Without data, we are blind

Research comparing crash rates of highly automated vehicles and humans

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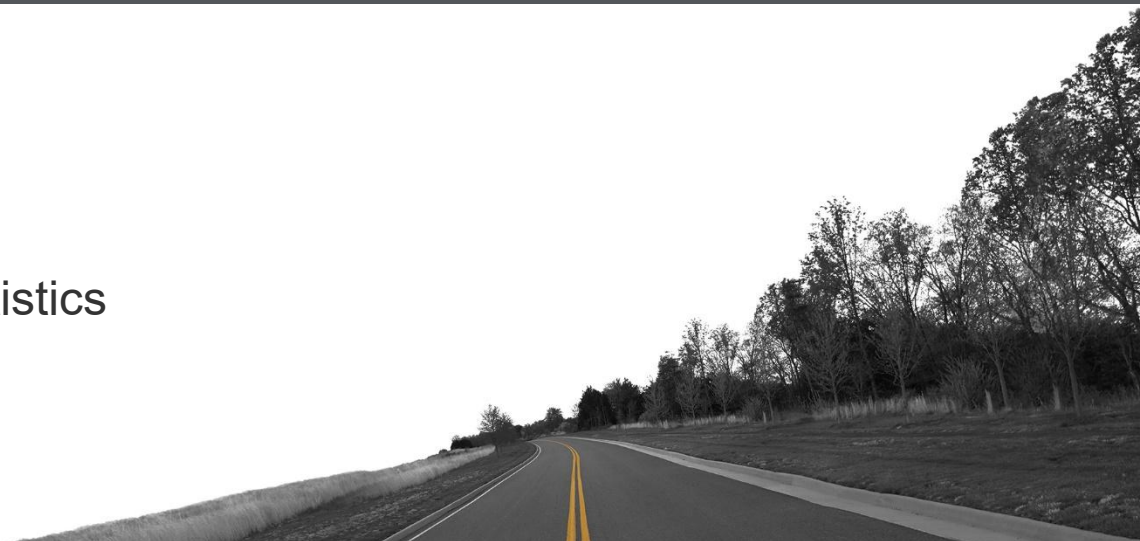


Are driverless vehicles safe?

- **Isn’t yes or no:** different AV developers and locations, possibly changing practices
- **Safer than humans:** clear goal to meet, good way to monitor relative performance
- **Crash rates is a key metric:** how we meassure most things in roaad safety
- **Without data, we’re blind:** must be able to get results quickly



Comparing crash involvements of highly automated vehicles (SAE Level 4) and human drivers

- Exposure
- Geography
- Road type
- Vehicle type
- Crash type and severity
- Evolving tech/practices
- Reporting differences



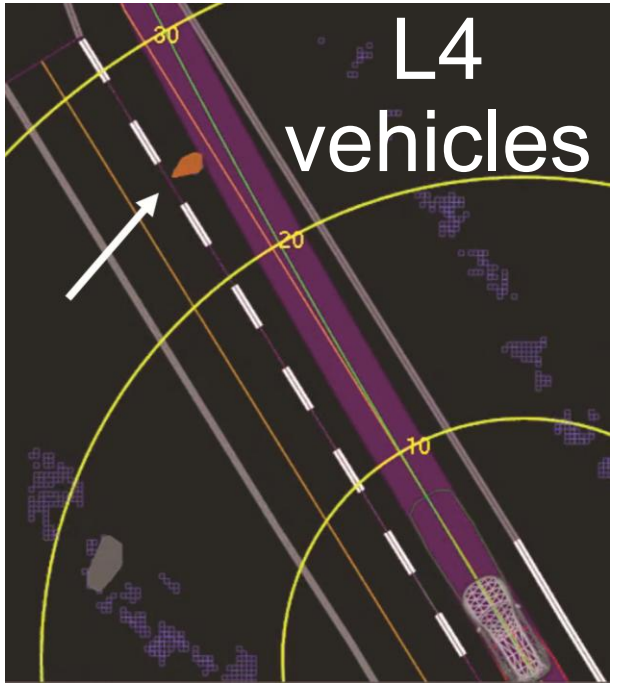
Crash reporting thresholds – humans vs AVs (SAE Level 4)

Police crash reports, NHTSA Standing General Order (SGO)





Or injury/fatality, usually restricted to crashes on public roads



Any physical contact, no minimums, virtually anywhere (or injury/fatality)

until latest version of the SGO (3rd one), which comes closer to aligning with typical police crash reporting thresholds but not quite equivalent

