Characterization of ADS Performance by Pre-Crash Movement and Crash Type Using the SGO Data

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Background

- June 2021: NHTSA issued a Standing General Order (Revised April 2025)
  - Requires identified manufacturers and operators to report certain crashes involving vehicles equipped with SAE Levels 3 through 5 Automated Driving Systems (ADS).
  - Also covers vehicles equipped with SAE Level 2 Advanced Driver Assistance Systems (ADAS).
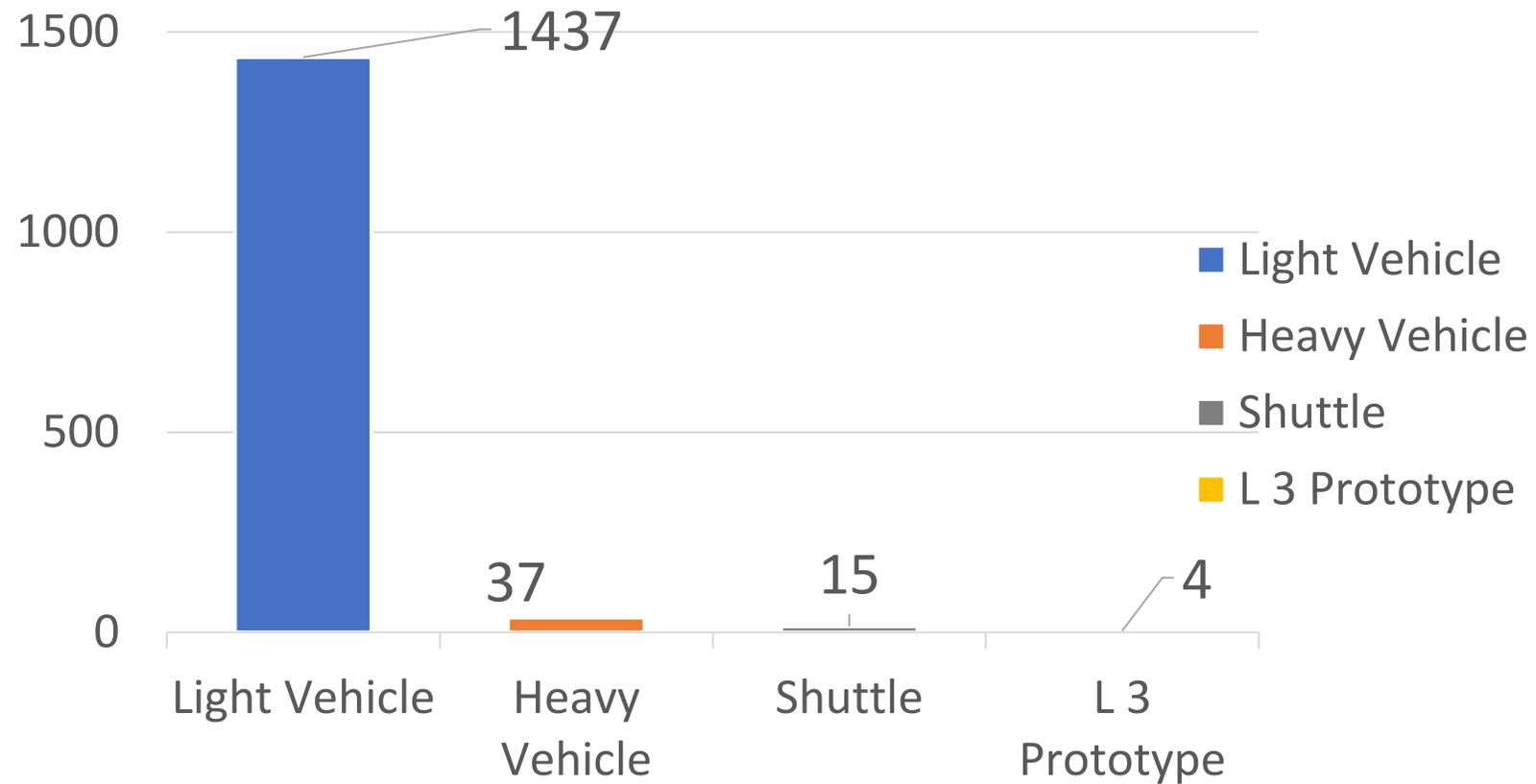
Analysis - Methodology

- Analysis of crashes when vehicle had ADS engaged in the 30-second window prior to the crash.

