

Challenging common assumptions around autonomous vehicles to maximize safety

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The safety potential of autonomous vehicles



- ▶ Driver error contributes to most crashes
- ▶ Why shouldn't we assume that AVs will be safer than humans by default?

What types of driver errors lead to crashes today?

Using real world crash data

- ▶ National Motor Vehicle Crash Causation Survey (NMVCCS)

5,471 police reported crashes during 2005-2007

6 a.m. to midnight, EMS was called, and at least one vehicle towed

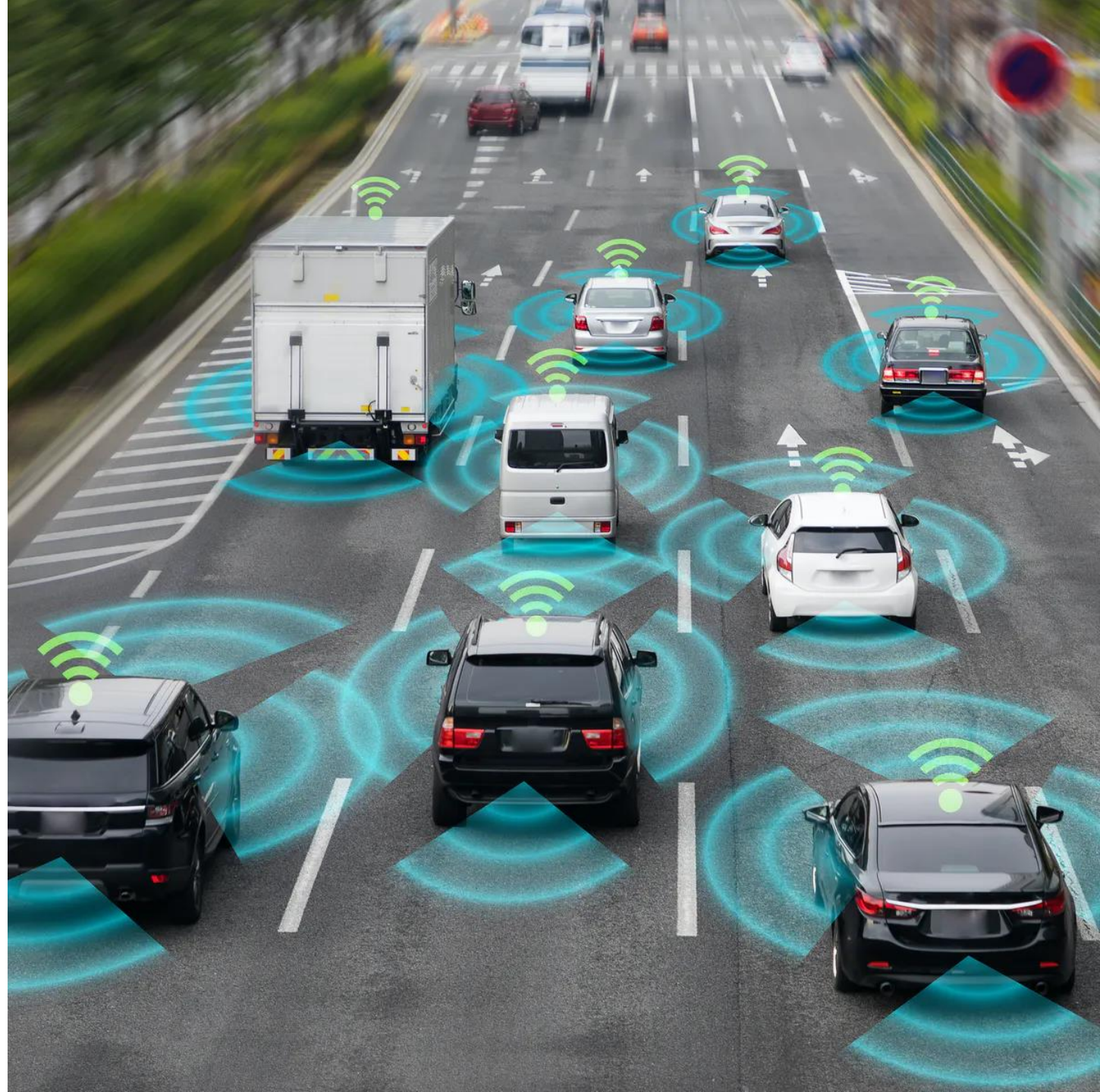
Weighted to represent 2,188,970 crashes nationally

Dataset identifies factors in the causal chain of events that led to each crash

Critical reason: immediate reason for final event in causal chain leading to crash

