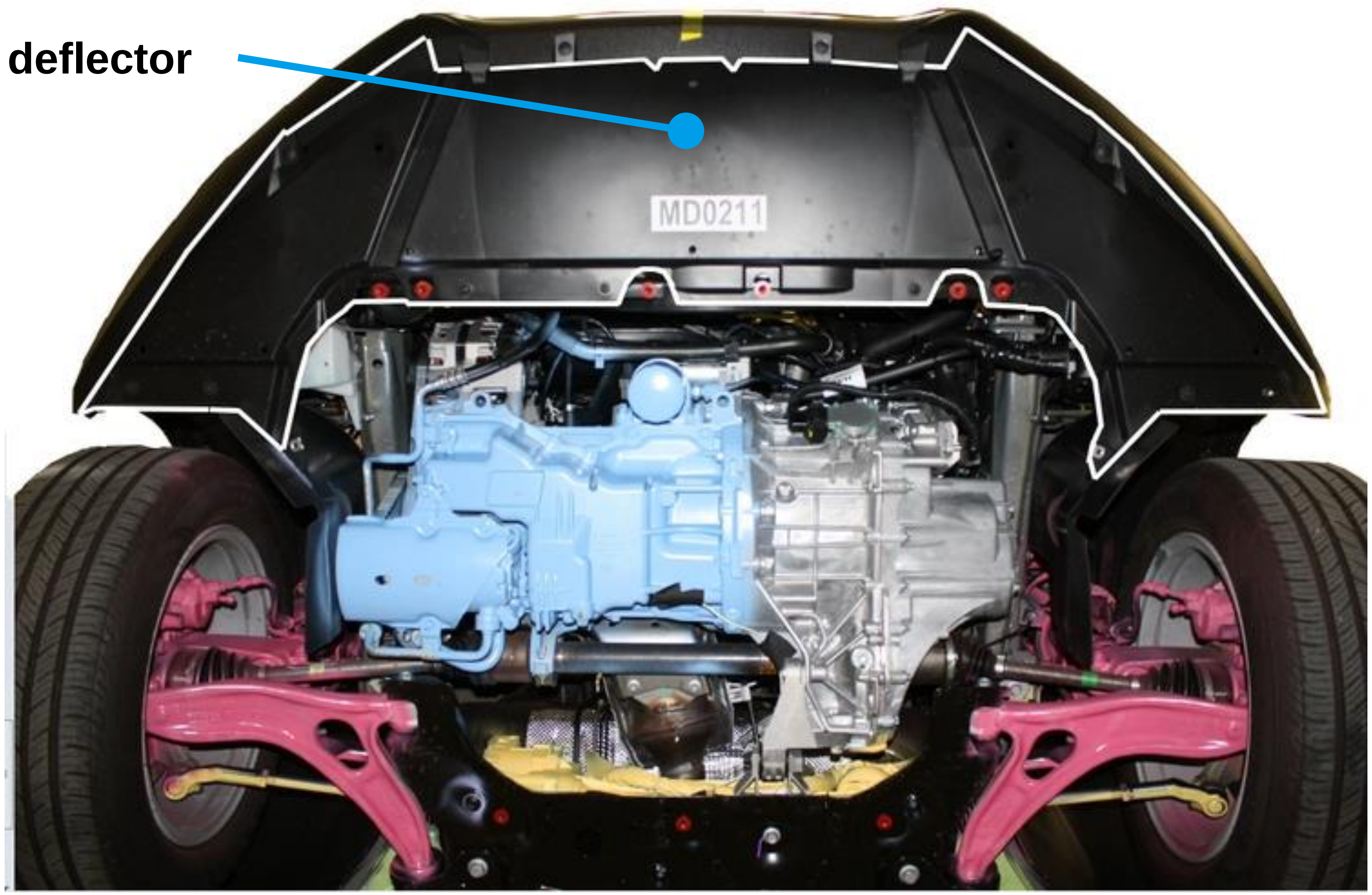
Example of a difference between European vs. U.S. variants: Lower valence/air deflector

Front-end Underside, Ford Focus (U.S. variant)

