Safer Speeds: Considerations for Speed Limits and Management

(Image: Photo by David Lofink)

Presented by:

Dr. Offer Grembek

Berkeley SafeTREC

Presented to:

CA Zero Fatalities Task Force

June 25, 2019

Outline

Background

- Safe System
- Informing Speeds
- International Practices

Speed and Safety

- Speeding
- Risks of speeding
- Modal vulnerability

US & California

- 85th Percentile
- National efforts
- California MUTCD

Goal of the transportation system?

Provide mobility.

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Provide mobility.

Provide efficient, cost-effective, equitable, sustainable, …, and safe mobility.

So, is our transportation system safe?

So, is our transportation system safe?

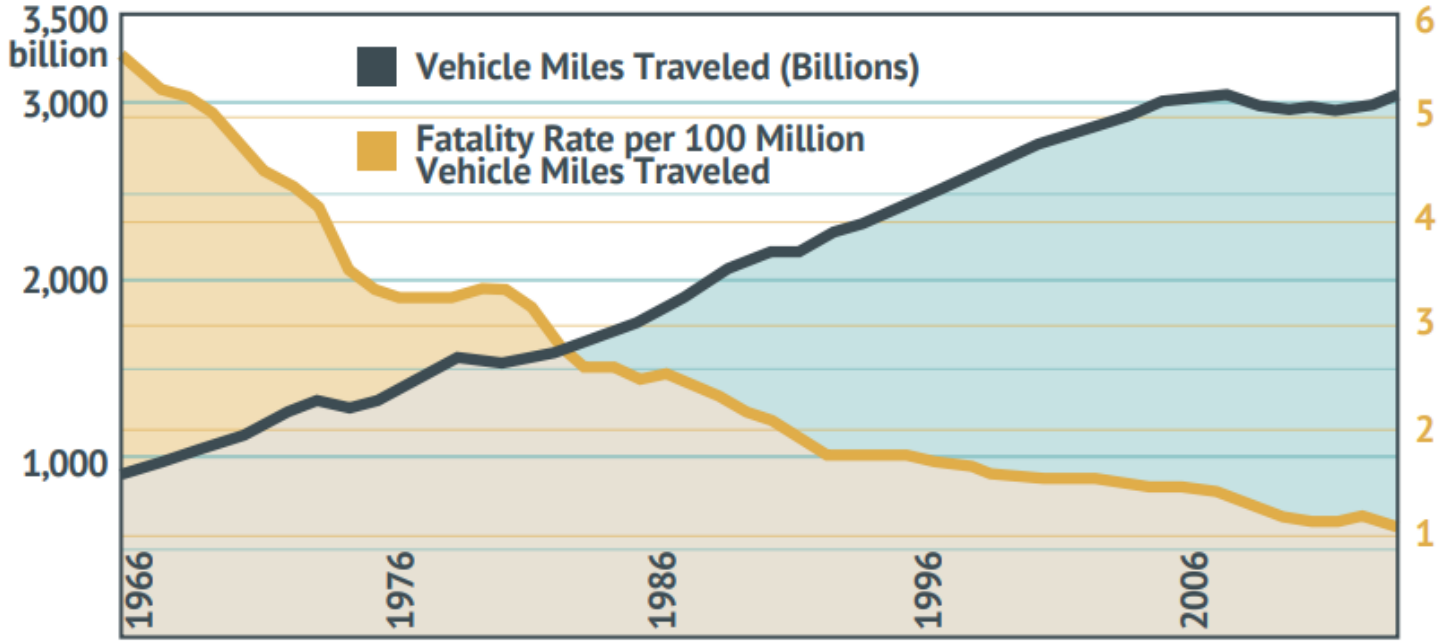


FIGURE 1-3: Fatality Rate and Vehicle Miles Traveled, 1966-2013 (Source: NHTSA FARS)

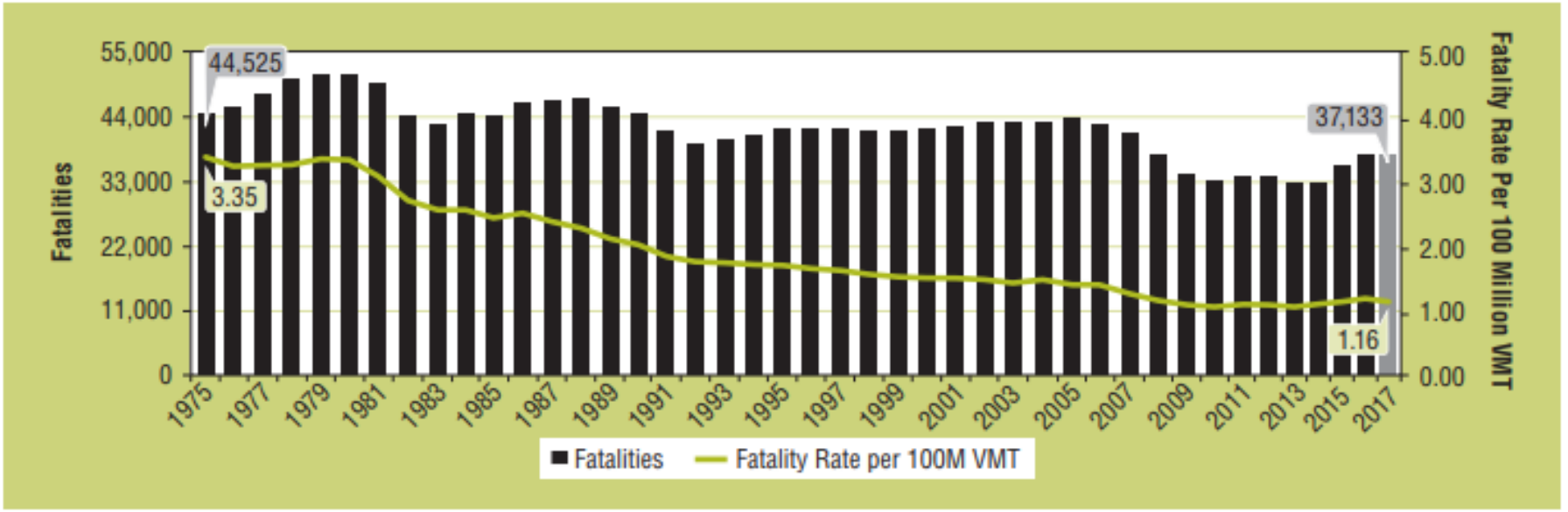
The fatality rate has demonstrated a downward trend for decades.

We're on the right track towards safety.

So, is our transportation system safe?

No. It is not safe.

Fatalities and Fatality Rate per 100 Million VMT, by Year, 1975–2017



Sources: FARS 1975–2016 Final File, 2017 ARF; Vehicle Miles Traveled (VMT): FHWA.

2017 Fatalities:

California:
3,602

USA:
37,133

Globally:
Over 1,300,000

So, is our transportation system safe?

No. It is not safe.

10 Leading Causes of Injury Deaths by Age Group Highlighting Unintentional Injury Deaths, United States – 2017

	Age Groups										
Rank	<1	1-4	5-9	10-14	15-24	25-34	35-44	45-54	55-64	65+	Total
1	Unintentional Suffocation 1,106	Unintentional Drowning 424	Unintentional MV Traffic 327	Unintentional MV Traffic 428	Unintentional MV Traffic 6,697	Unintentional Poisoning 16,478	Unintentional Poisoning 15,032	Unintentional Poisoning 14,707	Unintentional Poisoning 10,581	Unintentional Fall 31,190	Unintentional Poisoning 64,795
2	Homicide Unspecified 139	Unintentional MV Traffic 362	Unintentional Drowning 125	Suicide Suffocation 280	Unintentional Poisoning 5,030	Unintentional MV Traffic 6,871	Unintentional MV Traffic 5,162	Unintentional MV Traffic 5,471	Unintentional MV Traffic 5,584	Unintentional MV Traffic 7,667	Unintentional MV Traffic 38,659
3	Unintentional MV Traffic 90	Homicide Unspecified 129	Unintentional Fire/Burn 94	Suicide Firearm 185	Homicide Firearm 4,391	Homicide Firearm 4,594	Suicide Firearm 3,098	Suicide Firearm 3,937	Suicide Firearm 4,219	Suicide Firearm 5,996	Unintentional Fall 36,338
4	Homicide Other Spec., Classifiable 76	Unintentional Suffocation 110	Homicide Firearm 78	Homicide Firearm 126	Suicide Firearm 2,959	Suicide Firearm 3,458	Suicide Suffocation 2,562	Suicide Suffocation 2,294	Unintentional Fall 2,760	Unintentional Unspecified 5,125	Suicide Firearm 23,854
5	Undetermined Suffocation 56	Unintentional Fire/Burn 95	Unintentional Suffocation 36	Unintentional Drowning 110	Suicide Suffocation 2,321	Suicide Suffocation 3,063	Homicide Firearm 2,561	Suicide Poisoning 1,604	Suicide Suffocation 1,631	Unintentional Suffocation 3,920	Homicide Firearm 14,542

Data Source: National Center for Health Statistics (NCHS), National Vital Statistics System.
Produced by: National Center for Injury Prevention and Control, CDC using WISQARS™.