Categories of driver-related factors

- ▶ Sensing and perceiving
- ▶ Predicting
- ▶ Planning and deciding
- ▶ Execution and performance
- ▶ Incapacitation



Chain of events that lead to crashes are often complex

Crashes often have more than one contributing factor

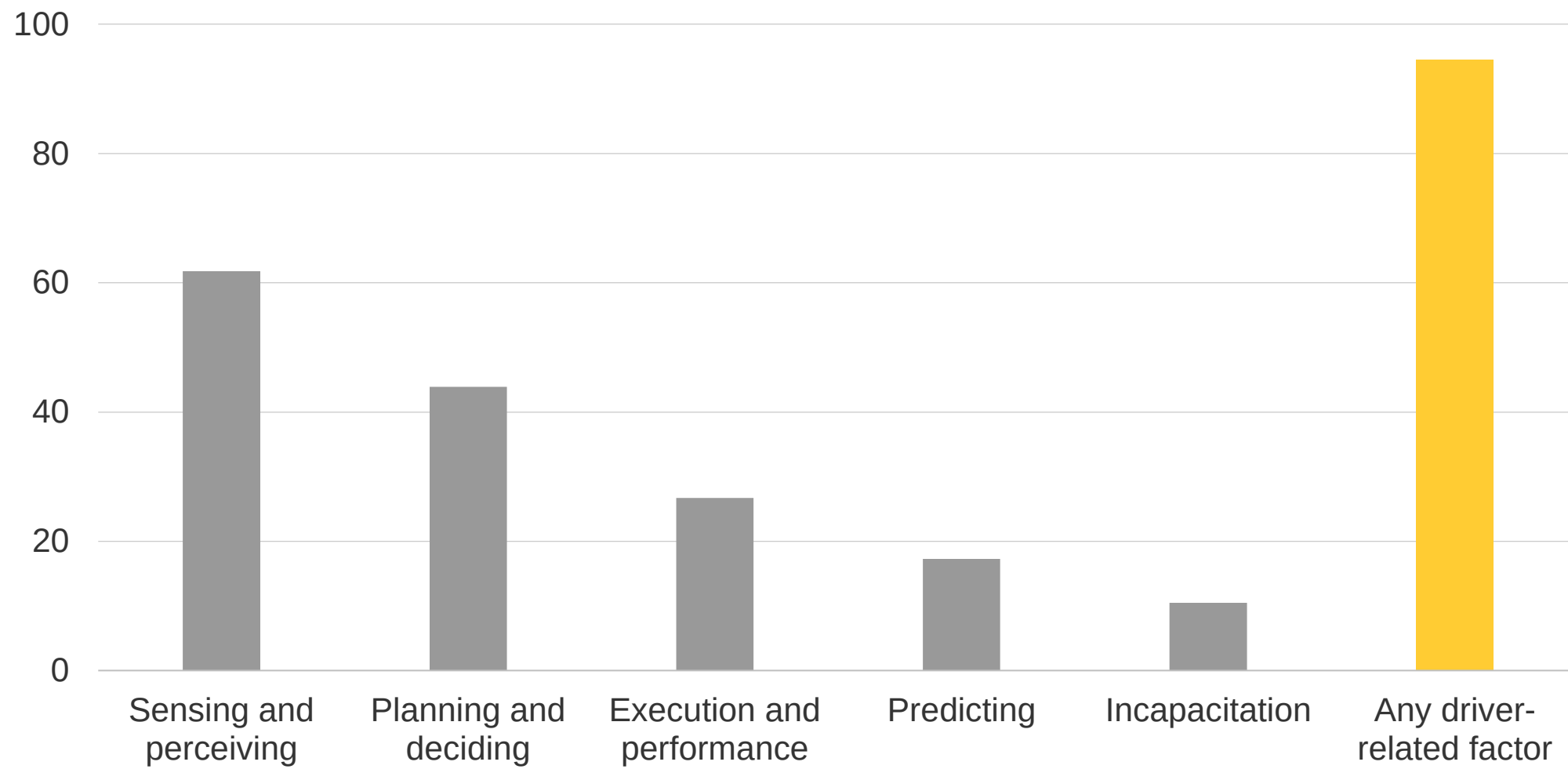
“This crash occurred in the morning of a weekday on the left roadside of a two-lane undivided rural roadway. The east/west roadway consisted of one lane in each direction with a speed limit of 64kmph (40 mph). The bituminous roadway was curved to the left (in the westbound direction) with a downhill grade greater than 2%. At the time of the crash it was raining, which caused standing water to accumulate at certain areas on the roadway.