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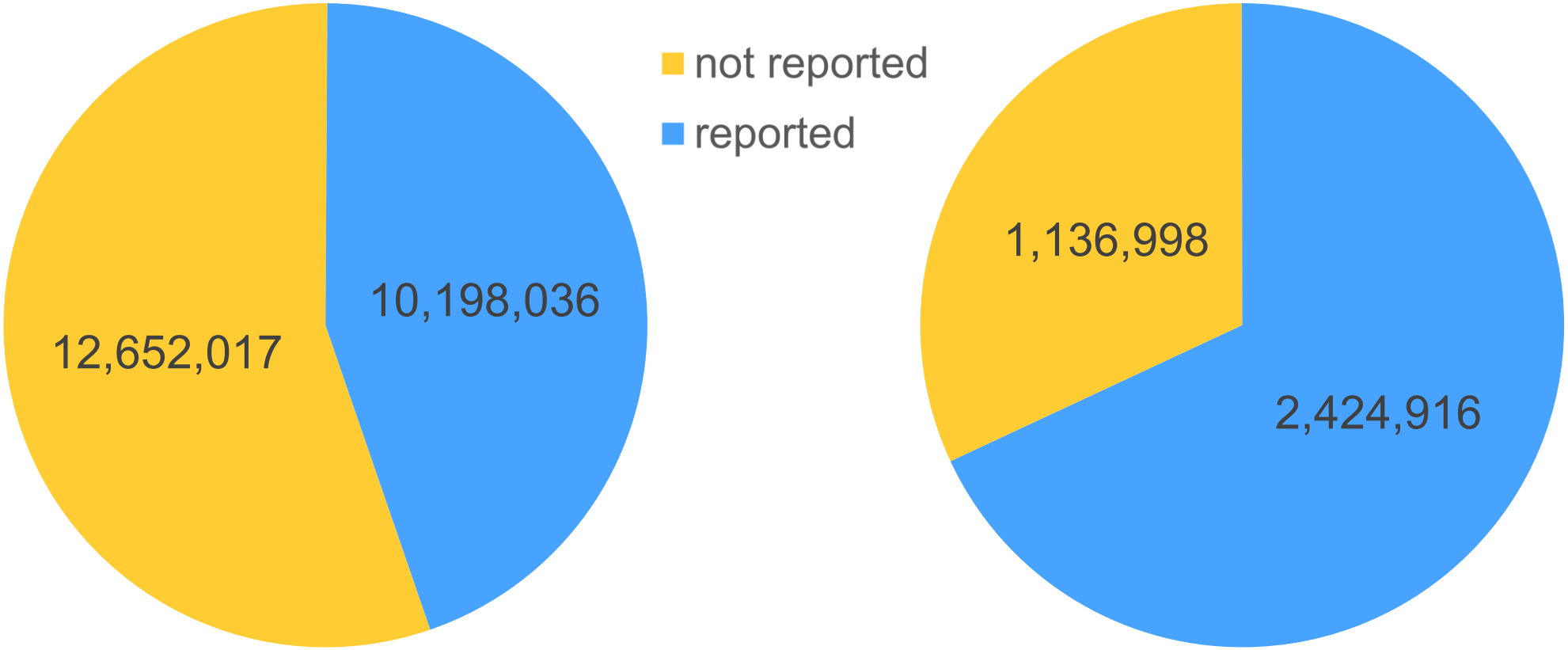
Thresholds ≠ actual practices

Were crashes (of human drivers) reported to police? (2019 data: Blincoe et al., 2023)



Vehicles involved in all crashes

Vehicles involved in injury crashes

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AV data (SGO) includes many extremely minor incidents

Example crash narratives (partial, for brevity)

