NHTSA's Backover Crash Prevention Research

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The Backover Problem

A "Backover" crash is one in which a backing vehicle strikes a pedestrian

NHTSA estimates 183 fatalities in 1998

- One time study of 1998 FARS and death certificates
- As indicated in 2006 report to Congress; More recent estimates may be available

Estimate 7,419 emergency room treated injuries in 2001

- Based on data from Consumer Product Safety Commission
- A majority of incidents involved victims who were treated and released from the hospital

Backover Facts

- Children under 5 years old have the highest involvement
  - 38% of the estimated 183 fatalities were children under 5 years old
- Elderly pedestrians also show high involvement
  - 27% of the estimated 183 fatalities were over 70 years old
- Incidents most frequently occur in driveways
- Minivans, pickups and SUVs have higher involvement rate than passenger cars

What Prompted NHTSA's Backover Research?

- Section 10304 SAFETEA-LU states
  - *Identify*, *evaluate* … available backover avoidance technologies for detecting people or objects behind a passenger vehicle for their *accuracy*, *effectiveness*, cost, and feasibility for installation
- Senate Appropriations Report No. 109-109
  - Evaluate means to reduce backover incidence, including educational efforts, …technological means provided by *original equipment* manufacturers and *aftermarket*

Marketing of Available Technologies

OEM systems on the market are sold as parking aids

Aftermarket systems imply that they detect kids ("safety systems")

Guardian Alert

Poron

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5

Available "Backover Technologies"

~ Generic term to describe countermeasures

Sensors

Video

Mirrors

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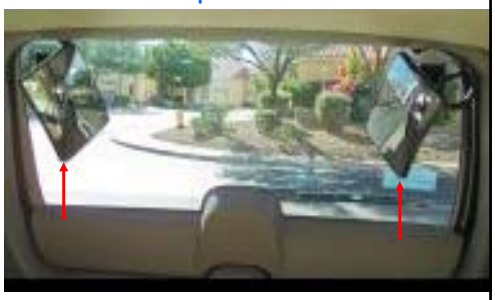
6

Mirror Systems Examination

Systems examined:

Toyota 4Runner
C-pillar cross-view mirrors

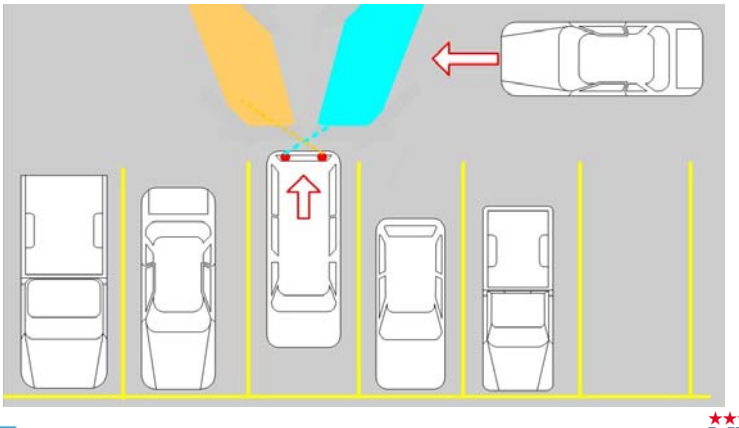
ScopeOut mirrors



7

Mirror Systems Examination

Mirrors help the driver see objects approaching the rear of the car at a 90 degree angle



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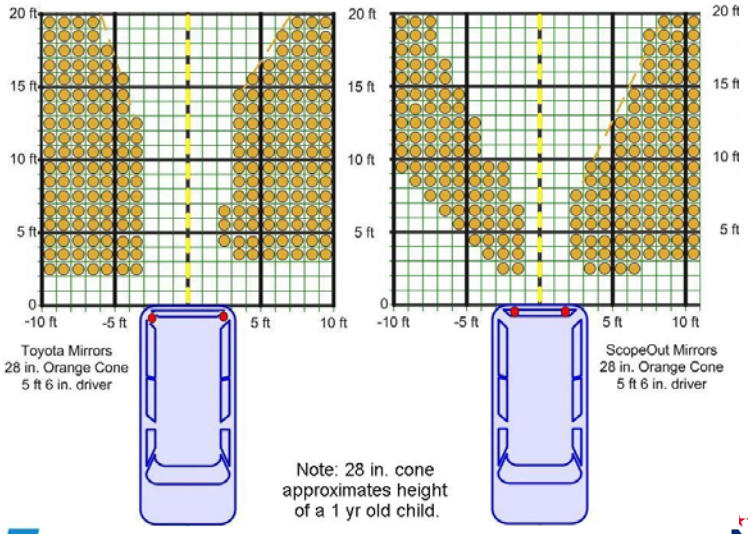
Mirror Field of View for 28” Cone for a 5’6” Tall Driver