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Data Source: National Center for Health Statistics (NCHS), National Vital Statistics System.
Produced by: National Center for Injury Prevention and Control, CDC using WISQARS™.

First, or Second; Age > 1yr

So, is our transportation system safe?

a system in which people cannot die despite human error.

Job, and Sakashita. 2016a

safe system

So, is our transportation system dangerous?

So, is our transportation system dangerous?

dangerous system

a system in which people can die with no human error (e.g., mine field, avalanche area).

Job, and Sakashita. 2016a

Our system is not safe and also not dangerous

Our system is not safe and also not dangerous

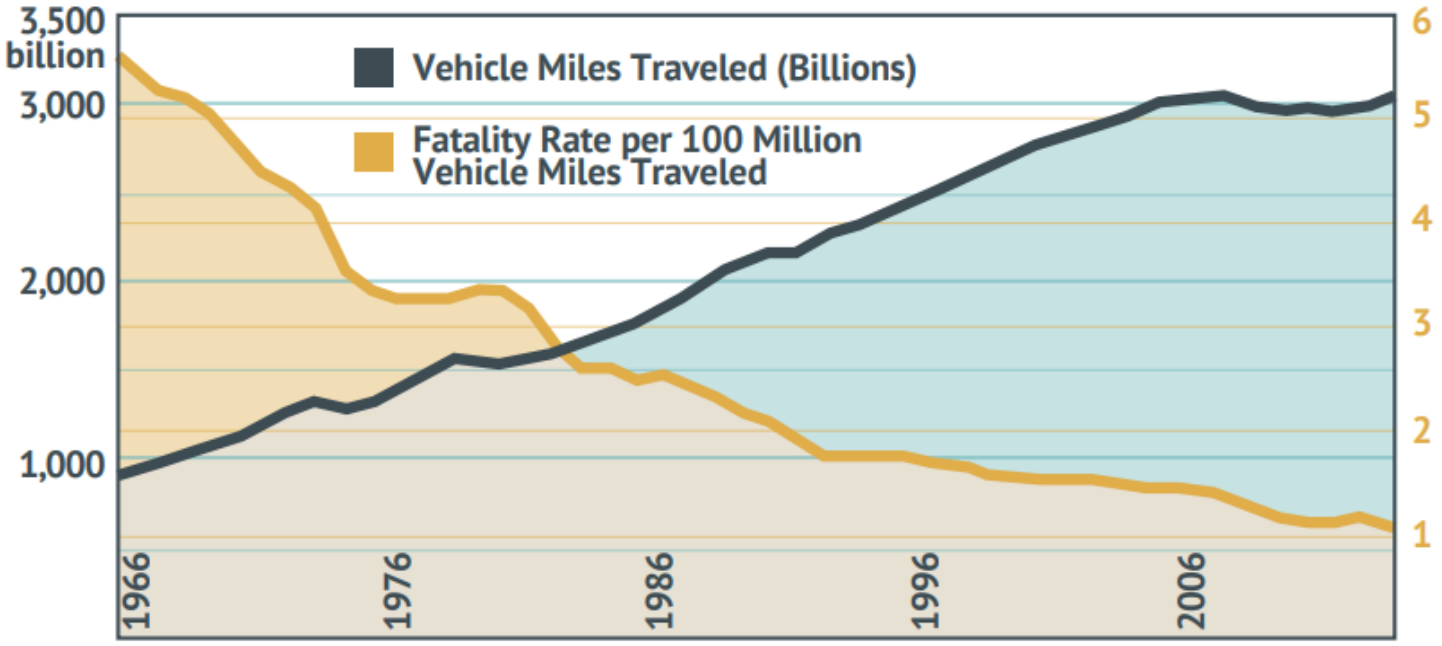


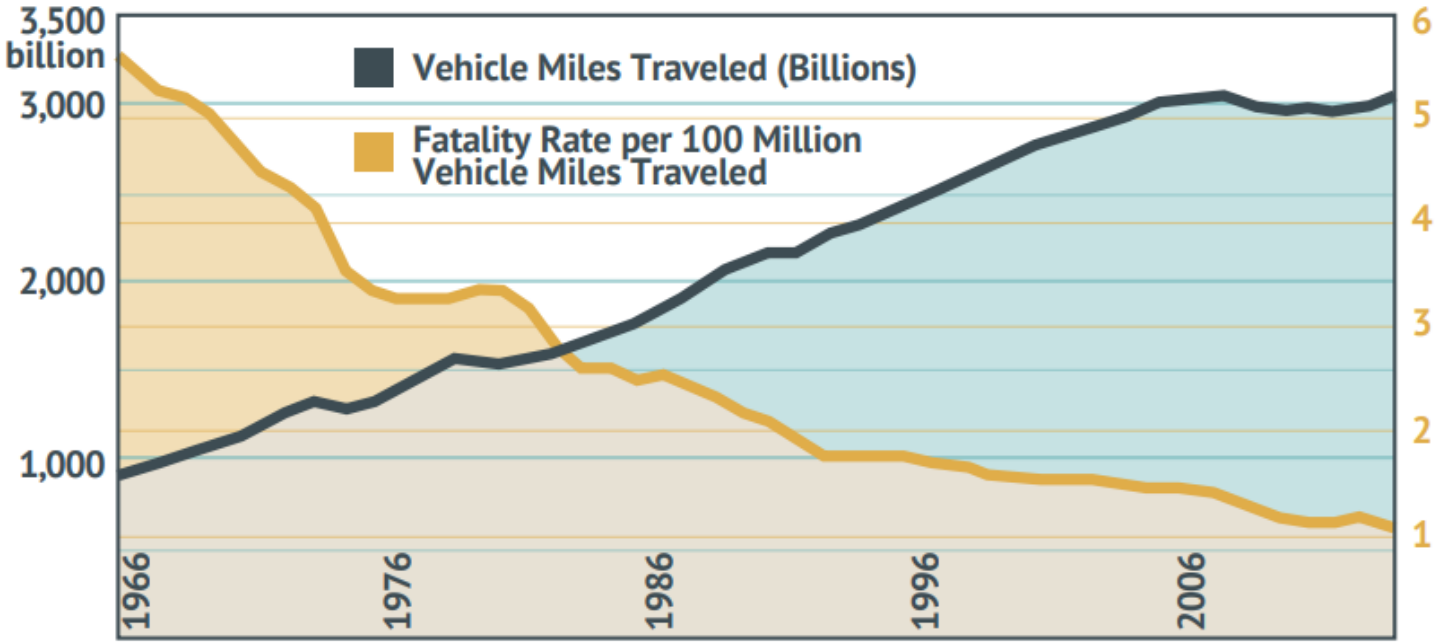
FIGURE 1-3: Fatality Rate and Vehicle Miles Traveled, 1966-2013 (Source: NHTSA FARS)

unsafe system

a system in which people can die through human error

Job, and Sakashita. 2016a

Our transportation system is unsafe



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unsafe system

a system in which people can die through human error

Job, and Sakashita. 2016a

Policy innovation to move the needle

V1.0

V2.0

dangerous system

unsafe system

safe system

Policy innovation to move the needle

Vision Zero & *Safe System*

challenge our ability to reach zero without a major change

ROAD TO ZERO

TZD Toward Zero Deaths®
National Strategy on Highway Safety

V1.0

V2.0

dangerous system

unsafe system

safe system

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Multi-layered systems approach

Mooren et al., 2011

Figure 3 – The Safe System model reproduced from Howard, 2004 [25]