V1, a 1993 Toyota Camry, was westbound negotiating the downhill curve traveling near the speed limit. As V1 continued to negotiate the curve it drove through some standing water (6mm/1/4” deep) causing the vehicle to hydroplane and rotate counterclockwise. The vehicle crossed over the opposite lane of traffic and departed the roadway where it impacted a utility pole with its right side. The vehicle continued to rotate counterclockwise and came to rest facing east completely blocking the opposite lane of travel. V1 was towed due to damage. Vehicle 1 was driven by a 39-year-old female who was seriously injured in the crash and transported for treatment. Numerous attempts were made to obtain an interview but the driver could not be reached as she was still receiving treatment for her injuries.

The Critical Precrash Event was coded this vehicle traveling, off the edge of the road on the left side. The Critical Reason for the Critical Precrash Event was coded as a **vehicle related factor, other tire degradation (the rear tires had 0mm of tread)**. In addition to the lack of tread, **traveling too fast for conditions (reasons unknown)** and the **wet roads with standing water** were coded as associated factors.”

Case ID: 2006008450882

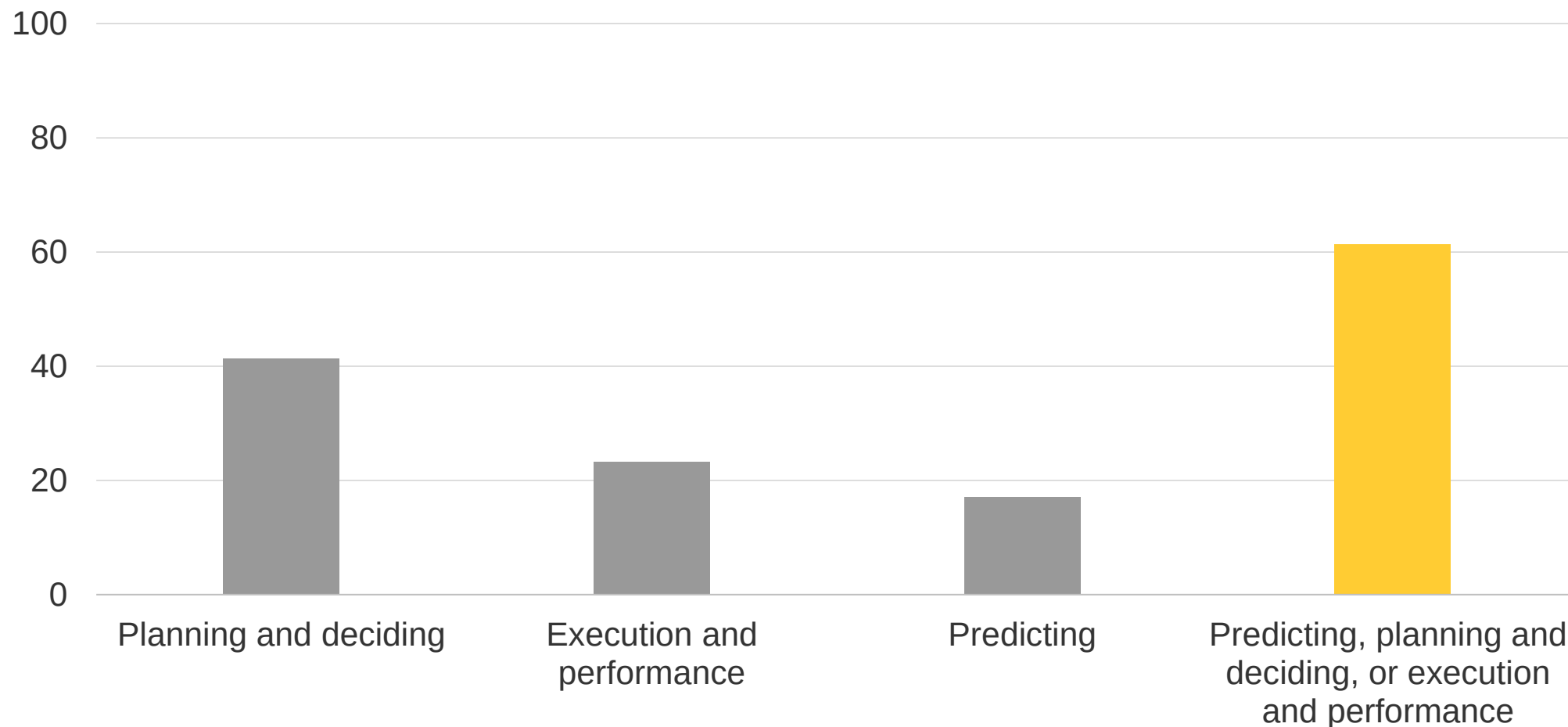
Percent of crashes with various types of contributing factors