Lower valence/air deflector



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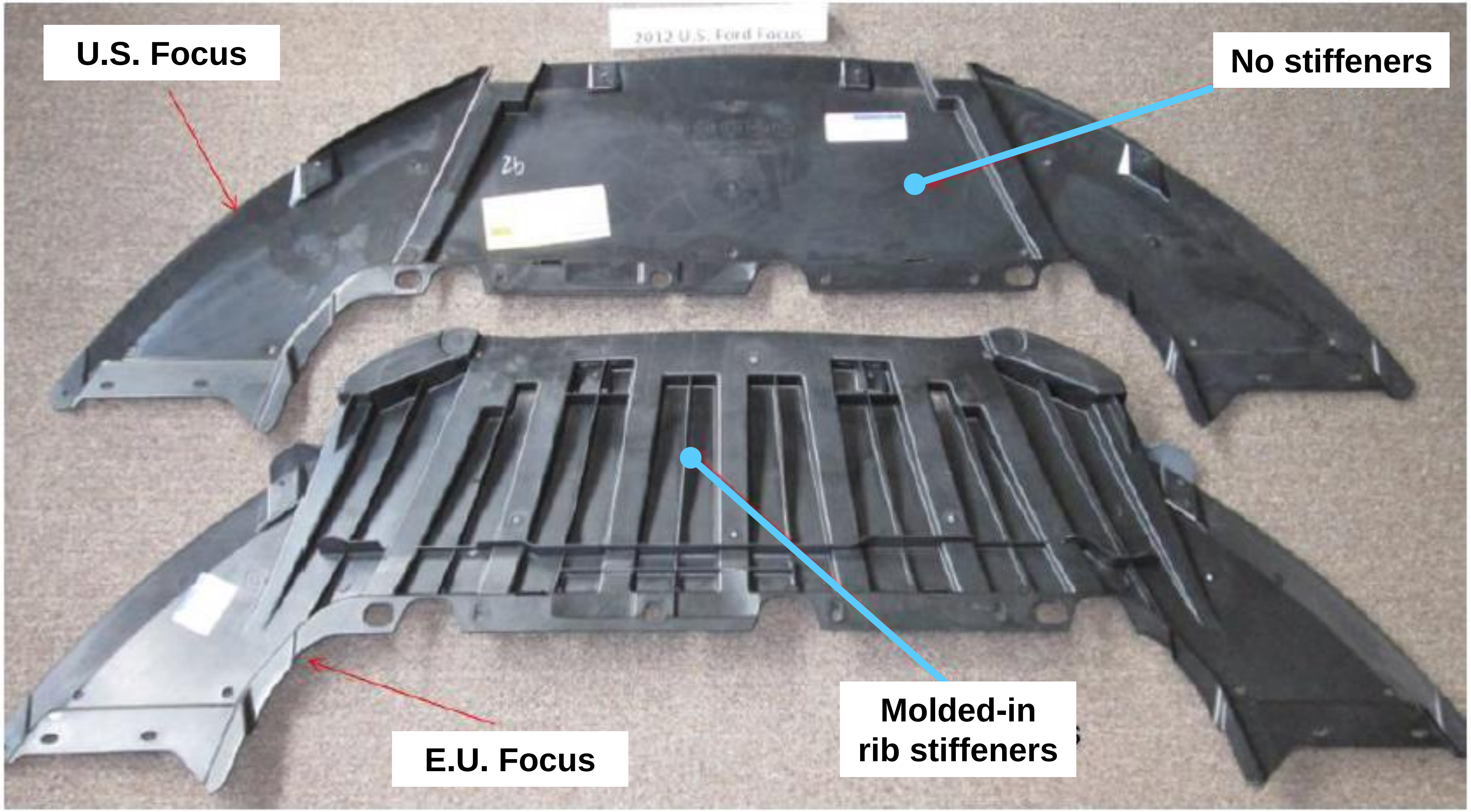
Example of a difference between European vs. U.S. variants: Lower valence/air deflector



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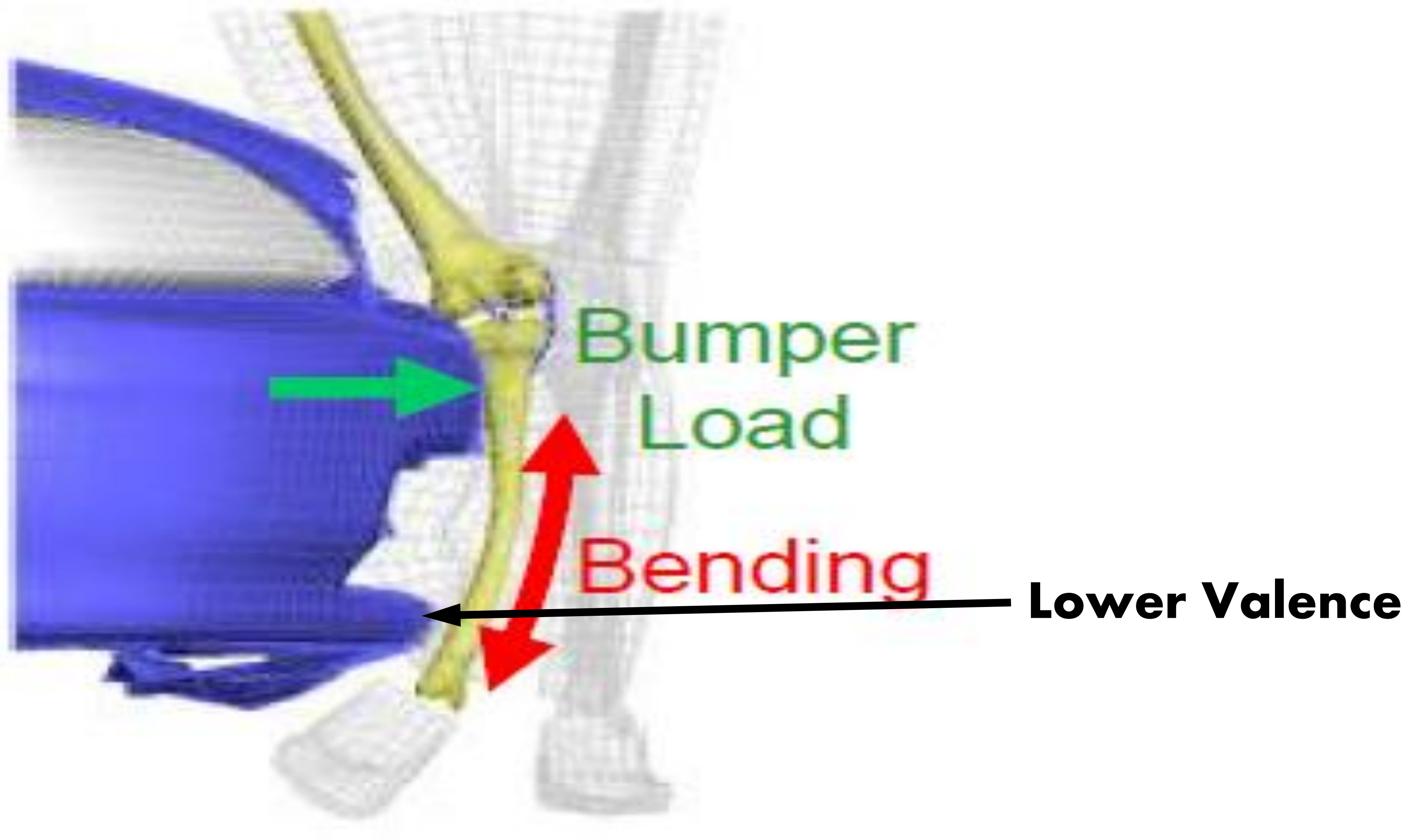
Example of a difference between European vs. U.S. variants: Lower valence/air deflector