dangerous system

unsafe system

safe system

System core: human tolerance to force

Mooren et al., 2011

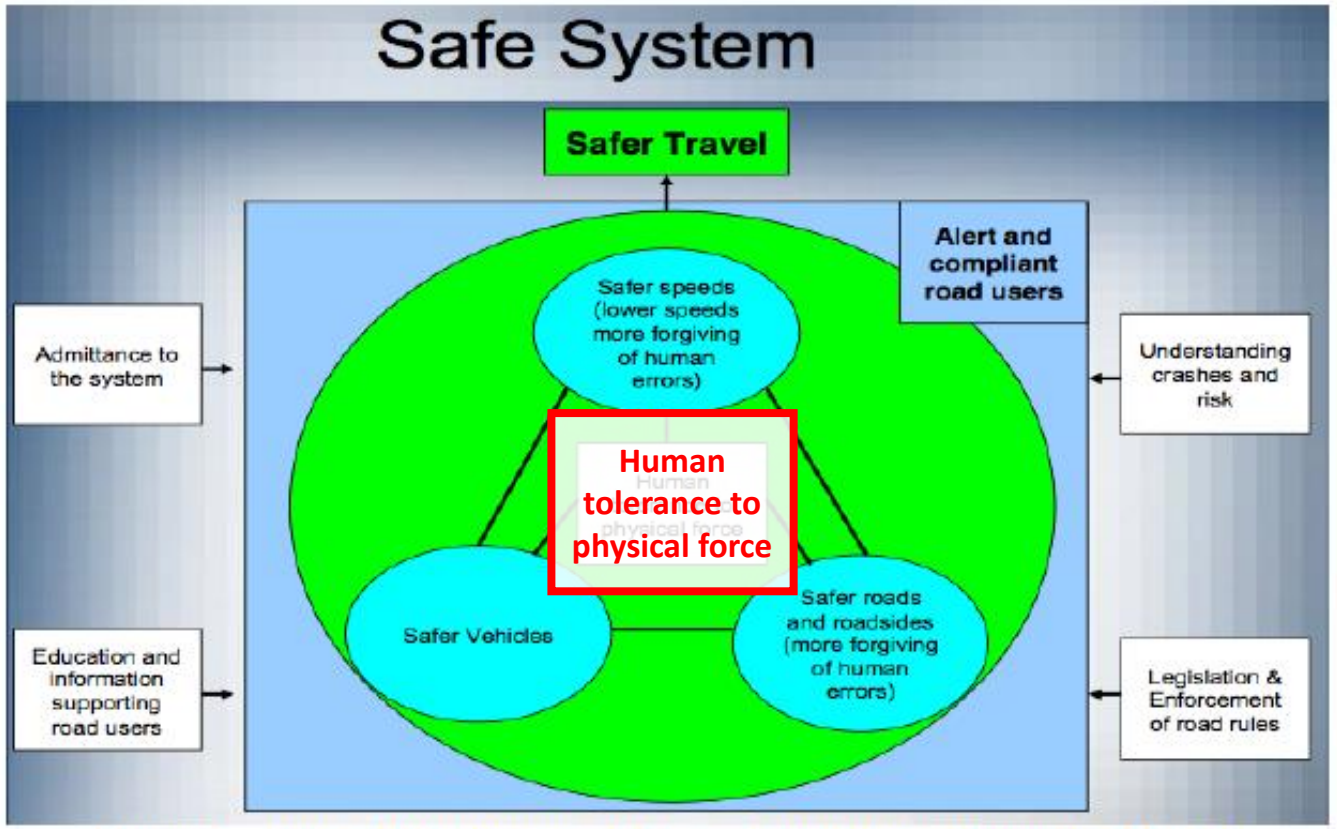

Figure 3 – The Safe System model reproduced from Howard, 2004 [25]

dangerous system

unsafe system

safe system

Safe System: safer roads, vehicles, speeds

Mooren et al., 2011

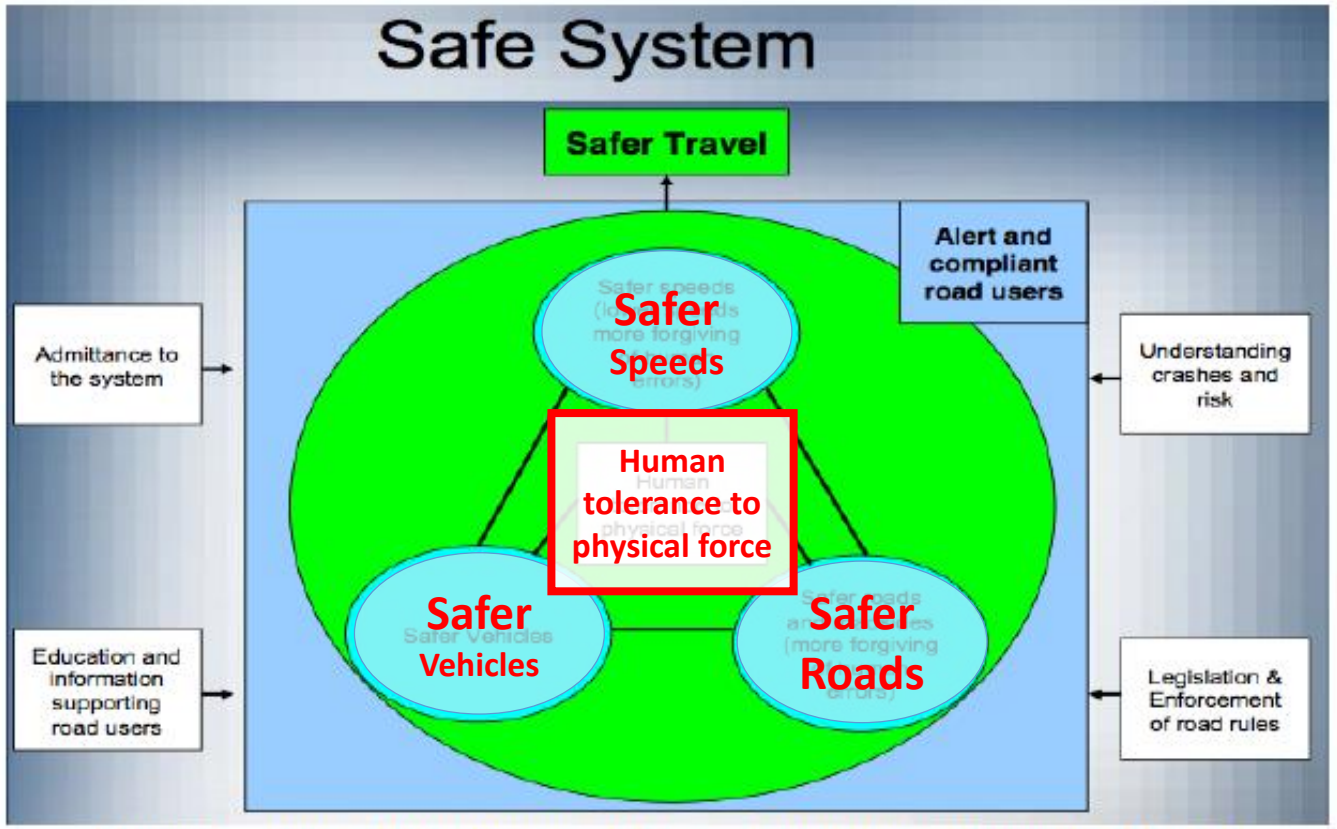

Figure 3 – The Safe System model reproduced from Howard, 2004 [25]

dangerous system

unsafe system

safe system

Safer Roads, Safer Vehicles, Safer Speeds

Danny Bagwell Flips Violently At Daytona 1999

https://www.youtube.com/watch?v=lIotGXqBH0Y

Safe System: safer roads, vehicles, speeds

Mooren et al., 2011

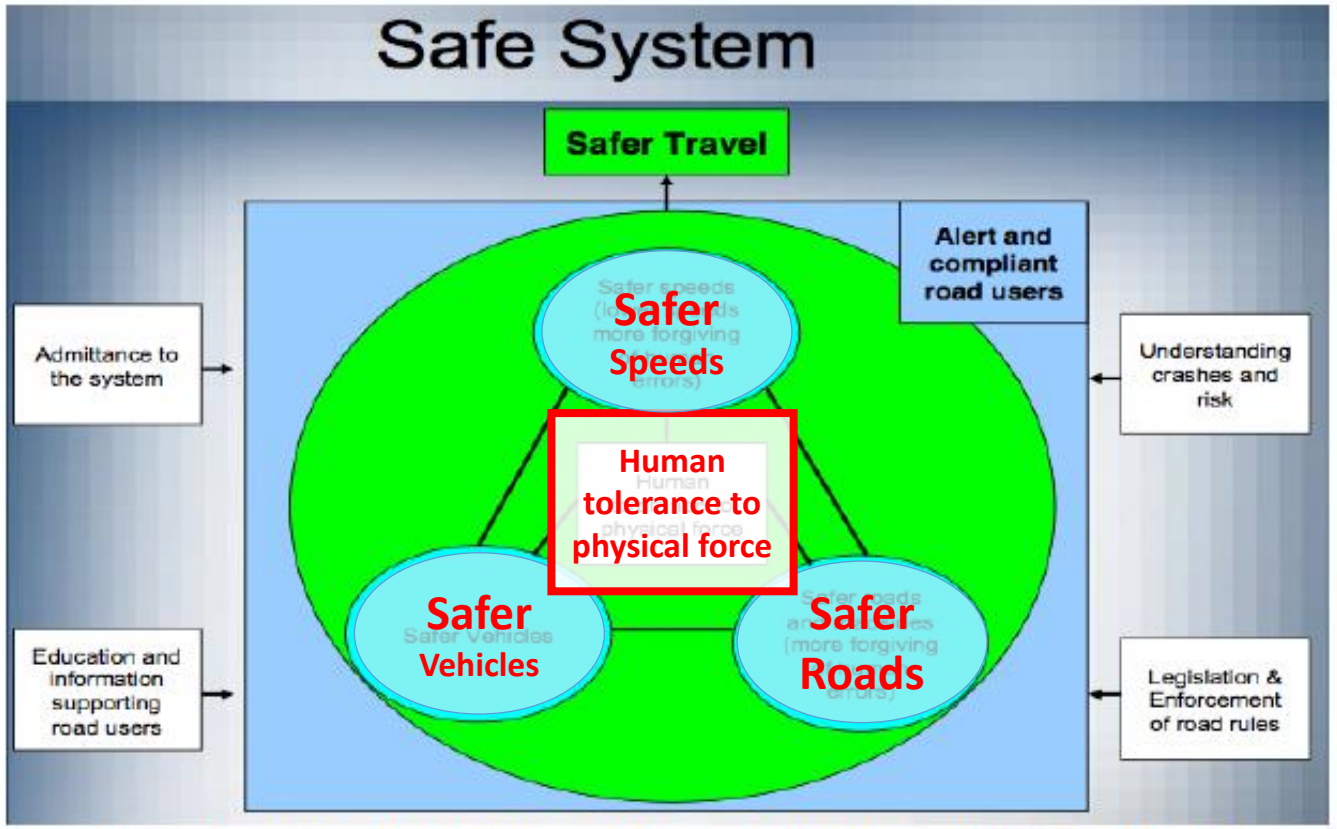

Figure 3 – The Safe System model reproduced from Howard, 2004 [25]