- Report_ID 30270-4274, Oct 2022

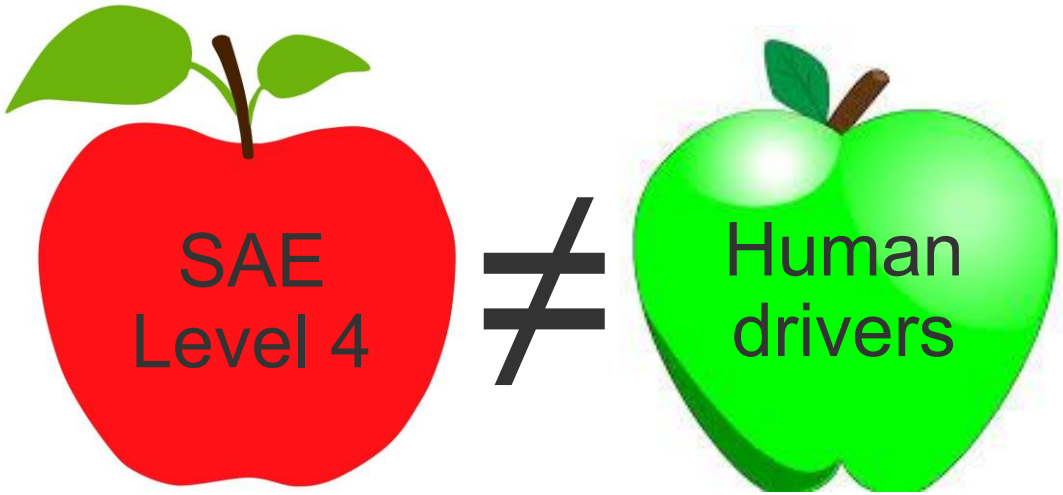
…The Waymo AV was on a steep hill; turning from [XXX] onto [XXX]; when the Waymo AV's undercarriage made contact with the pavement (the AV did not contact any vehicle or road user)…

- Report_ID 30610-2151, Dec 2021

A Zoox vehicle was traveling through a hotel loading zone, when the driver's side door of a stopped passenger vehicle in the right adjacent lane opened, and made contact with the front right sensor of the Zoox vehicle. There were no injuries and the police were not called. Autonomy was engaged…

- Report_ID 30270-3011, Apr 2022

…Level 4 ADS was not engaged and a test driver was operating the Waymo AV in manual mode…



SGO (or CA-DMV) data

Police-reported data

Ways to align crash data

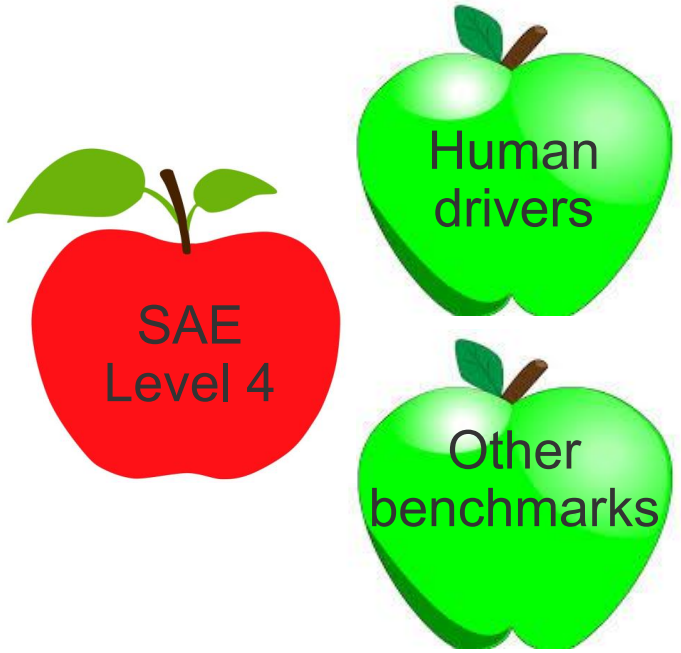
- Remove L4 crash involvements less severe than what people report to police
- Add estimates of underreporting to police-reported human crash data
- Find some common measures (e.g., airbag deployment, fatality)
- Use (non-public) alternative data source (e.g., naturalistic, insurance claims)
- **No method or data source is perfect, all have strengths and weaknesses**