9

Mirror System Conclusions

- Substantial areas behind the vehicle are not visible to the driver
- Distortion of image due to mirror convexity
  - Objects appear skinnier
  - Objects can be difficult to discern

Electronic Backing Systems Tested

Vehicle Mfr. and Model	# Sensors	Camera	Display Type
2005 Nissan Quest: Ultrasonic Sensor	4		Auditory Alert
2006 BMW 330i: Ultrasonic Sensor	4		LCD graphical display, birds-eye view; Auditory alert, multi-level
2005 Lincoln Navigator: Ultrasonic/Radar	2/1		Auditory alert
Poron: Ultrasonic Sensor	3		LED distance display; Auditory alert
Guardian Alert: Doppler Radar, K-Band	1		LED, 3 colors
Guardian Alert: Doppler Radar, X-Band	2		LED, 3 colors
2005 Infiniti FX35: Video		X	LCD Video display
2007 Cadillac Escalade: Video/Ultrasonic	4	X	LCD video display with icon overlay; Auditory alert
Audiovox: Video/Ultrasonic	4	X	3 inch LCD display in rear-view mirror; Auditory alert

Sensor System Testing

Measure capability to detect objects (including children, adults, objects)

- Define static detection zones
- Define dynamic detection ranges
  - Adult walking, children walking and riding toys
  - Objects suspended and moved using hoist

Example Sensor-Based System:
Park Distance Control (2006 BMW 330i)

4 Ultrasonic sensors

Visual and auditory alerts

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13

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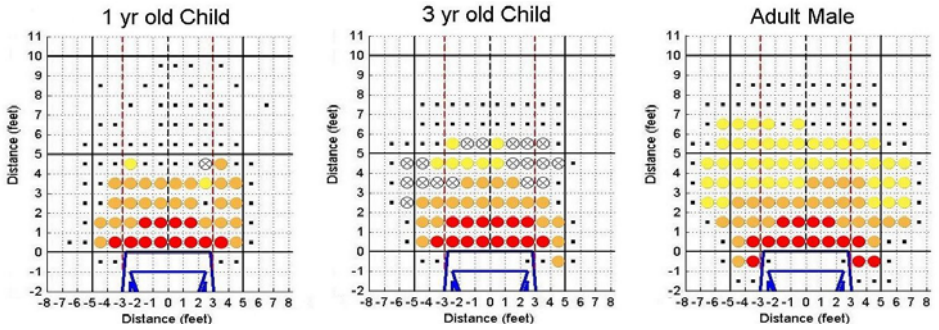
Example Results – Static Testing: BMW 330i

High	●
Intermed.	●
Low	●
Inconsistent	⊗
No Detect	·



Example Dynamic Sensor System Tests with Children

15

Example Dynamic Sensor System "Uncommanded Trials" with Children

16

Sensor System Testing Conclusions

Detection of objects was inconsistent
- "Holes" in detection zones
- Day-to-day performance variability was observed

Adults
- Standing: detected well with both sensor technologies within a limited range
- Laying on ground: not well detected

Children
- Not well detected, particularly when standing still

Test objects less than 28 in. in height typically were not detected

17

Example Video-Based System:
RearView Monitor (2005 Infiniti FX35)