- Includes 1493 unique crashes from July 2021 through June 2025.

- Multidisciplinary team of analysts reviewed the crash data.
  - Crash types determined.
  - Pre-crash movement (i.e., stopped, turning, slowing, etc).
  - Traffic control device - ADS right of way.
  - Crash location (i.e., intersection, street, etc).
  - Vehicle type.
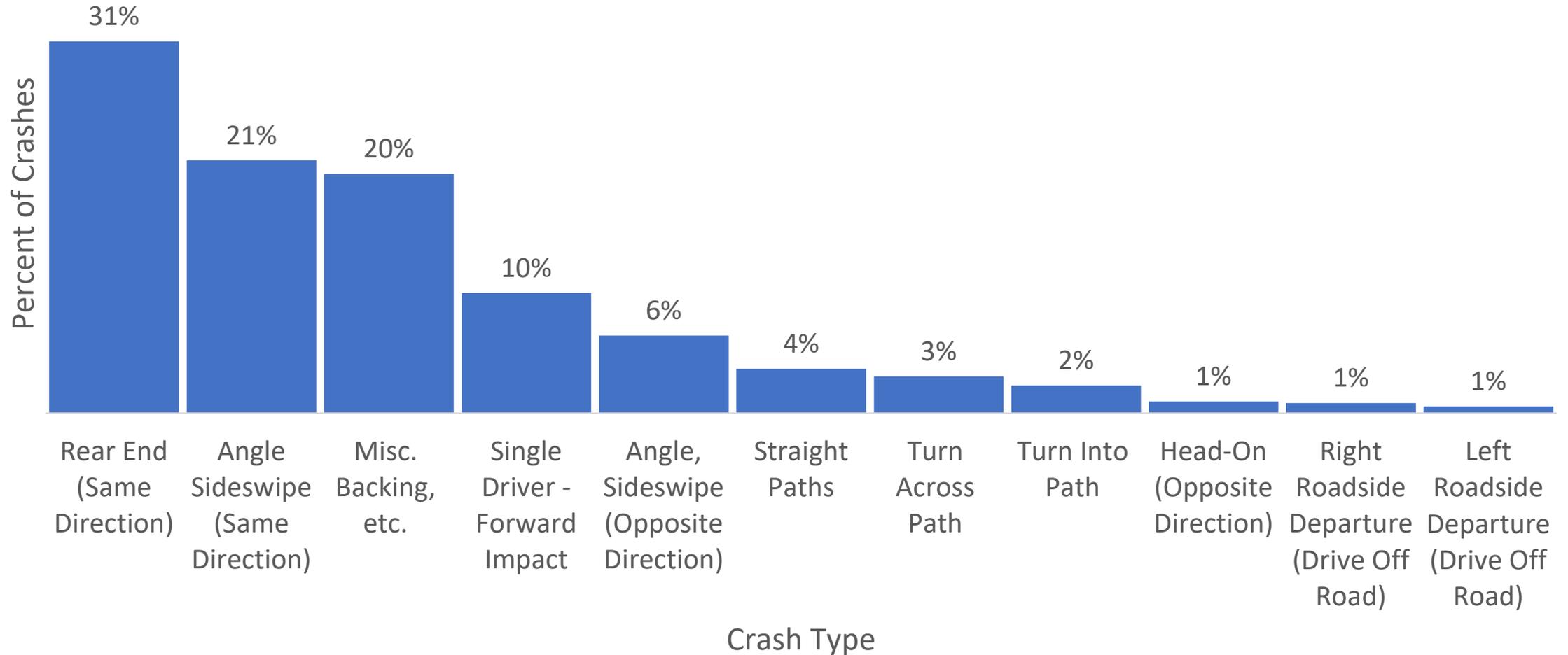
Analysis - Crash Types

- Based upon narrative and coded data:
  - A crash type was assigned.
  - Identified if safety driver was present or driverless.
  - If the ADS was engaged at time of crash.