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Does the very latest vehicle generation of passenger cars offer better safety to pedestrians than previous generations?

“Conventional Wisdom” leads us to believe “YES”

- *As regulatory requirements and NCAP assessments in the Europe and Japan have become more demanding over the years, vehicle front-ends have become more pedestrian friendly.*
- *Now more than ever before, many U.S. passenger cars and SUVs share the same basic pedestrian-friendly design underpinnings as model variants sold in Europe.*
- *As vehicle front end have become more pedestrian friendly on European models, so too have they become more pedestrian friendly on U.S. models.*
- *European and North American variants are especially similar in the hood and windshield (sources of most pedestrian head and upper thorax injuries).*
- *Since pedestrian injury rates have dropped in Europe, they should have also dropped in the U.S., too.*

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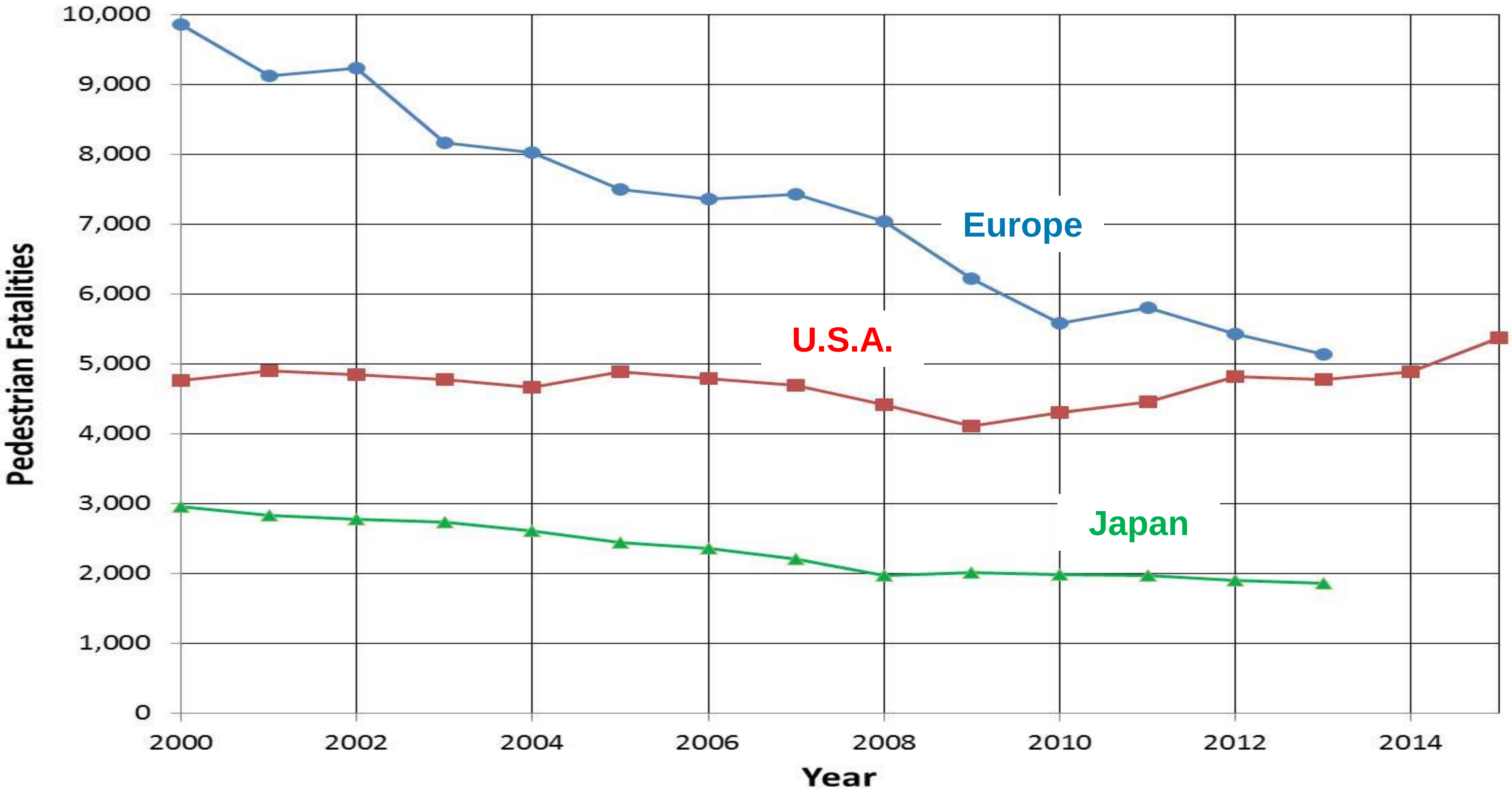
Pedestrian Fatality Trends