dangerous system

unsafe system

safe system

Safe System: alert and compliant users

Mooren et al., 2011

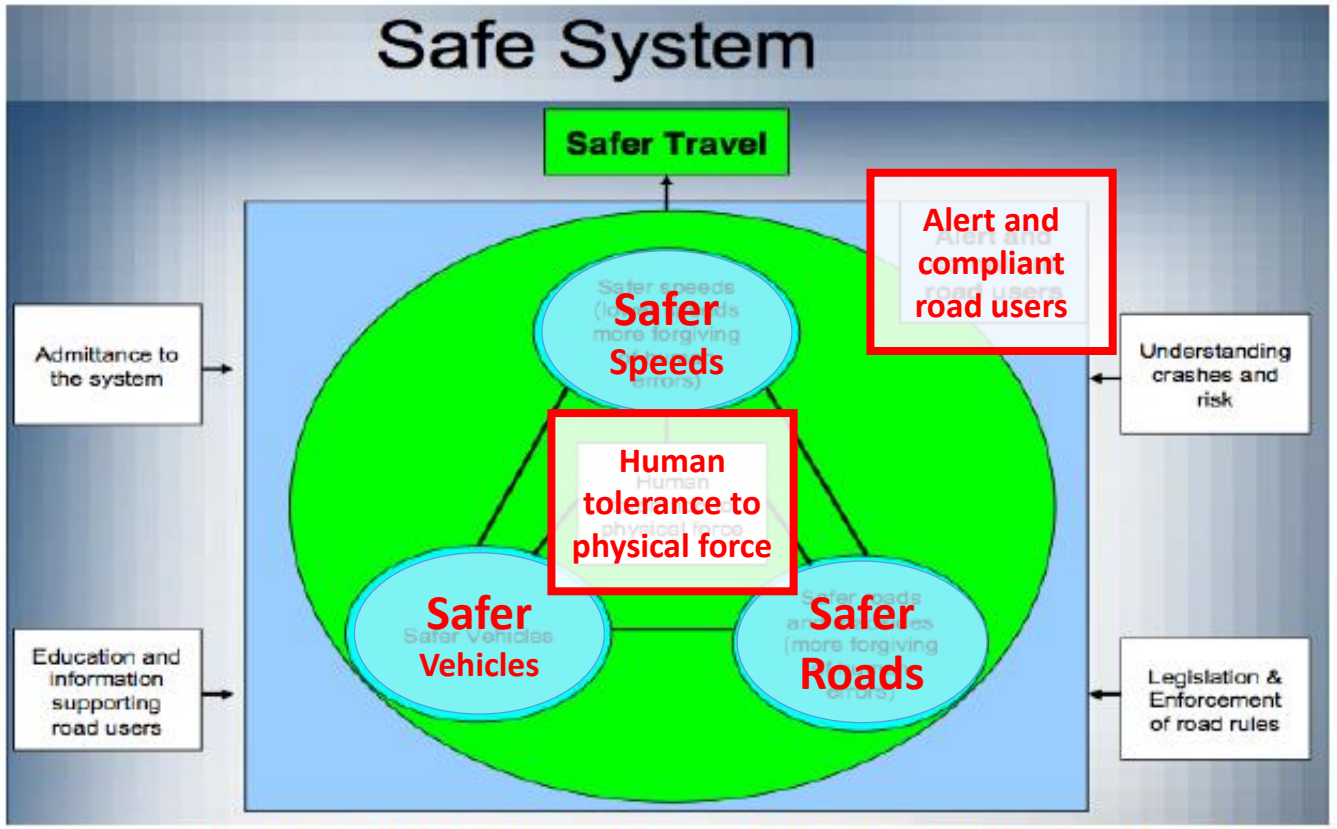

Figure 3 – The Safe System model reproduced from Howard, 2004 [25]

dangerous system

unsafe system

safe system

Dichotomy between behavior and belief

50.3% have driven 15 mph over the speed limit on the freeway

behavior

47.6% have driven 10 mph over the speed limit on residential streets

2.0x

as many people speed on the freeway than think it's acceptable

belief

3.4x

as many people speed on residential streets than think it's acceptable

23.9% believe driving 15 mph over the speed limit on the freeway is acceptable

14.0% believe driving 10 mph over the speed limit on residential streets is acceptable

Image created by freepik

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Source: AAA Foundation for Traffic Safety. (2018, March). *2017 Traffic Safety Culture Index*. Washington, D.C.: AAA Foundation for Traffic Safety.

Dichotomy between behavior and belief

72.6% have driven 10 mph over the speed limit on the freeway

behavior

30.0% have driven 10 mph over the speed limit on residential streets

4.0x
as many people speed on the freeway than think it's acceptable

belief

1.6x
as many people speed on residential streets than think it's acceptable

18.0% believe speeding on the freeway is a small problem or not a problem

19.0% believe speeding on residential streets is a small problem or not a problem

Image created by freepik

Source: Ewald And Wasserman Research Consultants, LLC. (2015, August). *California Public Opinion on Speeding and Aggressive Driving Study: Data Analysis and Results of 2015 Survey*. Sacramento, CA: California Highway Patrol.

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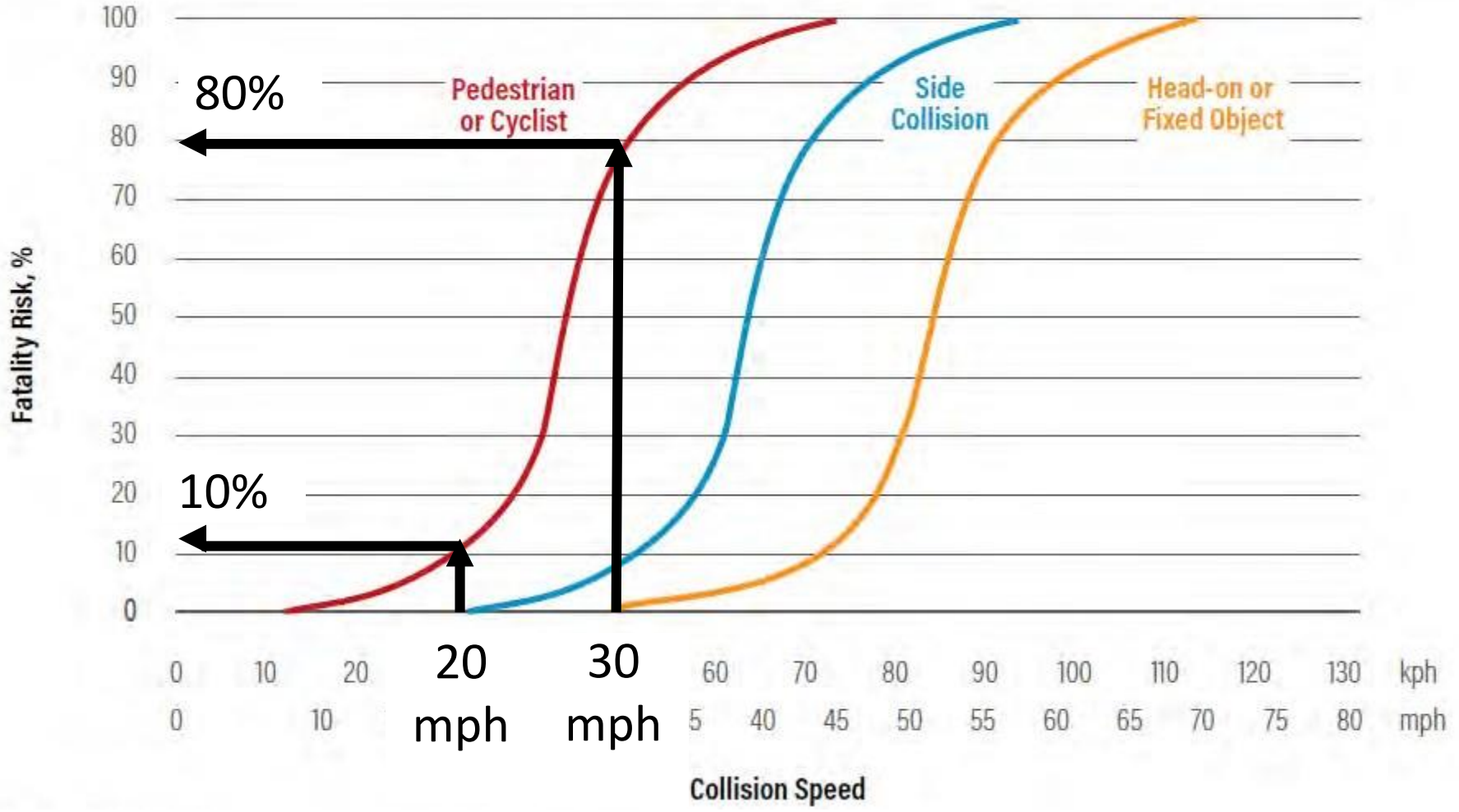
How does this affect speed management?