The RAVE Checklist

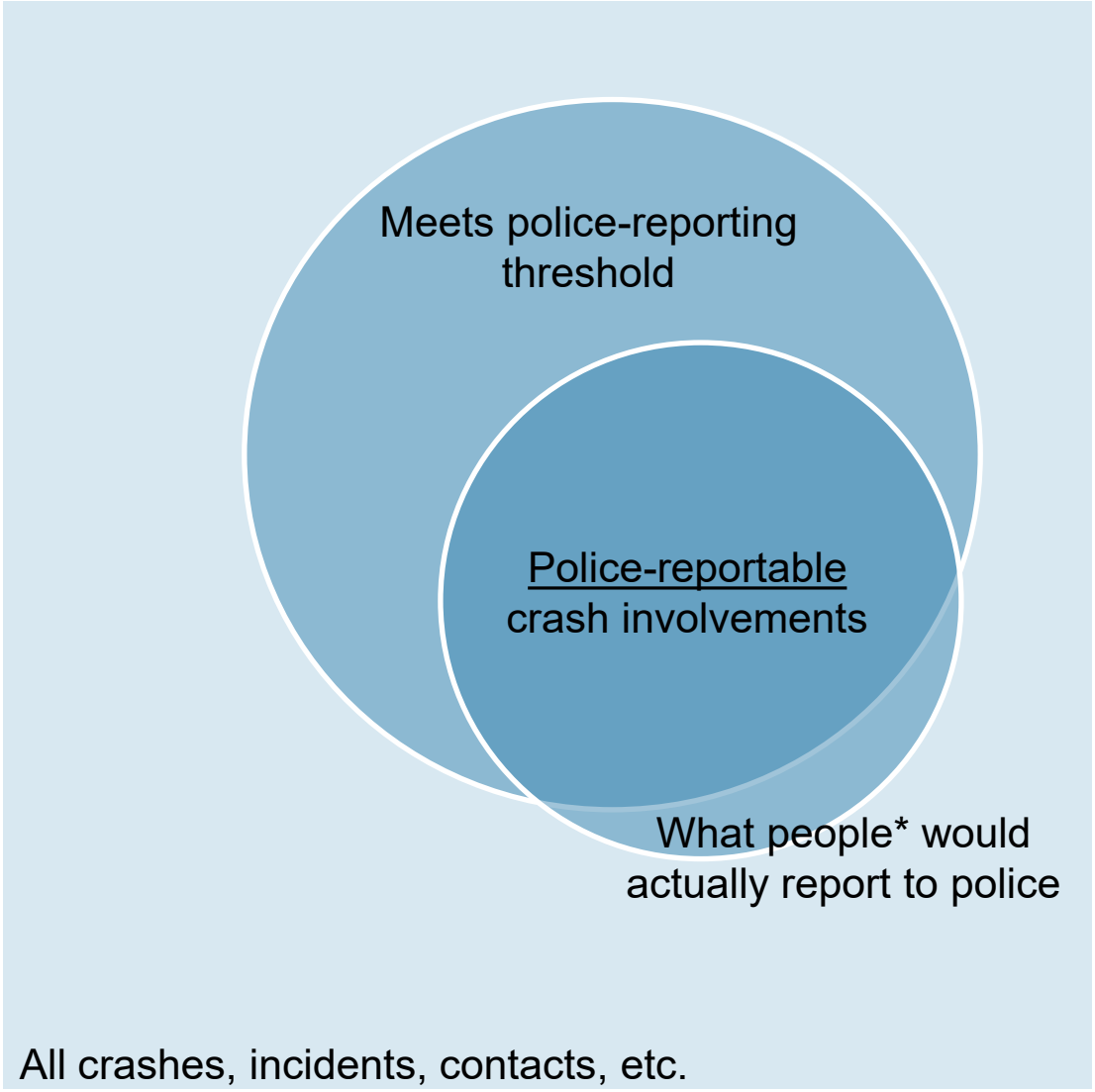
Guide to conducting and assessing
Retrospective **A**utomated **V**ehicle **E**valuation studies

- Broad interest in solid findings
- Multidisciplinary working group, 2024
- Paper with 15 topic areas for 43 recommendations

published paper available at:
https://tinyurl.com/RAVE-checklist



Extending Teoh & Kidd (2017) method: “Police-reportable”