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Does the very latest vehicle generation of passenger cars offer better safety to pedestrians than previous generations?

Reasons for Pessimism: "NO"

- *Significant differences exist in the bumper area, so injuries induced by the bumper area on recent generations of U.S. variants may not show reductions over previous generations.*

- *Pedestrian fatalities occur mostly at high impact speeds and are unaffected by vehicle designs (pedestrian overshoots hood).*

- *About 10% of European vehicles have active "pop-up hoods" to curb pedestrian injuries – not available on U.S. models so no safety benefit on U.S. variants.*

- *Most vehicles are "uniquely American." Sharing of design characteristics between U.S. and European variants seen in the exemplar Ford Focus may be unusually strong.*

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Does the very latest vehicle generation of passenger cars offer better safety to pedestrians than previous generations?

Hypothesis: Lower risk of pedestrian injuries may be observed in U.S. real-world collisions with more recent vs. older generations of passenger cars.

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Statistical Cohorts: Model year groupings and vehicle types

MY2001-MY2005

**Group 1.
Cars,
SUVs,
Minivans**

MY2011-MY2013

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Statistical Cohorts: Model year groupings and vehicle types

MY2001-MY2005

Group 2.
Cars only
(sedans, coupes)

MY2011-MY2013

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Statistical Cohorts: Model year groupings and vehicle types

MY2001-MY2005

Group 3. Pickups

MY2011-MY2013

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Approach

- Selected crash data from State Data System (SDS)
- Identified crashes involving a pedestrian
- Obtained Model Year (MY) of vehicle that struck the pedestrian
- Classified injury status of pedestrian

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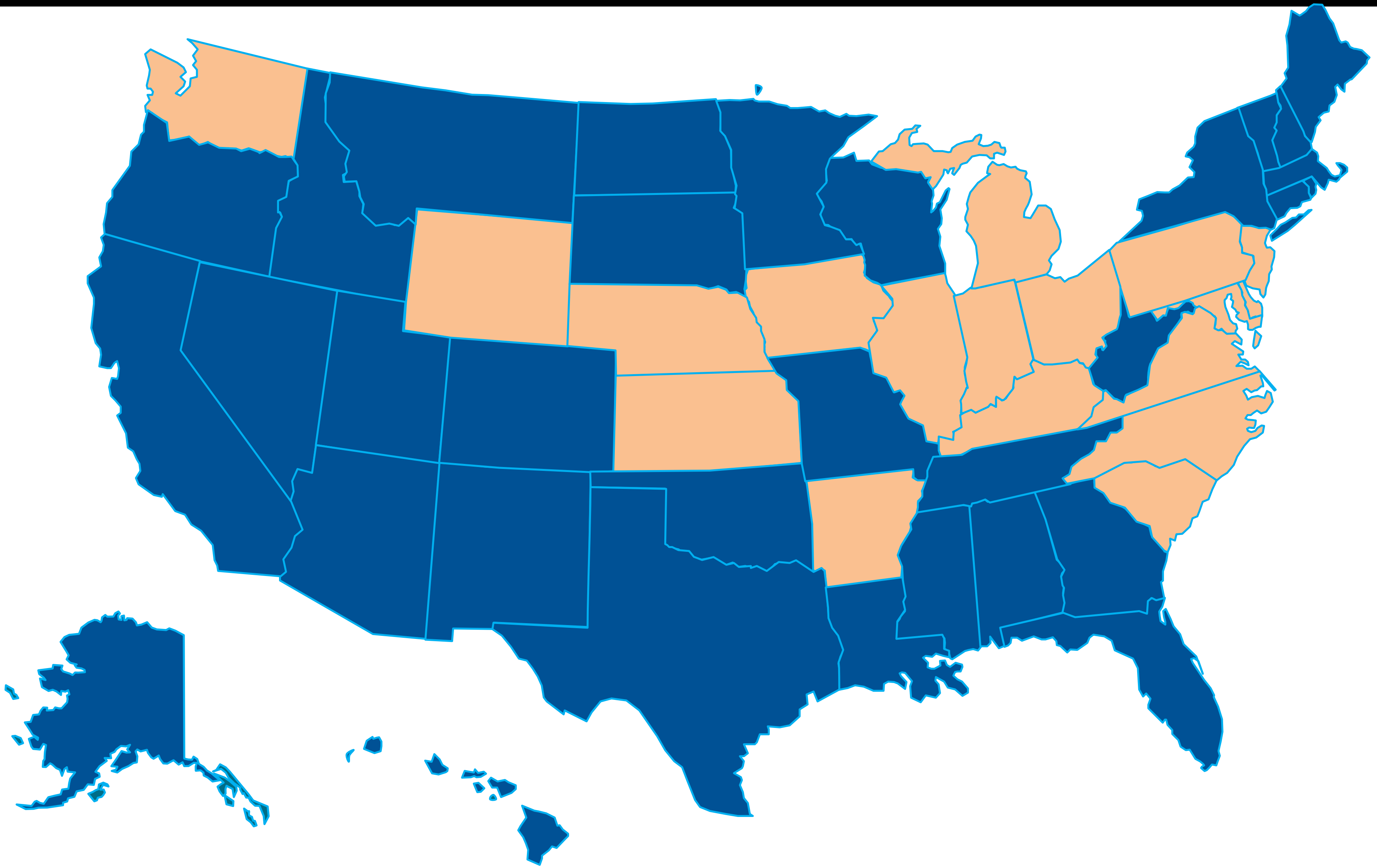
State Selection
Crash data 2006 through 2012