- Vehicle speed is the most important regulating factor for safe road traffic since it is subject to road-user behavior
- The kinetic energy that the human body can tolerate, forms the basic parameter in the design of a safe transport system

Fatality risk for collision speed, by crash type



Human tolerance to physical force

Source: Wramborg, P. 2005." A New Approach to a Safe and Sustainable Road Structure and Street Design for Urban Areas." Paper presented at 13th International Conference on Road Safety on Four Continents, Warsaw, Poland, October 5–7.

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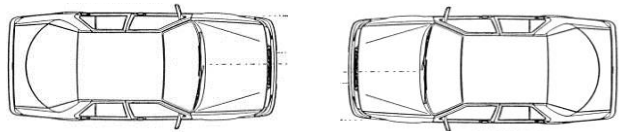
Speed limits for a safe system in Sweden

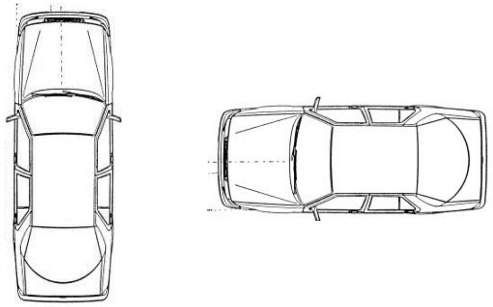
Safer Vehicles

45 mph



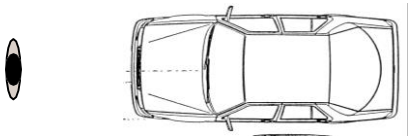
A safe car can protect occupants up to **45 mph** in a head-on collision

30 mph



A safe car can protect occupants up to **30 mph** in a side collision

20 mph



Most unprotected road users survive if a car travelling **20 mph** hits them

Source: Vision Zero and New Speed Limits in Sweden, Anna Vadeby, VTI.
Original Values have been converted from kph to mph and rounded.

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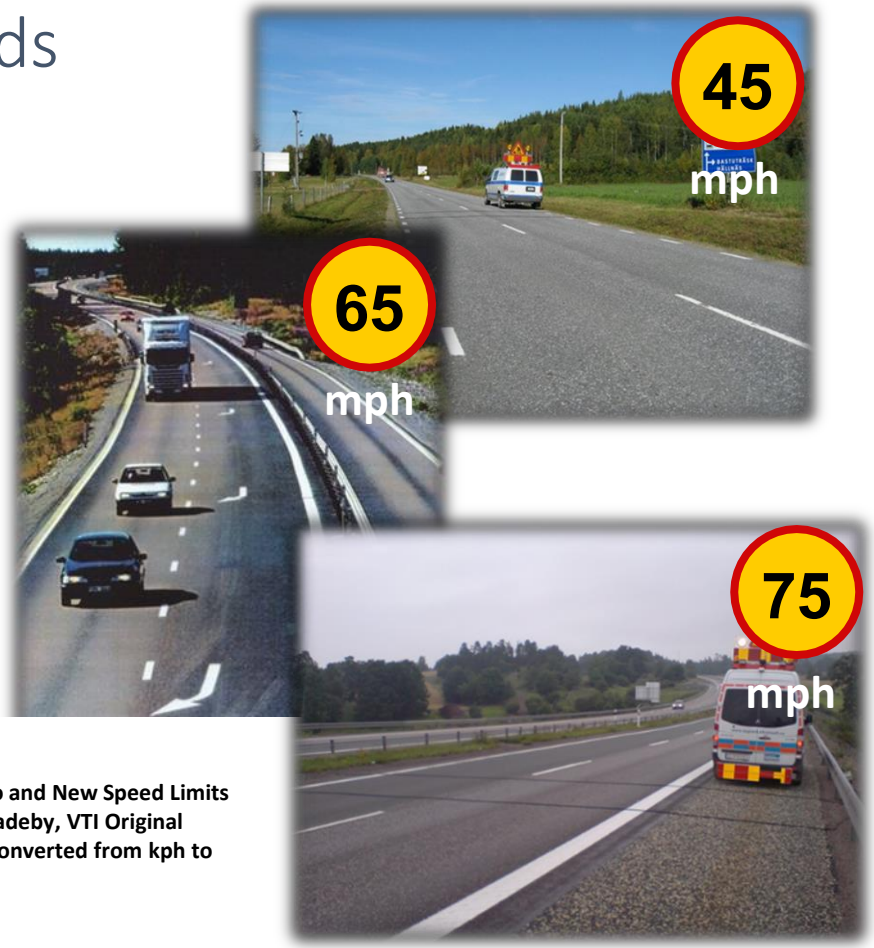
Rural speed limits for safe system, Sweden

Safer Roads

- **45 mph** (70 km/h): default limit on rural roads
- **50 mph** (80-90 km/h): 2-lane roads (milled rumble strips in middle of road)
- **65 mph** (100 km/h): 2+1 roads with median barrier
- **70 mph** (110 km/h): motorways
- **75 mph** (120 km/h): motorways with high standard and low traffic flow



Year	Increased speed limit (km)	Decreased speed limit (km)
2008	1 000	2 500
2009	1 600	15 000

Source: Vision Zero and New Speed Limits in Sweden, Anna Vadeby, VTI Original Values have been converted from kph to mph and rounded.

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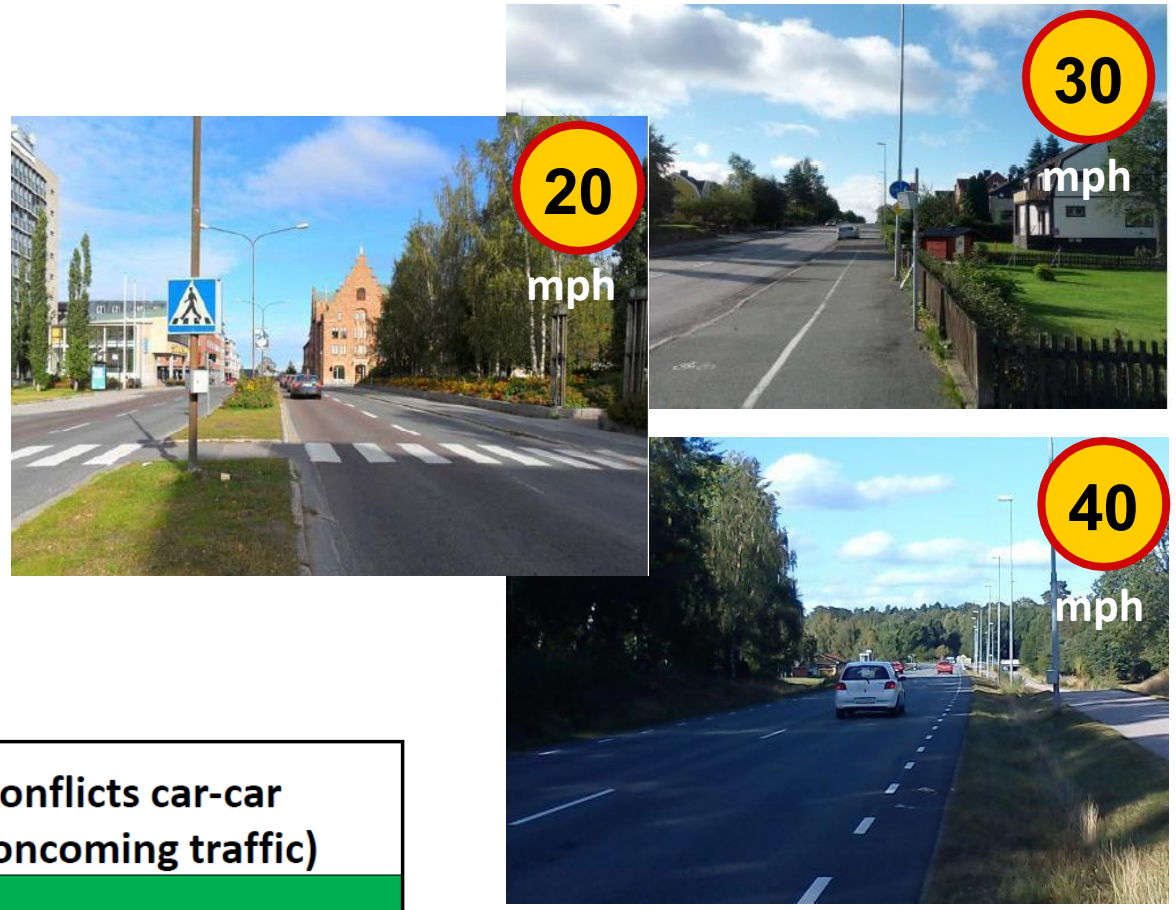
Urban speed limits for a safe system, Sweden

Guidelines consider:

- City's character
- Accessibility
- Security
- Traffic Safety
- Health and Environment



Safety Level	Conflicts VRU-car	Conflicts car-car (intersections)	Conflicts car-obstacle	Conflicts car-car (oncoming traffic)
High	≤ 20 mph	≤ 30 mph	≤ 40 mph	45 mph

Based on: Vision Zero and New Speed Limits in Sweden, Anna Vadeby, VTI.
Original Values have been converted from kph to mph and rounded.