Results - Aggregate of SGO Data by Vehicle Type

Results - Light Vehicle Crash Types (N=1437)

Bar chart showing Percent of Crashes by Crash Type:

Crash Type	Percent of Crashes
Rear End (Same Direction)	31%
Angle Sideswipe (Same Direction)	21%
Misc. Backing, etc.	20%
Single Driver - Forward Impact	10%
Angle, Sideswipe (Opposite Direction)	6%
Straight Paths	4%
Turn Across Path	3%
Turn Into Path	2%
Head-On (Opposite Direction)	1%
Right Roadside Departure (Drive Off Road)	1%
Left Roadside Departure (Drive Off Road)	1%

Same Direction - Rear End Crashes

	No Safety Driver	Safety Driver, ADS Engaged	Safety Driver, ADS Disengaged Intentionally	Safety Driver, ADS Not Engaged	Total
ADS Struck	256	156	15	8	97%
ADS Striking	6	0	6	0	3%
Total (Striking or Struck)	**262**	**156**	**21**	**7**	**446 (100%)**

Object and Event Detection (ADS Engaged and being Struck, N=412)

No Safety Driver: Red light 39%, Traffic jam 19%, Stop sign 13%, Yielding for law enforcement/opposite/cross traffic 10%, Slowing for another vehicle or pedestrian 9%, Other 11%

Safety Driver, ADS Engaged: Red light 32%, Traffic jam 4%, Stop sign 8%, Yielding for law enforcement/opposite/cross traffic 24%, Slowing for another vehicle or pedestrian 19%, Other 13%

Percent of Rearend Crashes (ADS Struck)

- ■ Red light
- ■ Stop sign
- ■ Slowing for another vehicle or pedestrian
- ■ Traffic jam
- ■ Yielding for law enforcement/opposite/cross traffic
- ■ Other

ADS Equipped Vehicle Pre-crash Movement as a Lead Vehicle (ADS Engaged and being Struck, N = 411)

	Stopped	Moving at Lower Constant Speed	Decelerating
No Safety Driver	78%	13%	9%
Safety Driver, ADS Engaged	68%	15%	17%

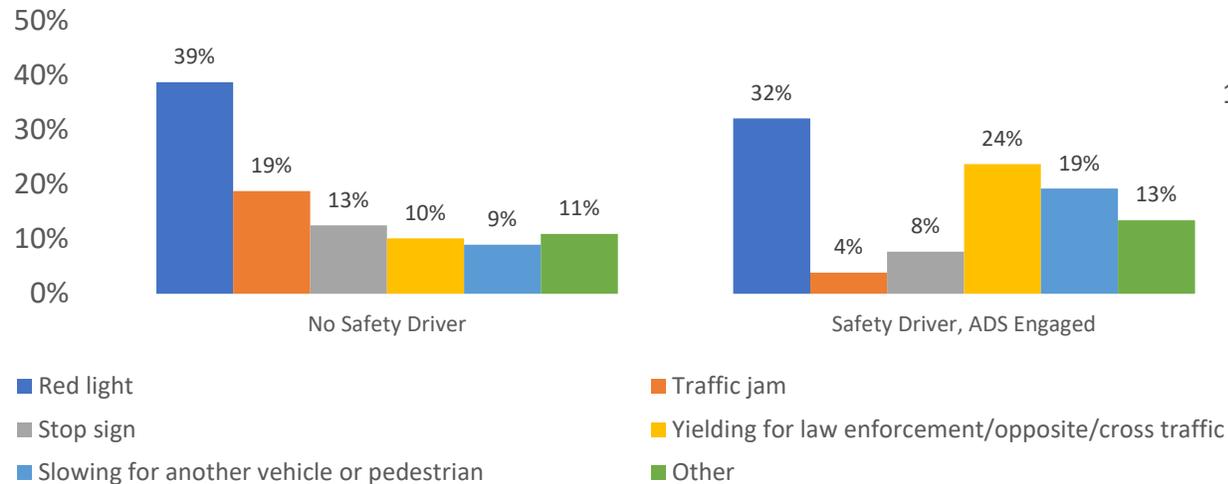- ■ No Safety Driver
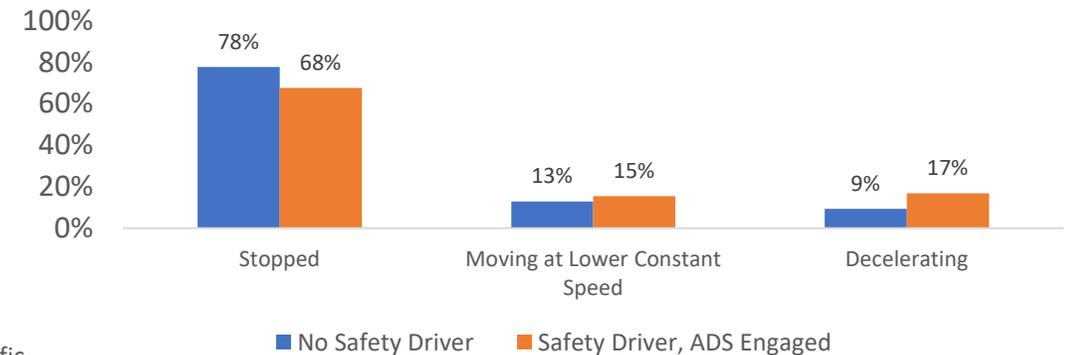- ■ Safety Driver, ADS Engaged