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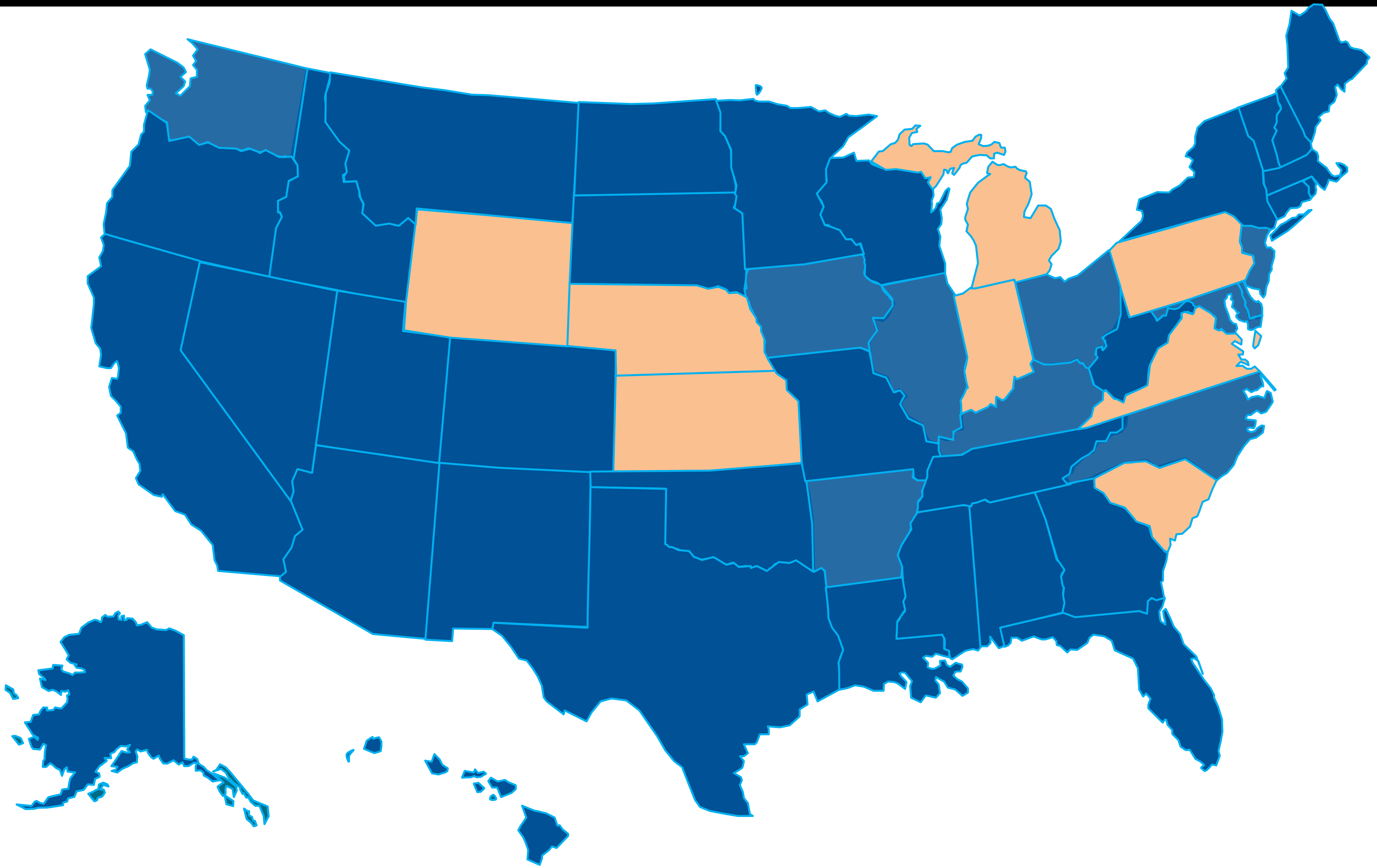
State Selection
Similar crash report criteria