Speed and Safety

https://youtu.be/6Xm9kp5PIB4

Speed and Safety

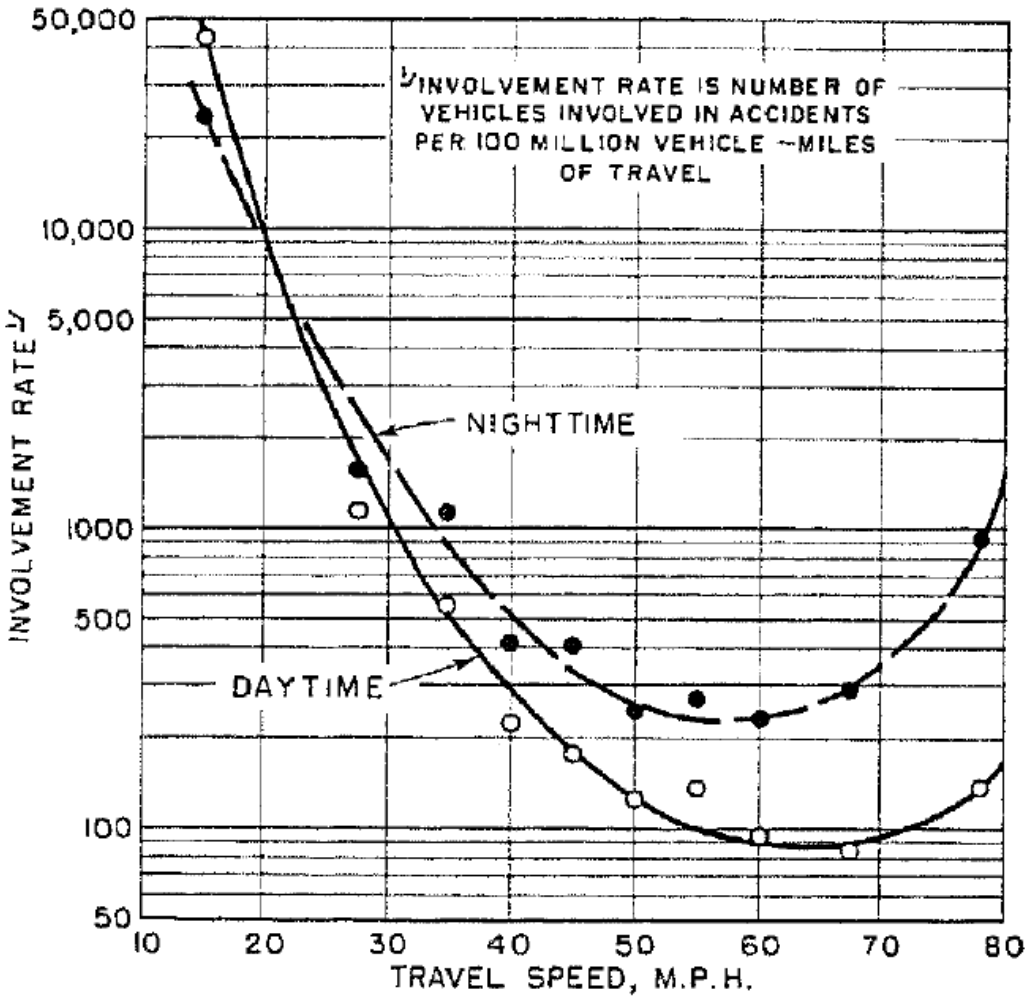
How do we set speed limits to provide the best mobility for a safety constraint of zero traffic fatalities?

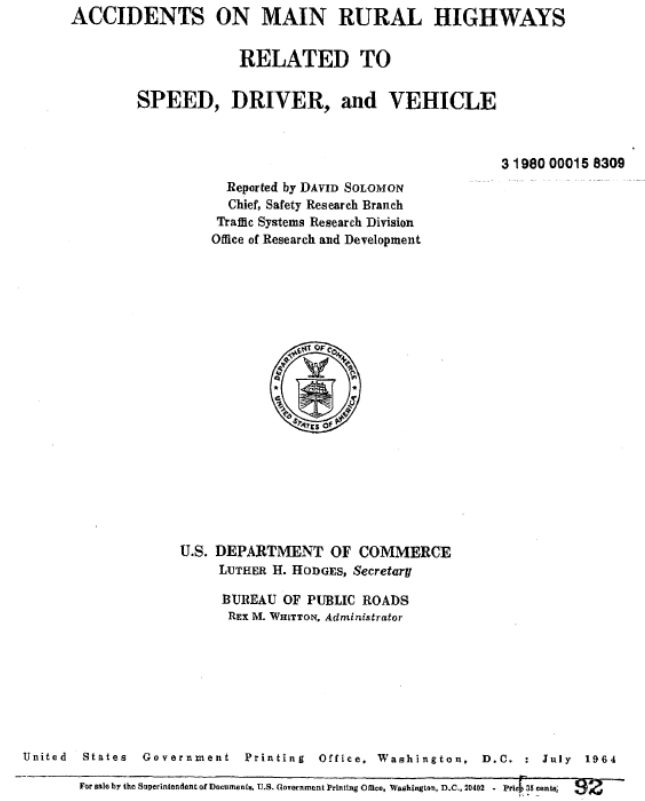
History of Setting Speed Limits in the US

- Speed limits are established by computing the 85th percentile speed during free-flow travel.
- This approach was developed based on a 1964 USDOT report labeled “Accidents on Main Rural Highways Related to Speed”. The report’s findings have not been successfully replicated since.
- Another stated rationale is that speed limits below the 85th percentile discourage drivers’ compliance with the posted speed limit.

Slide based on presentation by Jake Kononov

The Solomon Curve





ACCIDENTS ON MAIN RURAL HIGHWAYS
RELATED TO
SPEED, DRIVER, and VEHICLE

3 1980 00015 8309

Reported by DAVID SOLOMON
Chief, Safety Research Branch
Traffic Systems Research Division
Office of Research and Development

U.S. DEPARTMENT OF COMMERCE
LUTHER H. HODGES, *Secretary*

BUREAU OF PUBLIC ROADS
REX M. WHITTON, *Administrator*

United States Government Printing Office, Washington, D.C. : July 1964

For sale by the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C., 20402 - Price 35 cents

92

Conclusion was that traveling near or slightly above the average speed (approximately the 85th percentile speed) would result in the lowest crash risk

Evolution of Speed

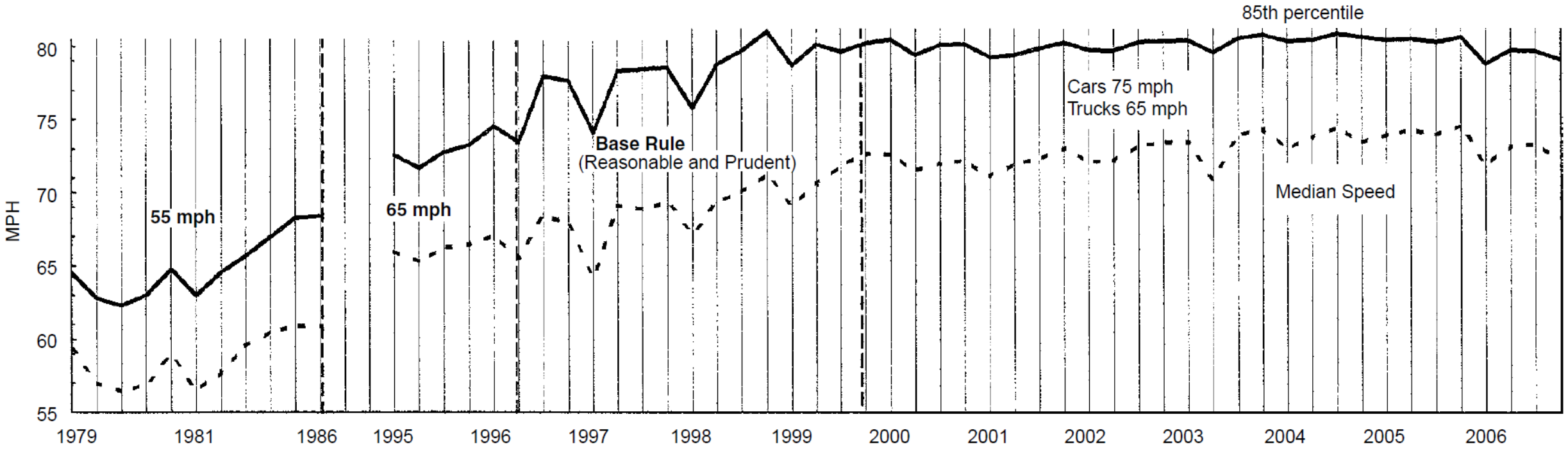


FIGURE 1 Median and 85th percentile speeds on rural Interstates in Montana. (Source: R. Retting of the Insurance Institute for Highway Safety.)

Hauer, E. (2009). Speed and Safety. Transportation Research Record, 2103(1), 10–17.