Same Direction – Angle, Sideswipe

	No Safety Driver	Safety Driver, ADS Engaged	Safety Driver, ADS Disengaged Intentionally	Safety Driver, ADS Not Engaged	Total
ADS Struck	234	29	16	6	94%
ADS Striking	8	1	8	1	6%
Total (Striking or Struck)	**242**	**30**	**24**	**7**	**303 (100%)**

Pre-Crash Movement (ADS Engaged and Struck, N =272)

Percent of Angle, Sideswipe Crashes (ADS Struck)

No Safety Driver: Stopped 43%, Passenger pick up 24%, Going Straight 18%, Parked 10%, Changing lanes 3%, Right turn 1%, Other 3%

Safety Driver, ADS Engaged: Stopped 24%, Passenger pick up 0%, Going Straight 48%, Parked 0%, Changing lanes 10%, Right turn 7%, Other 10%

Legend: Stopped, Passenger pick up, Going Straight, Parked, Changing lanes, Right turn, Other

Misc. – Backing, Etc.

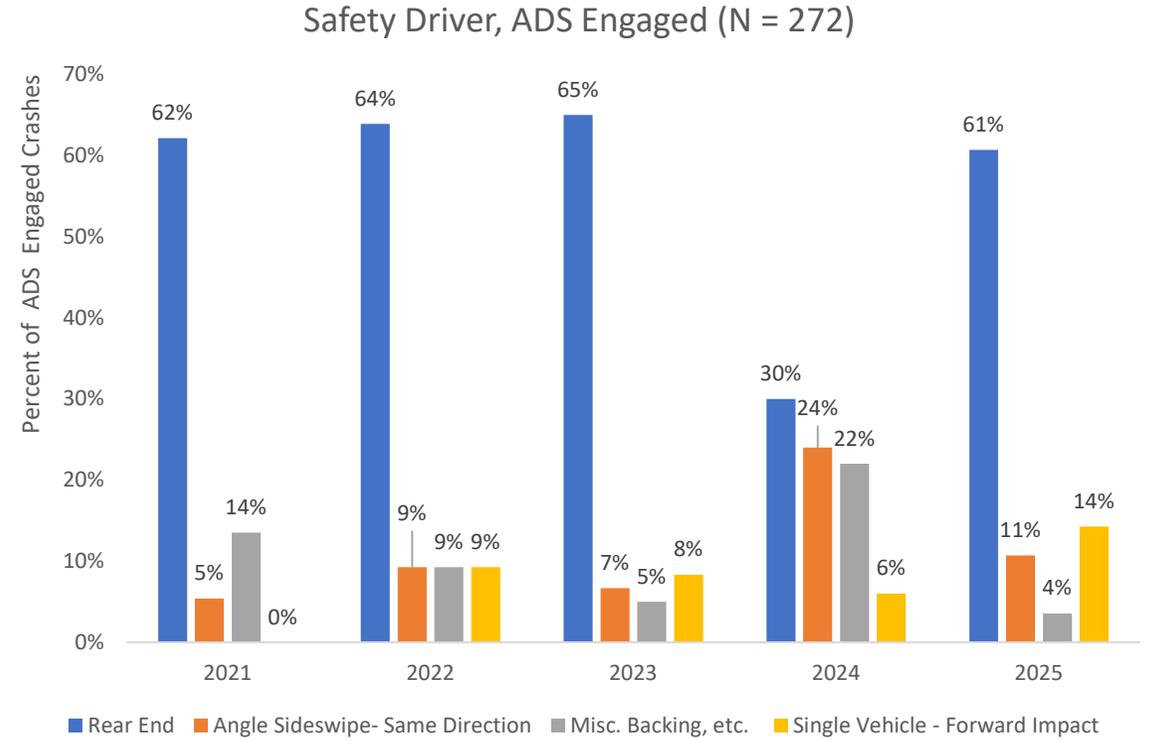| Misc. Backing Crash Type	No Safety Driver	Safety Driver, ADS Engaged	Safety Driver, ADS Disengaged Intentionally	Safety Driver, ADS Not Engaged	Total
93 - Other Vehicle or Object "Backing into ADS"	163	18	6	4	67%
98 - Other Accident Type	60	8	2	1	25%
00 - No Impact	10	2	0	0	4%
92 - Backing "ADS" Vehicle "into another Vehicle"	5	1	2	2	3%
99 - Unknown Accident Type	3	0	0	0	1%
Total	**241**	**29**	**10**	**7**	**287 (100%)**