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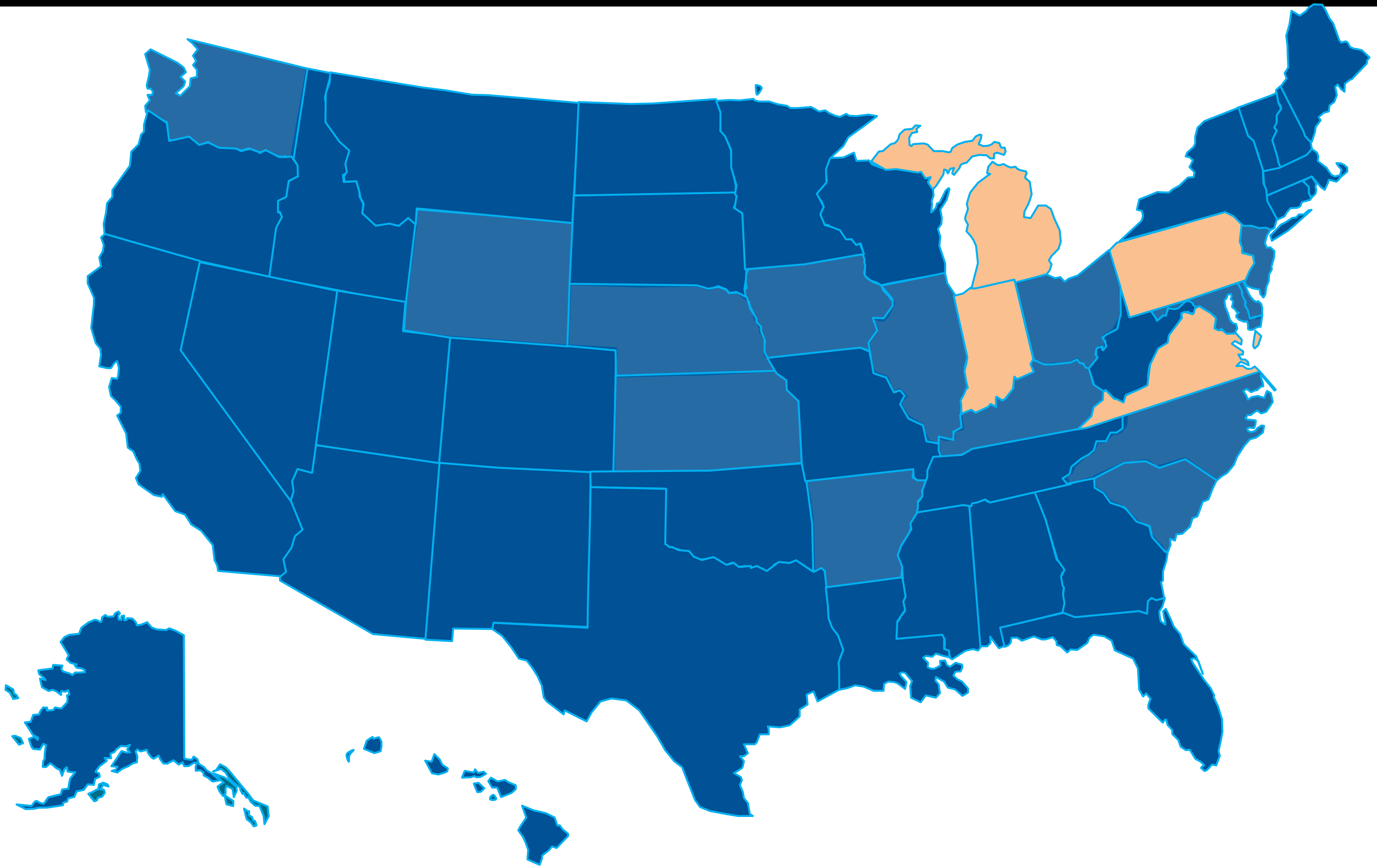
State Selection
Pedestrian fatalities and MY