Types of Speed Limits

- Basic Speed Law (CVC 22350) states that a driver may never driver faster than is reasonable or prudent for current conditions.
- Two types of speed limits
  - Statutory speed limit
  - Posted speed limit

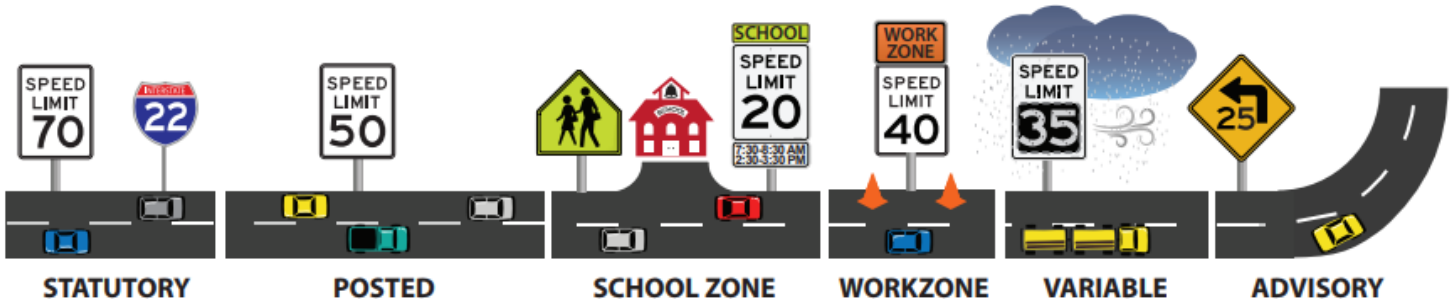


Image from FHWA-SA-16-076

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Statutory and Posted Speed Limits

- Statutory speed limit (maximum speed limit)
  - Set by the State Legislature and enforceable even if speed limit sign is not posted
- Posted speed limit (regulatory speed)
  - Set by a local jurisdiction (city or county)
  - Must have an up-to-date Engineering and Traffic Survey to be enforceable when radar or LiDAR is used
  - Takes priority over the established statutory speed limit

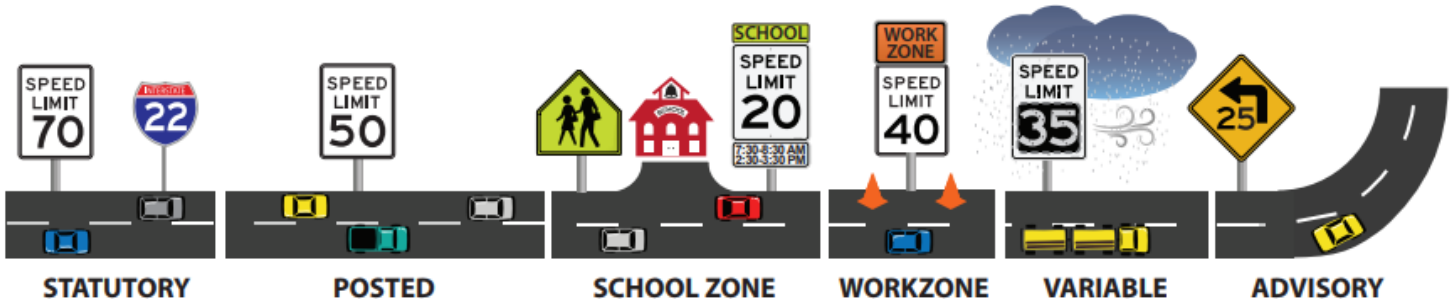

Image from FHWA-SA-16-076

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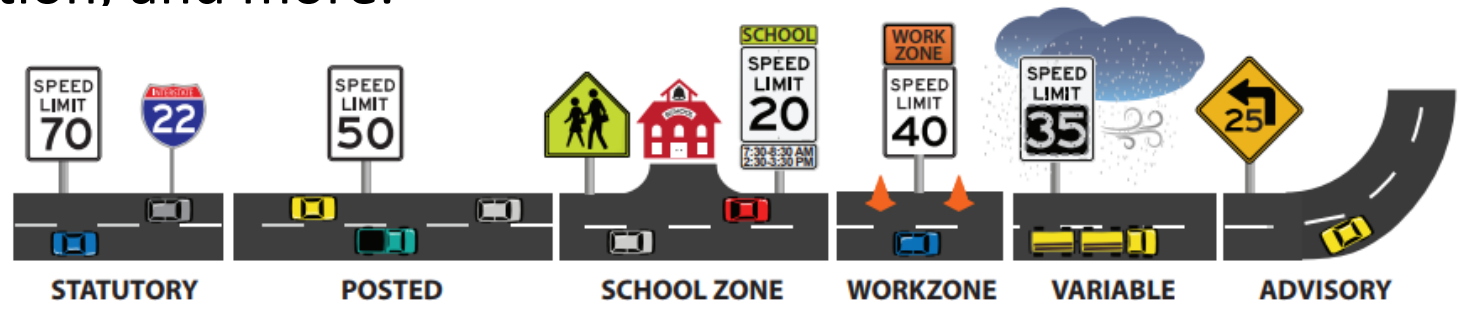
Engineering & Traffic Survey

- Defined by CVC 627 as a survey of "highway and traffic conditions in accordance with methods determined by the Department of Transportation for use by state and local authorities" and considers:
  - Prevailing speeds as determined by traffic engineering measurements
  - Traffic crash records
  - Highway, traffic, and roadside conditions not readily apparent to the driver.
- **85th percentile** speed of free flowing traffic is often considered a safe and reasonable speed limit.[1]
- Valid for five years, but may be extended to seven or ten years if a registered engineer determines conditions are met

[1] FHWA-RD-92-084 and FHWA-RD-98-154
[2] CVC 40802

Speed Limits – Special Conditions

- School Zone local authorities can reduce the maximum speed limit allowable to 25 mph, or lower if the E&TS indicates that 25 mph is too fast for prudent and safe operations[1]
- Work Zone authorized to "restrict the use and regulate the movement of traffic"[2] and can be set as low as 25 mph[3]
- Other 15 mph in alleys, at blind intersections, blind railroad xing, and more[4]
- Variable displayed on CMS due to specific conditions such as weather, congestion, and more.



[1] CVC 22358.4
[2] CVC 21370
[3] CVC 22362
[4] CVC 22352

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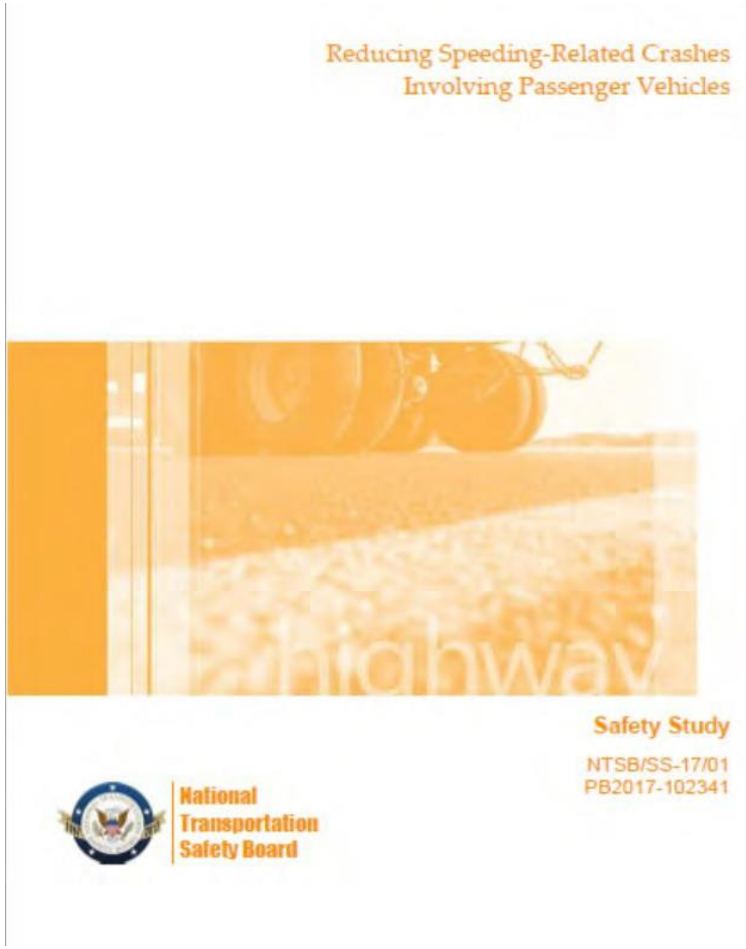
NTSB Safety Study Recommended

- (H-17-27) Revise Section 2B.13 of the MUTCD:
  - Factors currently listed as optional for all engineering studies are required
  - Require that an expert system such as USLIMITS2 be used as a validation tool
  - Remove the guidance that speed limits in speed zones be within 5 mph of the 85th percentile speed.
- (H-17-28) Revise Section 2B.13 of the MUTCD:
  - to (at a minimum) incorporate the safe system approach for urban roads to strengthen protection for vulnerable road users.



Practitioner Survey

National Committee on
Uniform Traffic Control Devices

12615 West Keystone Drive * Sun City West, AZ, 85375
Telephone (623)680-9592 * e-mail: ncutcd@aol.com

- Spring 2018
- 13 questions
- Distributed to numerous transportation professionals
- Number of respondents: 740
- Over 80% use MUTCD regularly
- Average experience: 20 years

Based on slide by Randy McCourt, Chair NCUTCD Task Force on Speed Limit

Factors most utilized in setting speed Limits?