Single Driver – Forward Impact

Forward Impact Crash Type	No Safety Driver	Safety Driver, ADS Engaged	Safety Driver, ADS Disengaged Intentionally	Safety Driver, ADS Not Engaged	Total
12/15 – Stationary Object/Other	88	14	5	4	77%
13 - Pedestrian / Animal	15	4	1	1	15%
11 - Parked Vehicle	3	3	4	2	8%
Total	**106**	**21**	**10**	**7**	**144 (100%)**

Crash Trends by ADS Engagement at Impact
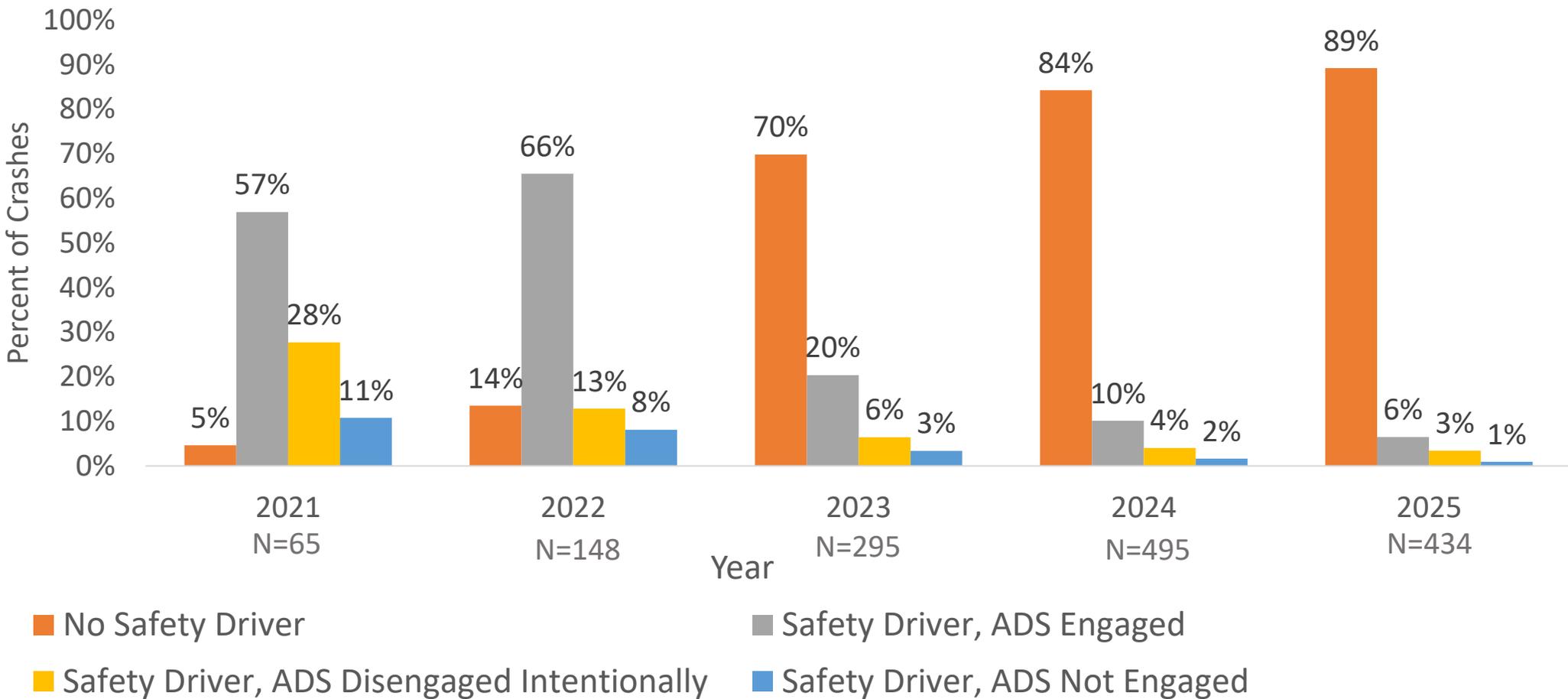
No Safety Driver Vs. Safety Driver, ADS Engaged at Impact: Trends by Crash Type, 2021–2025