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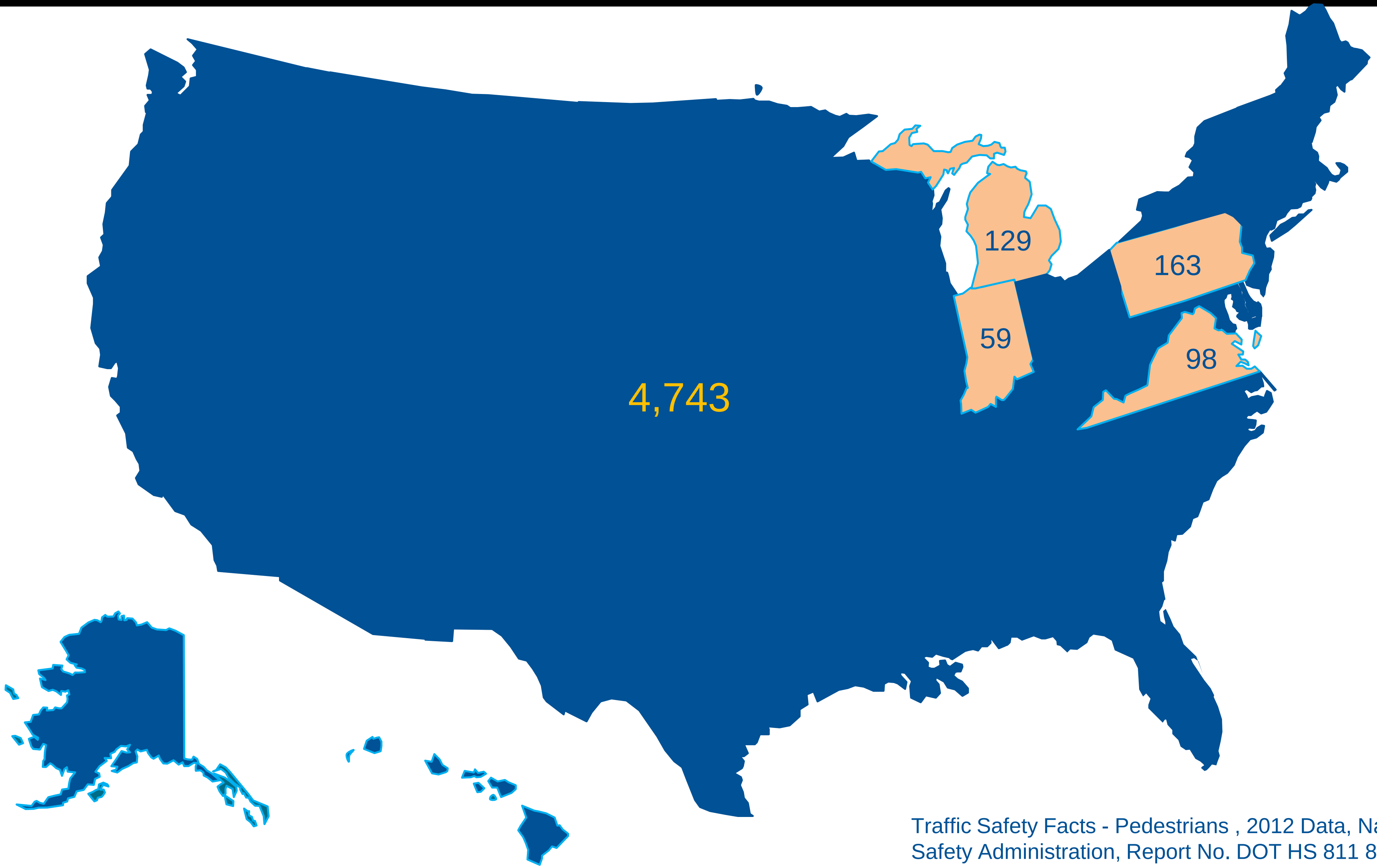
State Selection
Pedestrian fatalities in 2012 crashes



Traffic Safety Facts - Pedestrians , 2012 Data, National Highway Traffic Safety Administration, Report No. DOT HS 811 888, April 2014.

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Methods

- Identified crashes involving a pedestrian
  - Only 1 pedestrian involved
- Obtained MY of vehicle that struck pedestrian
  - Based on vehicle events
  - Passenger vehicles
- Classified injury status
  - Excluded pedestrians struck by more than one vehicle

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Passenger Vehicles
Analysis limited to passenger vehicles

Vehicle categories

- Passenger Vehicles
  - Automobile
  - Passenger car or station wagon
  - Sport utility vehicle/SUV
  - Van

- Cars
  - Automobile
  - Passenger car or station wagon

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Pedestrian Injury Status
Not just fatalities

Injury categories

- Serious injury or fatality
  - Incapacitating injury
  - Serious injury
  - Bleeding wound or distorted member/had to be carried from scene
  - Fatality

- Any injury – Serious injury or fatality plus
  - Moderate injury
  - Minor injury
  - Non-incapacitating injury
  - Injury of unknown severity

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Statistical Analysis

Proportion injured

- Calculated two proportions - injured and uninjured
- For each of two model year groupings
  - Fisher's exact test for 2x2 comparisons

Percent change

- Change in proportion injured: Later MY versus earlier MY

Individual and grouped states

- For each state
- For 4 states combined

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Results
Serious injury or fatality: Passenger vehicles

State	Percent injured		P-value	Percent change
	MY2001-MY2005	MY2011-MY2013		
IN	16%	14%	NS	-11%
MI	24%	13%	<0.05	-46%
PA	10%	9%	NS	-12%
VA	34%	25%	<0.05	-27%
All 4 states	16%	13%	<0.05	-19%

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Results
Serious injury or fatality: Cars

State	Percent injured		P-value	Percent change
	MY2001-MY2005	MY2011-MY2013		
IN	15%	14%	NS	-2%
MI *	24%	13%	<0.05	-46%
PA	10%	10%	NS	4%
VA	32%	30%	NS	-6%
All 4 states	16%	14%	NS	-10%