Utilization criteria (top 10 with always utilized)	Overall Rank	10 years or less (rank)	11-20 years (rank)	Over 20 years (rank)
Speed of vehicles	**1**	4	1	2
Crash history	**2**	2	3	3
Context - location	**3**	1	2	5
Statutory requirements	**4**	9	4	1
Geometrics (curve)	**5**	6	5	4
Facility classification type	**6**	7	10	7
Context - land use	**7**	3	6	10
Geometrics (sight distance)	**8**	--	8	6
Geometrics (lane width, CS)	**9**	10	9	9
% vehicles above PSL / speed distribution curve / % veh in pace	**10**	--	7	8

Slide by Randy McCourt, Chair NCUTCD Task Force on Speed Limit

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% vehicles above PSL / speed distribution curve / % veh in pace	**10**	--	7	8

Slide by Randy McCourt, Chair NCUTCD Task Force on Speed Limit

NCUTCD Recommendations

Factors that should be considered

- **Speed distribution** of free-flowing vehicles (such as current 85th percentile, the pace, review of past speed studies).
- **Crash experience** for at least a 12-month period relative to similar roadways.
- **Road characteristics** (such as lane widths, curb/shoulder condition, grade, alignment, median type, sight distance).
- **Road context** (such as roadside development and environment including number of driveways, land use, functional classification, parking practices, presence of sidewalks/bicycle facilities).
- **Road users** (such as pedestrian activity, bicycle activity).

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Source: National Committee on Uniform Traffic Control Devices Item 18B-RW-03, April 2019

Review of Current Practices for Setting Posted Speed Limits

April 2019

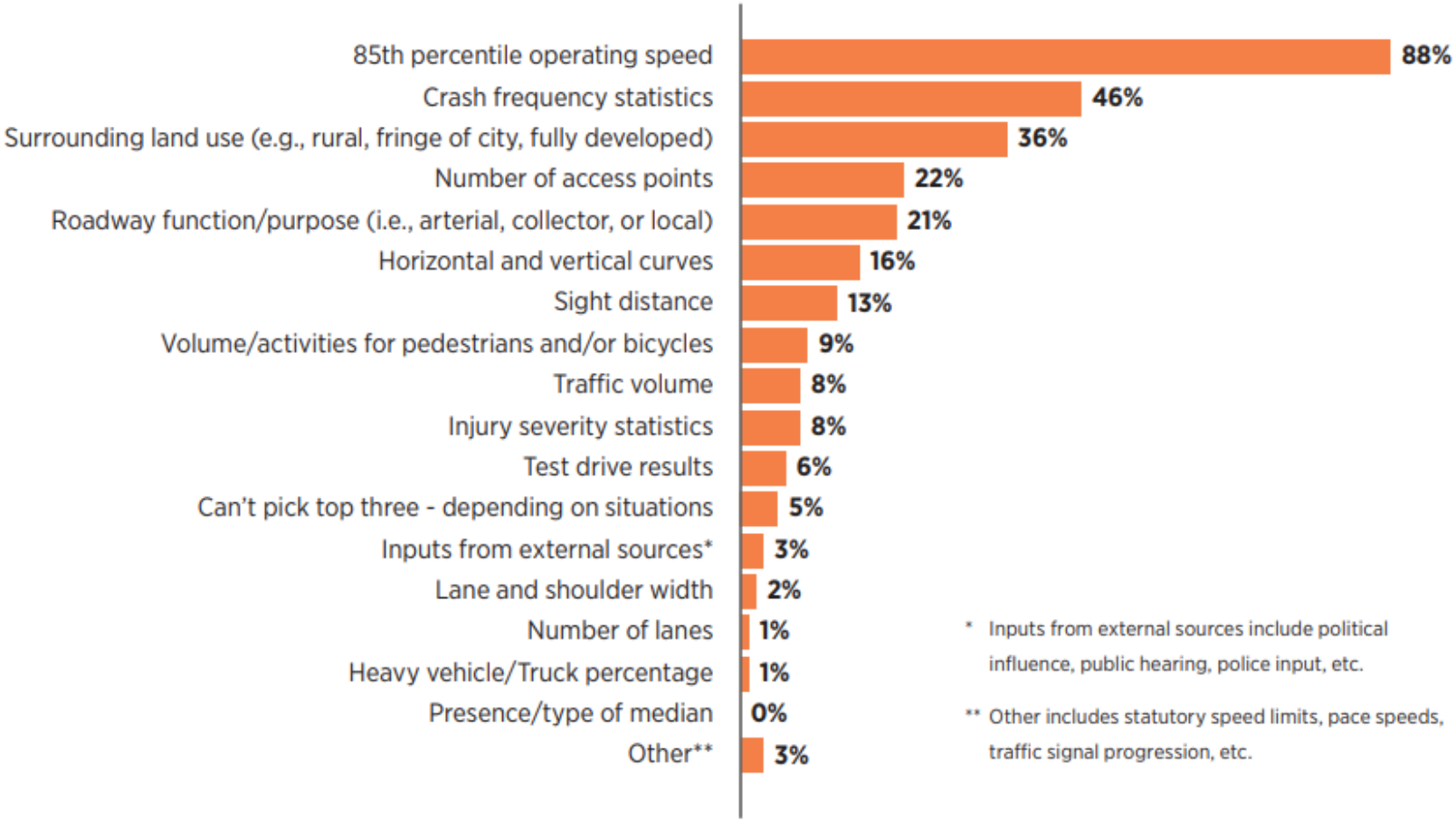

Figure 1. Prevalence of factors that traffic professionals consider the most when setting speed limits

Source: Review of Current Practices for Setting Posted Speed Limits, Research Brief, AAA Foundation for Traffic Safety, April 2019

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CA MUTCD is a living document

Timeline of recent speed limit updates

2003

CA Supplemental. Posted speed limit should be established at the nearest 5 mph increment of the 85th percentile speed with the option for further 5 mph reduction.

2006

MUTCD updated. Posted speed limit should be established at the nearest 5 mph increment of the 85th percentile speed with the option for further 5 mph reduction per E&TS.

2010

MUTCD updated. Posted speed may be reduced by 5 mph from the nearest 5 mph increment of the 85th percentile speed, in compliance with CVC Sections 627 and 22358.5

2012

MUTCD updated. Where the posted speed would be required to be rounded up, Caltrans or local authority may round down to the nearest 5 mph of the 85th percentile speed, if no further reductions can be used per CVC Section 21400(f).

2014

Caltrans releases an updated CA MUTCD

2019

Zero Traffic Fatalities Task Force convenes to develop recommendations related to determining speed limits

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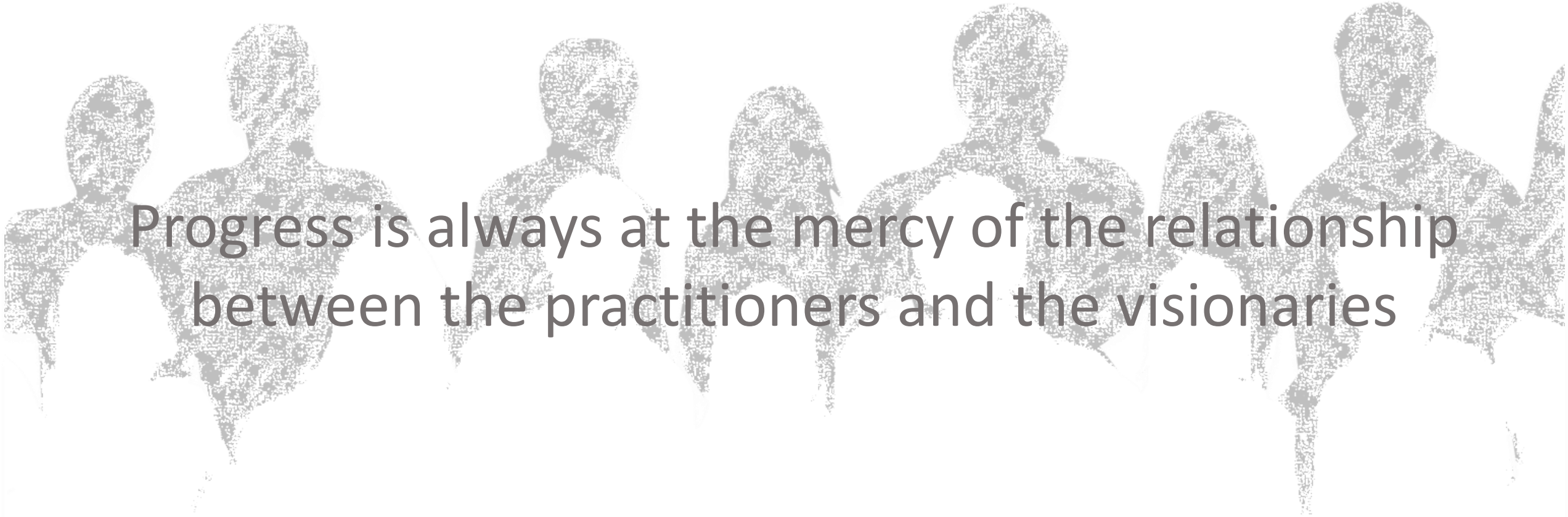

Progress is always at the mercy of the relationship between the practitioners and the visionaries

Thank you!

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