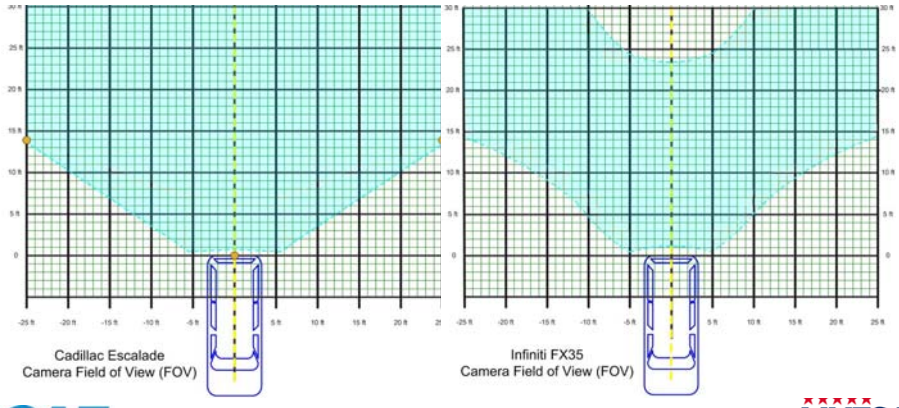
Video only

18

Assessment of Video Systems

Measure fields of view

Examine image clarity and resolution



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19

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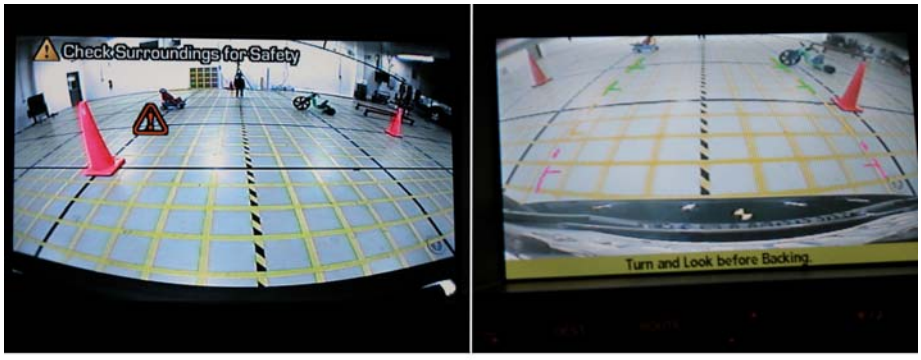
Assessment of Video Systems

Cadillac Escalade **Infiniti FX35**



3 yr old dummy at 20 ft range

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Rearview Video System Conclusions

Image clarity generally good in daylight

However, system effectiveness depends on:

- Whether driver looks at video in time to detect object
- Environmental conditions degrade display (e.g. rain, darkness, glare)

Up to driver to look at display, perceive any threat, and respond appropriately

Escalade view had significantly greater range

Superimposed visual alerts helpful, but must be timely

- Video image displayed objects behind the vehicle immediately

Overall Test Conclusions

Mirrors have limited benefit for backover prevention due to incomplete field of view and distortion

Sensor-based systems:

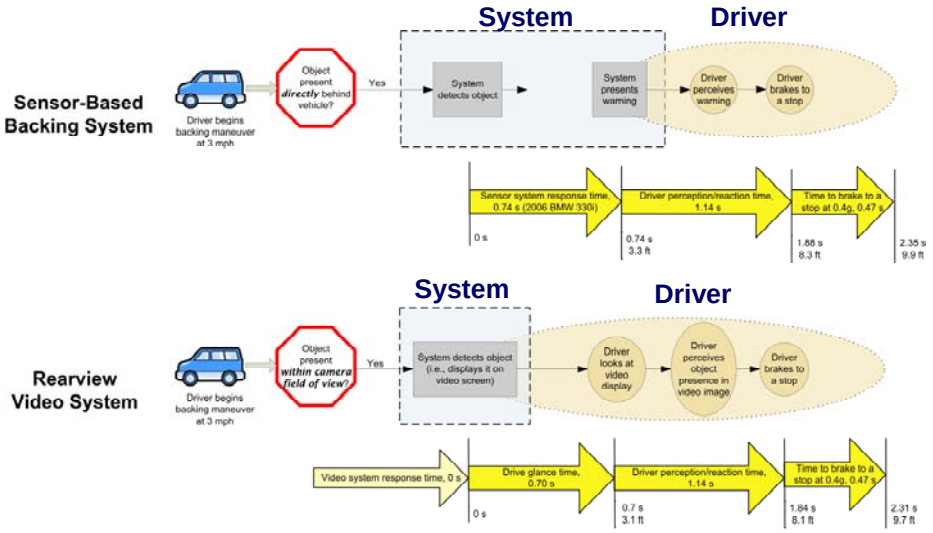
- Detection of children was poor and inconsistent
- Current sensor-based systems are unreliable for backover prevention

Video-based systems:

- Effectively display the view behind the vehicle in well-lit area
- Large field of view
- Most systems do not alert the driver to objects behind the vehicle (passive)
  - Adding an audible alert (e.g., Escalade)
  - could potentially increase effectiveness

Backover System Effectiveness Timeline

(Testing addressed system component performance)



Current Research

Examine whether drivers can effectively use rearview video systems and/or rear object detection systems to avoid collisions

Characterize rear visibility for current vehicles

Additional Information

Vehicle Backover Avoidance Technology Study - Report to Congress (Nov. 2006)

Experimental Evaluation of the Performance of Available Backover Prevention Technologies (DOT HS 810 634, Sept. 2006)

Docket No. NHTSA-2006-25579