Ways to determine

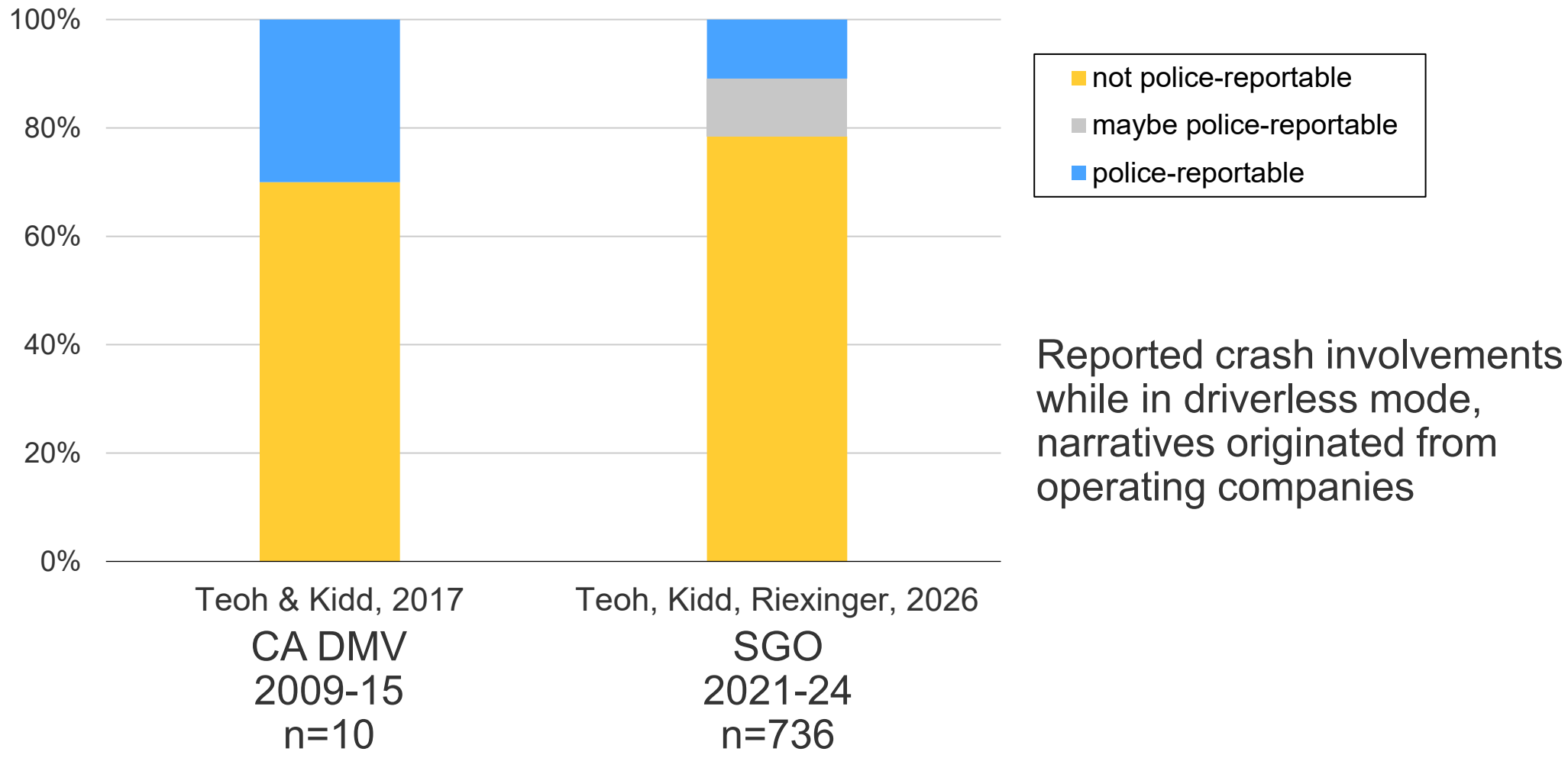
- Read the AV crash narrative
- Use coded data elements
- Review video/photos (currently unavailable publicly)
- Use onboard vehicle data like delta-V (currently unavailable publicly)

* A reasonable person, in our best judgement, and not counting damage cost from very expensive automation sensors

Teoh ER, Kidd DG, 2017. Rage against the machine? Google’s self-driving cars versus human drivers. *Journal of Safety Research*, vol. 63, pages 57-60.

Most U.S. driverless crash involvements are <u>not</u> police-reportable

Judging from the crash narratives



Reported crash involvements while in driverless mode, narratives originated from operating companies

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There is no national requirement in U.S. to report driverless exposure data

- Exposure data = distance traveled by vehicles (VMT, VKT)
- Waymo voluntarily reports this for driverless operation by city and year
- Rest of the analysis focused only on Waymo

$$\text{crash rate} = \frac{\text{crash involvements}}{\text{distance traveled}}$$