Percent of crashes related to sensing and perceiving only or to incapacitation

Factor type	%
Only sensing and perceiving	23
Incapacitation	10
<i>Crashes preventable by AVs</i>	33

Percent of crashes that could remain if crashes related to sensing and perceiving only or to incapacitation categories were eliminated by AVs



Most common remaining planning and deciding factors

Factor type	%*
Speeding	23
Illegal maneuvers	15
Following too closely	3
Other aggressive driving	3
<i>Total remaining crashes with planning and deciding factors</i>	41

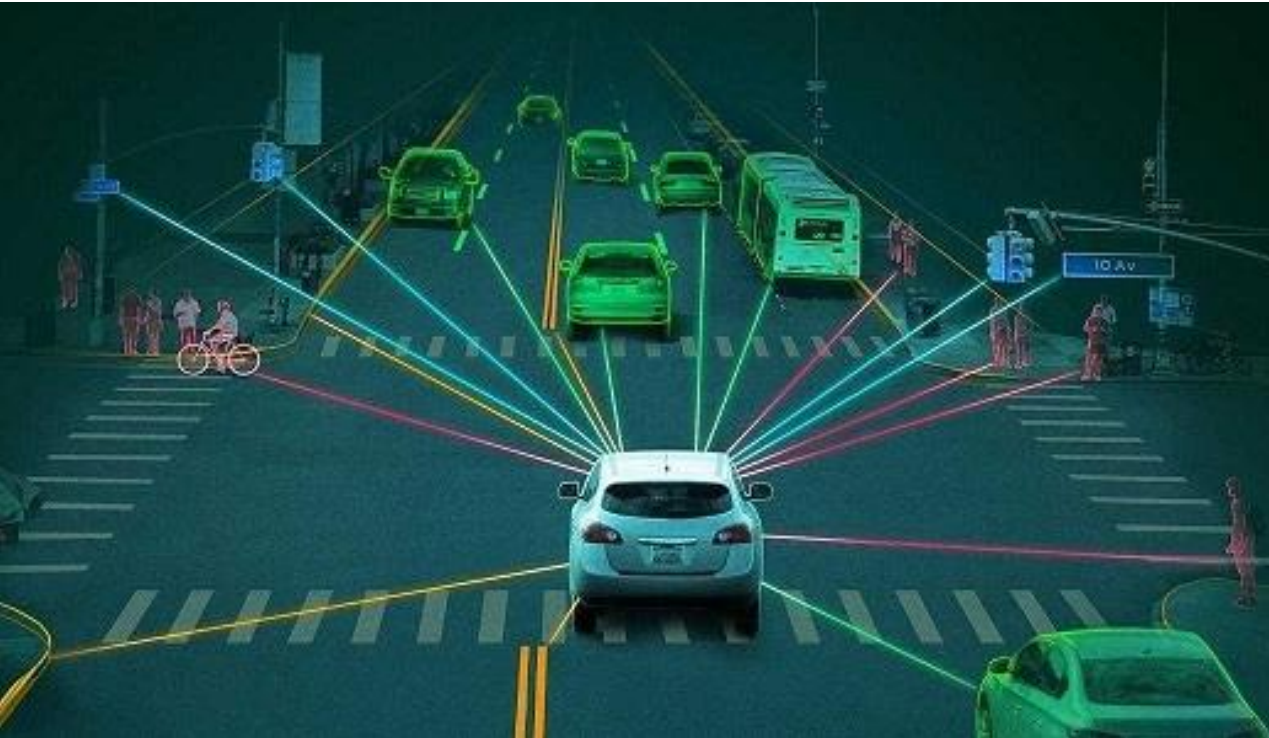
*Crashes may have had multiple planning and deciding factors

A caution for common assumptions around AVs



- ▶ Not all crashes could be preventable by AVs if they only have superior perception and invulnerabilities to inattention, distraction, or incapacitation
- ▶ AVs also need to be able to respond safely to what they perceive

Challenges of designing for convenience without undermining safety



- ▶ Intentional decisions are major contributing factors leading to crashes, which supports concerns about AVs having capabilities that could undermine safety
- ▶ Obeying traffic laws is a starting point, but AVs also need be programed with decision making strategies to drive defensively and adapt to conditions
- ▶ For AVs to maximize their safety potential, rider preferences will not always be fulfilled

Insurance Institute for Highway Safety
Highway Loss Data Institute

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THANK YOU



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