* MI did not have an SUV or Van category – all “passenger vehicles” were “cars”

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Results
Any injury: Passenger vehicles

State	Percent injured		P-value	Percent change
	MY2001-MY2005	MY2011-MY2013		
IN	92%	88%	NS	-5%
MI	92%	90%	NS	-3%
PA	99%	99%	NS	0%
VA	93%	78%	<0.05	-16%
All 4 states	96%	92%	<0.05	-4%

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Results
Any injury: Cars

State	Percent injured		P-value	Percent change
	MY2001-MY2005	MY2011-MY2013		
IN	91%	87%	NS	-5%
MI *	92%	90%	NS	-3%
PA	99%	99%	NS	0%
VA	92%	81%	<0.05	-12%
All 4 states	96%	92%	<0.05	-4%

* MI did not have an SUV or Van category – all “passenger vehicles” were “cars”

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Results
Serious injuries and fatalities: Pickups

For comparison, proportion injured by pickup trucks/small trucks

- MY2001-MY2005: 22%
- MY2011-MY2013: 24%
- No significant difference (p = 0.59)
- 12% increase

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Limitations

- Fatalities: Too few for analysis
- Any injury: May be too common – generally reported
- Serious injuries: Small numbers in the later MY group
- Earlier MY vehicles may have been on the road longer
- Physical location of injury unknown
  - injury to leg or torso from being struck by vehicle versus
  - injury to head or arm by being knocked over

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Summary

Is the proportion of pedestrians sustaining serious injuries different in collisions with more recent versus older generation passenger vehicles?

- *Lower* proportion for later MY passenger vehicles
  - Significantly so for 2 of 4 states and when 4 states combined
- *Higher* proportion for later MY pickup trucks

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Next Steps

- Update analysis with additional years of crash data
  - May provide greater power to detect differences
- Include additional states in analysis
  - Similar reporting criteria between states may not be important as long as reporting criteria within each state does not change
- Investigate particular make and model and relate pedestrian injury rates to test data

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Questions

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ADDITIONAL INFORMATION

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Numbers
Serious injury or fatality: Passenger vehicles

State	Number injured	
	MY2001-MY2005	MY2011-MY2013
IN	351	16
MI	565	26
PA	776	42
VA	458	35
All 4 states	2,150	119

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Results
Serious injury or fatality: Passenger vehicles

State	Percent injured		P-value	Percent change
	MY2001-MY2005	MY2011-MY2013		
IN	15.60%	13.91%	0.6936	-10.81%
MI	23.58%	12.68%	0.0002	-46.22%
PA	10.42%	9.19%	0.4298	-11.79%
VA	33.83%	24.82%	0.0306	-26.62%
All 4 states	15.99%	12.96%	0.0149	-18.92%

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Numbers
Serious injury or fatality: Cars

State	Number injured	
	MY2001-MY2005	MY2011-MY2013
IN	234	12
MI *	565	26
PA	503	31
VA	284	28
All 4 states	1,586	97

* MI did not have an SUV or Van category – all “passenger vehicles” were “cars”

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Results
Serious injury or fatality: Cars

State	Percent injured		P-value	Percent change
	MY2001-MY2005	MY2011-MY2013		
IN	14.63%	14.29%	1.0000	-2.38%
MI *	23.58%	12.68%	0.0002	-46.22%
PA	9.51%	9.90%	0.7670	4.18%
VA	31.87%	30.11%	0.8150	-5.54%
All 4 states	15.58%	13.96%	0.2782	-10.44%

* MI did not have an SUV or Van category – all “passenger vehicles” were “cars”

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Numbers
Any injury: Passenger vehicles

State	Number injured	
	MY2001-MY2005	MY2011-MY2013
IN	2,070	101
MI	2,214	184
PA	7,373	453
VA	1,257	110
All 4 states	12,914	848

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Results
Any injury: Passenger vehicles

State	Percent injured		P-value	Percent change
	MY2001-MY2005	MY2011-MY2013		
IN	92.00%	87.83%	0.1163	-4.54%
MI	92.40%	89.76%	0.1750	-2.87%
PA	98.99%	99.12%	1.0000	0.13%
VA	92.84%	78.01%	0.0000	-15.97%
All 4 states	96.03%	92.37%	0.0000	-3.81%

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Numbers
Any injury: Cars

State	Number injured	
	MY2001-MY2005	MY2011-MY2013
IN	1,461	73
MI *	2,214	184
PA	5,232	309
VA	820	75
All 4 states	9,727	641

* MI did not have an SUV or Van category – all “passenger vehicles” were “cars”

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Results
Any injury: Cars

State	Percent injured		P-value	Percent change
	MY2001-MY2005	MY2011-MY2013		
IN	91.37%	86.90%	0.1662	-4.89%
MI *	92.40%	89.76%	0.1750	-2.87%
PA	98.88%	98.72%	0.7790	-0.16%
VA	92.03%	80.65%	0.0009	-12.37%
All 4 states	95.58%	92.23%	0.0002	-3.50%

* MI did not have an SUV or Van category – all “passenger vehicles” were “cars”