Results and conclusions

Police-reportable crashes

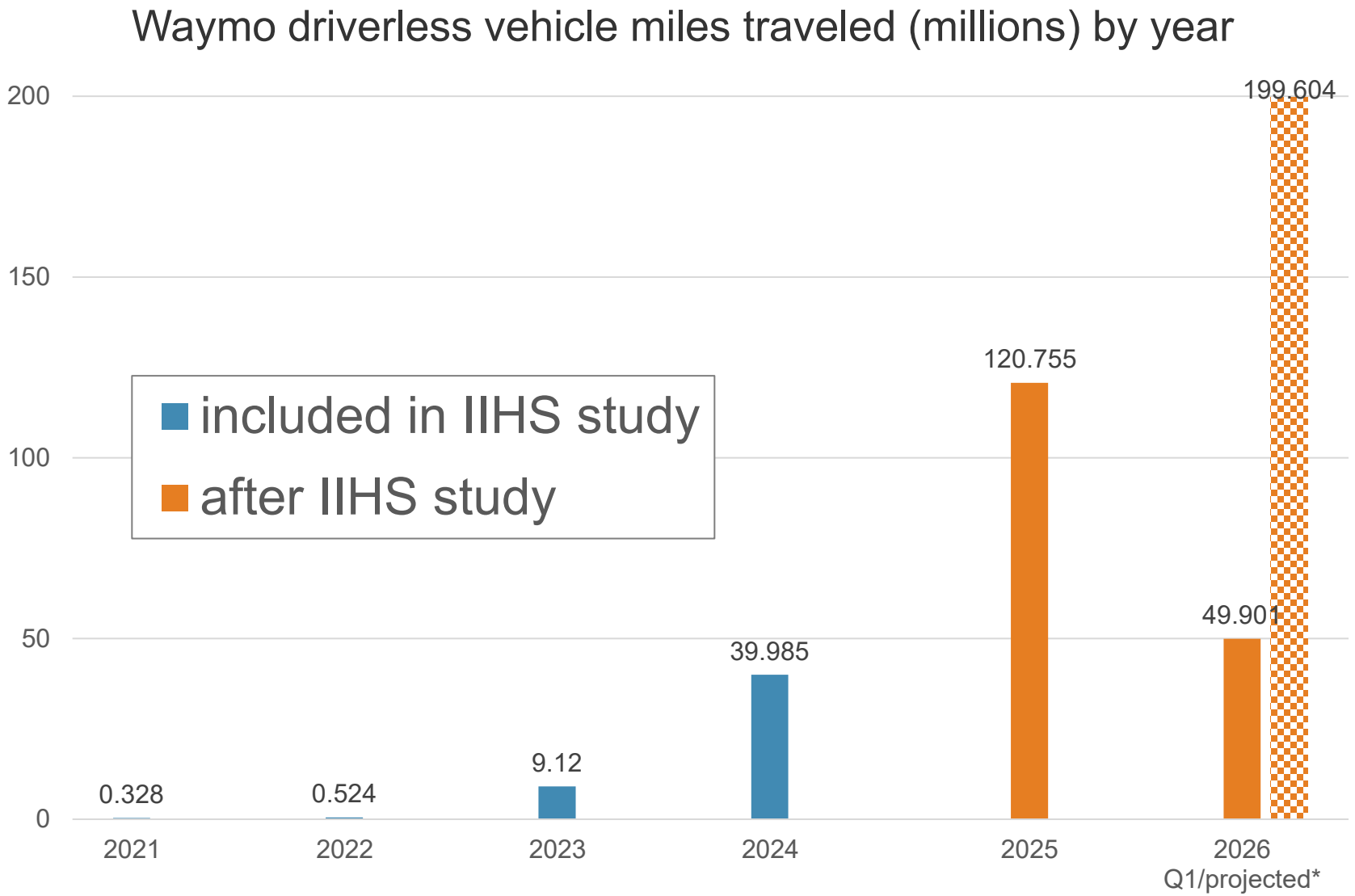
- Waymo had 68% lower crash rates than humans
- Injury crash rate was 81% lower
- Waymo was far less likely to be the striking vehicle
- Doesn’t necessarily apply to future locations or to other companies as their operations expand

Improving data systems

- Coding narratives is an unsustainable method
- Require standardized reporting of travel distance
- Improve database quality and structure
- Improve comparability with human crash reporting

Teoh ER, Kidd DG, Riexinger LE. 2026. Rise of the Machines: crash experiences of highly automated vehicles and human drivers. Arlington, VA: Insurance Institute for Highway Safety. Available at www.iihs.org