No Safety Driver (N = 1033)

Safety Driver, ADS Engaged (N = 272)
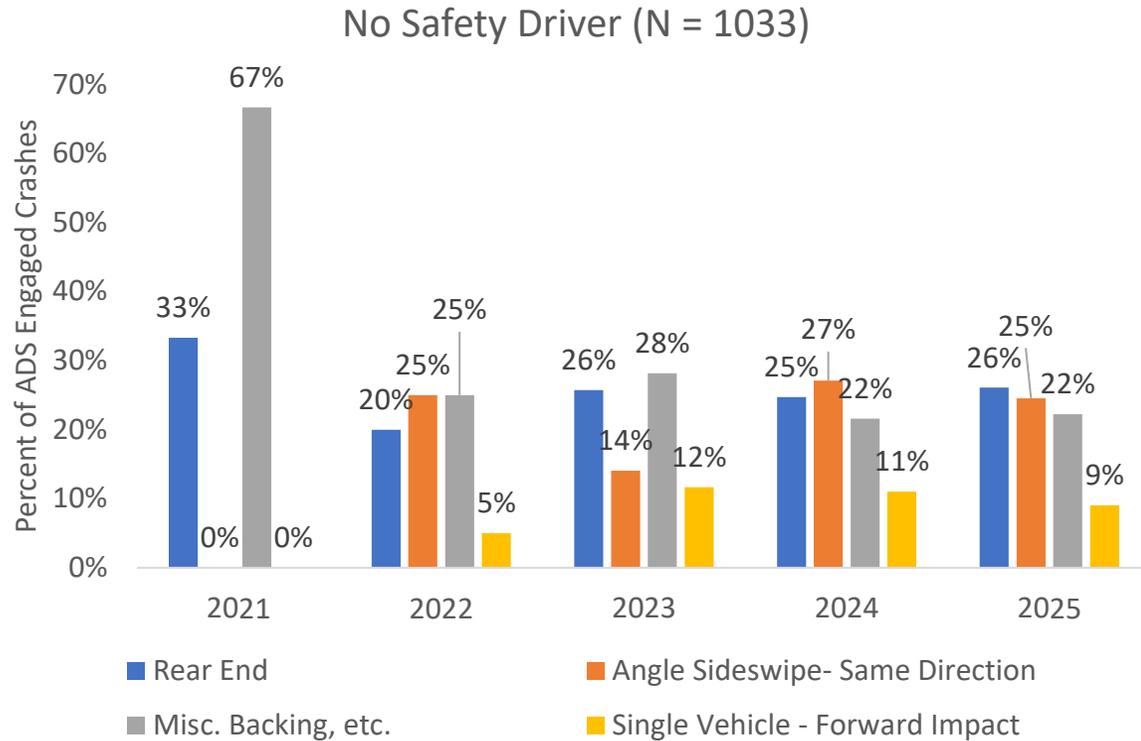
Vehicle Speed at Impact Vs. Speed Limit, 2021–2025 (N = 1426)

Average Speed Limit – 30 mph

Legend:
- Stopped
- More than 20 MPH under speed limit
- 10 - 20 MPH under speed limit
- 5 - 10 MPH under speed limit
- Less than 5 MPH over or under speed limit
- 5 - 10 MPH over speed limit

Y-axis: Percent of Crashes (0% to 70%)

No Safety Driver: 63%, 15%, 14%, 4%, 4%, 0%
Safety Driver, ADS Engaged: 58%, 21%, 9%, 6%, 7%, 0%
Safety Driver, ADS Disengaged Intentionally: 23%, 32%, 30%, 6%, 9%, 1%
Safety Driver, ADS Not Engaged: 27%, 34%, 27%, 7%, 5%, 0%

Conclusions

- Rear end and angle, side-swipe crashes while stopped or slowing were the most frequent crash type when ADS engaged.

- Another vehicle backing into an ADS vehicle was the third most frequent crash type.

- As deployment changed, almost all crashes in recent years involve a vehicle without a safety driver.

- Approximately 60% of crashes with the ADS engaged, the vehicle was stopped.

Questions?

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