Urgent need for faster-to-use crash data to monitor crash rates



Teoh ER, Kidd DG, Riexinger LE. 2026. Rise of the Machines: crash experiences of highly automated vehicles and human drivers. Arlington, VA: Insurance Institute for Highway Safety. Available at www.iihs.org

* Full year projection is 4x the Q1 value, likely an underestimate

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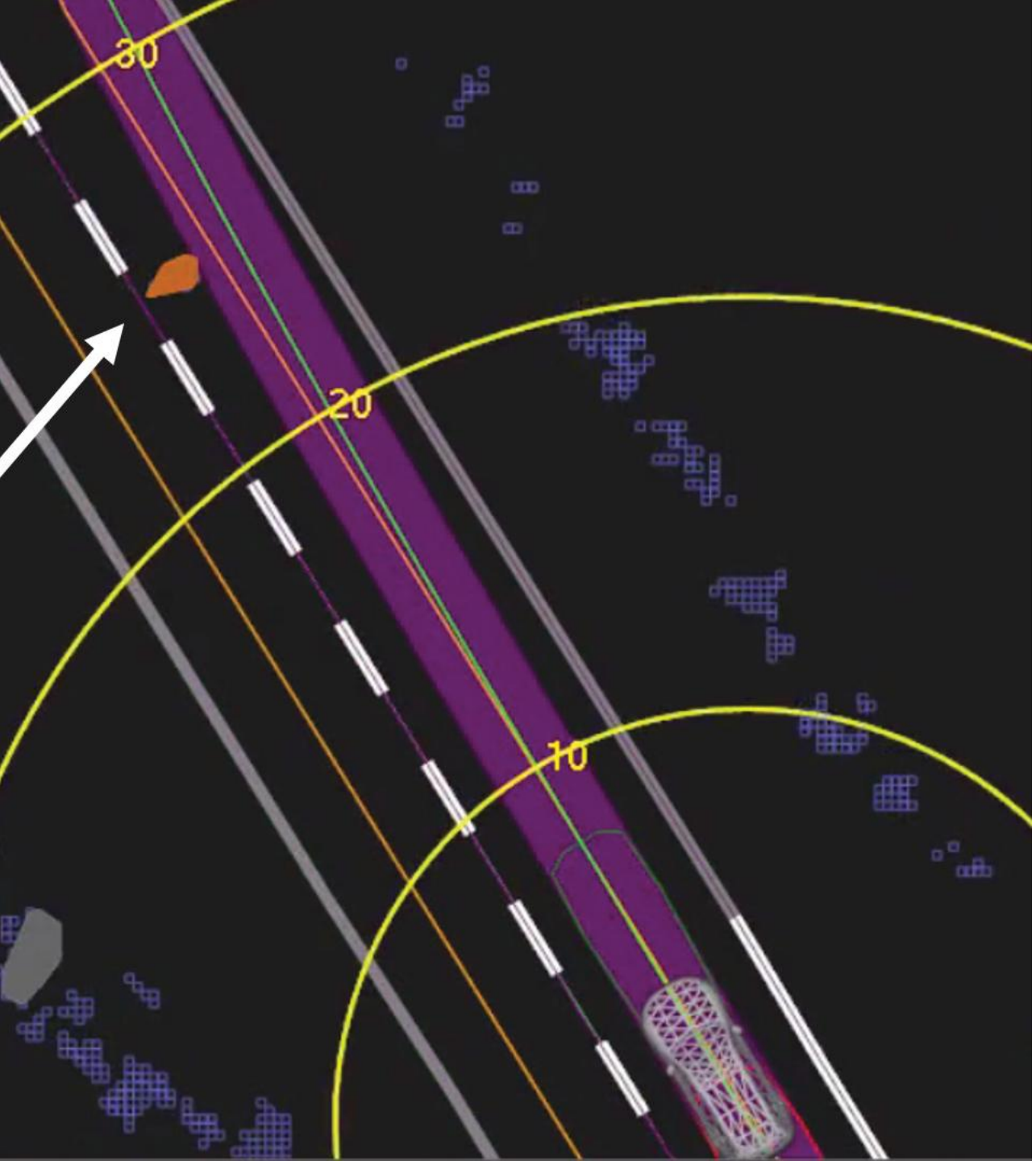

Data collection priorities

- Mandatory
  - Crash information
  - Exposure information
- Consistency, uniformity
- Adaptable in the future
- Comparable with data on humans
- Can be used to obtain results quickly

Insurance Institute for Highway Safety
Highway Loss Data Institute

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THANK YOU

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